NOTE: This chapter is currently being re-written and its content will be included in Chapter 108 in the future.

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CHAPTER 17

QUANTITY ESTIMATING

In addition to preparing clear and concise plans, as described in Chapter 14, the designer should compile an accurate summary of the project quantities. This information leads directly to the project cost estimate, which combines the computed quantities of work and the estimated unit prices. An accurate summary of quantities is critical to prospective contractors interested in submitting a bid on the project. In addition to the INDOT Standard Drawings and the INDOT Standard Specifications, Chapter 17 provides additional guidelines on calculating quantities for a highway, bridge, or traffic project.

17-1.0 GENERAL

17-1.01 Guidelines for Preparing Quantity Computations

When preparing quantity computations, the designer should consider the following guidelines.

1. Specifications. Cross check all items against the INDOT Standard Specifications to ensure that the appropriate pay items, methods of measurement, and bases of payment are used. If an item is not described in the Standard Specifications or recurring special provisions, a unique special provision must be included in the contract documents to cover the item. Chapter 19 discusses how to prepare special provisions.

2. Pay Item Code Number. Every pay item has a unique number assigned to it for data processing. This code number is located in the computer programs CES and Estimator. Section 20-2.01 describes these programs. Only the official pay item name and description should be used in the contract documents, special provisions, or summary of quantities.

3. Rounding. The quantity of any item should check exactly with the figure on the computation sheets. Indicate any rounding of the raw estimated figures on the computation sheets. Unless stated otherwise, rounding of the calculations should not be done until the value is incorporated into the Quantity Summary Tables.

4. Significant Digits. When calculating quantities, consider the implied correspondence between the accuracy of the data and the given number of digits.
5. **Cost Estimate.** Only use the total values from the Quantity Summary Tables to develop the cost estimate. Show all items described in the plans that will be included in the cost estimate. The designer will be responsible for inserting these values into either CES or Estimator.

### 17-1.02 Computation Records

Quantity-computation sheets may be generated by computer or by hand. Combine all computation sheets and bind them with a cover sheet. The preparer will sign or initial and date each sheet. The checker will also be required to sign or initial and date each sheet.

Check all values obtained through computations or use of standardized tables. For those pay items where agreements may be reached to make payment on the basis of plan quantities, an independent check should be performed and noted. The resolution of any differences between original and check computations should be identified. Where computations are performed by computer, an independent check is not required. However, check the input and review the computation output sheet for mistakes. Also, sign and date the computer output similarly to hand computation sheets.

Retain the quantity computations within the project file.

The contractor may request copies of the quantity calculations subsequent to the letting. Requests prior to the letting from contractors should be directed through the Legal Services Division.

### 17-1.03 Units of Measurement

Quantities for all contract pay items should be estimated using the measurement units shown in the INDOT *Standard Specifications* or the special provisions. The values determined from the computations should be rounded as described below and shown in the Quantity Summary Tables and elsewhere in the plans as required.

Rounding of values should be as follows.

1. **Small Quantity.** For a quantity of 10 or less, round to the nearer whole unit (i.e., 3.2 to 3, 5.5 to 6, or 9.8 to 10).

2. **Large Quantity.** For a quantity greater than 10, round up to the next whole unit (i.e., 27.8 to 28, or 146.2 to 147).
3. **Linearly-Measured Work.** Round each linear-measure quantity up to the next whole foot.

4. **Earthwork.** For an individual cross-section area, round to the nearer 0.1 ft². For an individual end-area volume, round to the nearer 1 yd³. For a total pay quantity, round up to the next multiple of 5 yd³.

5. **Structural Concrete.** Round each structural-concrete quantity to the nearest 0.1 yd³. This includes each individual pour or structure portion and the total quantity for each concrete class shown in bills of materials and the Bridge Summary sheet.

The values shown in the Estimate of Quantities and Cost Estimate developed by the designer should reflect this rounding procedure. The Engineer’s Estimate and Schedule of Pay Items developed by the Contract Administration Division’s Estimating Office will also reflect this procedure.

### 17-1.04 Non-Defined Work

#### 17-1.04(01) Lump Sum Pay Unit

Only use a lump-sum pay unit where the scope of work for the item is clearly defined, and the amount of work has a minimal chance of changing during construction. The INDOT *Standard Specifications* defines which quantities may be estimated as lump sum. Where practical, list the quantities for the separate work that will be included within the lump-sum item. The list should note that the separate quantities are for estimating purposes only. Where there is a significant chance of quantity changes, the work must be by the unit and not lump sum.

#### 17-1.04(02) Item Included in Other Work

No work should be shown as incidental to another pay item or the contract. If any work will be included as part of another item, it must be addressed by the specifications or with a special provision. The designer should only include an item of work in another pay item where the scope of work for both is clearly defined and the probability of the quantity of either item changing is minimal. Minimize the amount of work to be included in other pay items. It is impossible for bidders, or the Department, to prepare an estimate for a project which contains incidental items for which quantities or the scope of work is indeterminable.
17-1.05 Proprietary Material [Rev. Aug. 2011, Apr. 2016]

A proprietary material is defined through specifications that are so specific that only one product will satisfy the requirements, or that the name of the product is actually specified. To ensure competitive bidding, the designer should restrict the use of proprietary materials on a project. However, if a situation occurs where the use of a proprietary material will enhance safety, control costs, or will otherwise improve the project design, the use of a proprietary material may be justifiable.

17-1.05(01) Justification

The designer must submit for approval one of the following certification or a public-interest finding requests for the use of a proprietary material. This should occur at Stage 2, but not later than Stage 3. Editable versions of the forms appear on the Department’s website at www.in.gov/dot/div/contracts/design/dmforms/, under Proprietary Materials.

1. Certification for No Suitable Existing Equal Material. If no suitable equal material exists, a Certification should be prepared. Figure 17-1C should be used for this request.

2. Certification for Product Essential for Synchronization. A proprietary material may be justified where it is essential for synchronization with an existing highway facility, for which there is no equally-suited alternative. Figure 17-1D should used for this request.

3. Experimental. A proprietary material may be justified for research purposes or for a distinctive type of roadway. A justification for an experimental or research item should include a work plan which details the evaluation to be conducted. For such a material to be used on the State highway system, the procedure described in the INDOT Guidelines for Initiating and Reporting Experimental Features Studies should be followed. Figure 17-1C should be used for this request.

4. Public-Interest Finding for Proprietary-Material Use. The designer should prepare a Public-Interest Finding (PIF) for the use of a material if suitable alternatives exist but are not the most cost-effective or in the public’s best interest. This should include a description of the circumstance being addressed due to use of the proprietary material, alternative solutions that were considered, and the reasoning why the proprietary material was chosen. Figure 17-1E should be used for this request.

5. Programmatic Approval. A PIF is required for a product approved on a program-wide basis if there are other suitable alternatives. A Programmatic Certification is required if no
suitable alternatives exist. Figure 17-1F should be used for this request. The justification should include a work plan which details the evaluation to be conducted. A PIF or Programmatic Certification should include the length of time that the approval will be in effect. A Programmatic approval should be periodically reviewed to assess changes in the market conditions that can make them obsolete. If a pre-approved list has fewer than three vendors, a proprietary-product approval is required before that list can be used. The current Programmatic Proprietary Material Approvals list available on the Highway Design & Technical Support Division webpage, at [http://www.in.gov/indot/2684.htm](http://www.in.gov/indot/2684.htm).

### 17-1.05(02) Approval Process

Each request should include Figure 17-1A, the Transmittal Memorandum. The request should be submitted through ERMS to the project manager, who will forward the request to either the Highway Design and Technical Support Division Director or the Bridges Division Director for approval. FHWA approval or concurrence is as follows:

1. INDOT approval is required for each Figure 17-1C request that no suitable equal exists, or each Figure 17-1D request for product essential for synchronization. FHWA concurrence will be required only for a project that requires FHWA oversight.

2. FHWA approval is required for each Figure 17-1C experimental proprietary-material request.

3. FHWA approval is required for each Figure 17-1E PIF request.

4. FHWA approval is required for each Figure 17-1E Programmatic PIF request.

5. FHWA approval is required for each Figure 17-1F Programmatic Certification request.

FHWA approval listed in 2 through 5 above is required without regard to FHWA oversight.

If the project is under construction and a proprietary material is added to the contract, the Certification or PIF should be prepared and approved prior to completion of the change order. If a pay item is changed to proprietary during construction, federal participation is limited to the lower of either the contract unit price or the change-ordered unit price.

### 17-2.0 EARTHWORK QUANTITIES
17-2.01 Computerized Computations

Earthwork computations can be determined using a computer and special design software packages. Earthwork quantities for a small project, approach, S-line, side road, ditch, or additional-grading feature may require manual calculations (see Section 17-2.02). For computer calculation of mainline earthwork quantities, the information required is as follows:

1. cross section showing existing and proposed ground surfaces;
2. shrinkage and swell factors; and
3. identification of sections not to be included (e.g., bridge section).

The computer can generate a computation of end areas and volumes for each cross section. Show the actual computed end areas and volumes on the plans cross sections.

17-2.02 Manual Computations

For a small project, or to calculate special features on a larger project (e.g., approach, ditch), it may be necessary to calculate the earthwork quantities manually. The following procedures apply.

1. Computation Sheet. See Figure 17-2A, Computation Sheet, for that used by the Department. This format can be used for documenting cross-sectional areas and volumes between cross sections.

2. End Areas. The end areas used to compute the quantities are defined by the ground lines and typical-section template. See Figure 17-2B, End Area Template. After the cross sections have been plotted, determine the areas of cut and fill for each cross section. Include the waste of unsuitable soils, undercut, rock excavation, trench excavation, or special excavation or embankment on the section. Record the cut and fill areas for each cross section on the computation sheet.

3. Sum of End Areas. The Sum of End Areas columns are the sum of adjacent cross-section areas for the Cut and Fill columns. The line in the figure is offset between the two end areas. This line indicates that two areas are to be added together.

4. Length. Record the distance between stations in this column.
5. **Volume Computation.** Volumes for excavation (cut) and embankment (fill) are determined using the average-end-area formula,

\[ V = \left( \frac{A_1 + A_2}{2} \right)D \]  

(Equation 17-2.1)

Where: 
- \( V \) = volume, yd\(^3\)
- \( A_1 + A_2 \) = sum of cut or fill end areas of adjacent sections from the Sum of End Areas, yd\(^2\)
- \( D \) = distance between sections, ft

These values are recorded in the appropriate Volume of Cut and Volume of Fill columns on the computation sheet.

**17-2.03 Shrinkage and Swell Factors**

Fill quantities calculated manually or by a computer must be adjusted by the appropriate shrinkage factor to account for the compaction of material, loss from hauling, subsidence of the existing ground caused by the overburden, erosion, and clearing operation. The factors used in the calculations will depend on the soil type, quantity to be moved, and engineering judgment. Sand and gravel have smaller shrinkage factors than clay or silt. For rock excavation, it may be necessary to apply an expansion or swell factor. Figure 17-2C, Shrinkage and Swell Factors, provides factors that may be used for preliminary design purposes. A more definitive value may be available from other sources (e.g., the Geotechnical Report).

Only use one shrinkage factor for the entire project or for each individual balance within the project. The district office may provide guidance in choosing the applicable factor(s) to be used in the calculations. The designer may need to adjust the shrinkage factor to account for smaller quantities.

**17-2.04 Balancing**

For a large project, it is desirable to approximately balance the earthwork (cut and adjusted fill) for the project. An unbalanced project will require the contractor to haul extra material (borrow) or remove the excess (excavation) from the project site, which will typically increase construction
costs. Balancing within the project limits can be accomplished by revising the profile grade line, revising cut and fill slopes, revising ditch profiles, etc. To determine if balancing is appropriate, the designer should consider the following.

1. **Rural New Construction or Reconstruction.** It is desirable to make a reasonable effort to balance the earthwork quantities.

2. **Rural 3R Project.** The need for balancing will be determined for each project as required.

3. **Other Project.** For an urban-area, interchange, or partial 3R project it is impractical to provide a balanced grading design. Therefore, it will not be necessary to balance the earthwork.

For a long project, the designer should provide several intermediate balance points. The length of each balance section should not exceed 2000 ft unless an interchange, rest area, or area of deep cut or fill are included. A bridge is not included within the balance limits.

### 17-2.05 Earthwork Tabulation

To allow the contractor to determine the amount of excavation, borrow, etc., required the designer should include an earthwork balance table in the plans. For a long roadway project, provide a separate table for each balance section. Quantities for benching should be included in the earthwork balance. This table should be included on a Road Plan and Profile sheet, typically in the profile half of the sheet. Figure 17-2D, Earthwork Balance Table (Road Project), illustrates the typical format that should be used. For a bridge project, one earthwork tabulation table will be required for the entire project. Show this table on the Layout sheet. Figure 17-2E, Earthwork Tabulation (Bridge Project) illustrates the typical format that should be used.

### 17-2.06 Linear Grading

The use of the linear grading pay item is generally limited to a project with a minimal amount of earthwork. This will only include the applications as follows.

1. **Preventative Maintenance, Functional, or Structural Pavement Treatment.** Linear grading consists of earth wedging at the outside edge of each shoulder where the pavement is to receive one of these treatments. If this type of earthwork is significant enough to require benching, linear grading should not be considered.
2. **Guardrail.** Linear grading consists of earth wedging behind guardrail to obtain the required earth backup for the posts. If this type of earthwork is significant enough to require benching, linear grading should not be considered.

3. **Median.** Linear grading consists of earth filling a median required for paving shoulders and placement of a concrete median barrier where travel lanes are not being added.

All other earthwork should be paid for as common excavation and borrow.

Where linear grading is being considered, the measurement for payment will be based on the length of roadway per linear foot measured along the centerline actually constructed to the lines and grades shown in the typical cross section. Measurement will be made once per centerline per area. Typical cross sections should be separated.

The pay-quantity limits should be measured along the roadway centerline, with deductions for bridges, etc. For example, a divided-roadway project length is 25,000 ft, and includes two bridges with a combined length of 600 ft. Linear grading is to be done in the median and beyond the outside shoulders. The linear-grading pay length is 24,400 ft. The plans should indicate which work is to be included in the linear-grading pay item, both by typical section and in estimated quantities per area of linear grading, i.e., cubic yards of common excavation.

The pay unit for linear grading is linear-foot.

17-2.07 **B Borrow**

Where B borrow is specified, it should be considered as a separate pay item. All locations where B borrow is to be placed should be shown on the plans. When estimating the quantity of B borrow, the designer should consider the following.

1. **Mechanically Stabilized Earth Retaining Wall.** B borrow is placed outside of the limits of structure backfill (e.g., beyond the reinforcing straps). Section 17-4.05 provides additional information for determining backfill material quantities for a retaining wall.

2. **Unsuitable Materials.** B borrow is used to replace unsuitable materials (e.g., peat) within the roadway structure. Section 18-2.06 provides guidance for determining the locations for the placement of B borrow with peat excavation.

3. **Culvert Replacement.** Where a culvert is to be removed for an existing roadway, replace the culvert excavation material with B borrow.
17-2.08 Structure Backfill [Rev. Mar 2015]

17-2.08(01) Structure Backfill Types

Structure backfill has been subdivided into types. Each type should be specified as described below.

1. **Type 1.** This type should be specified for a location as follows:
   
a. longitudinal or transverse structure placed under, or within 5 ft of, the back of paved shoulder or back of sidewalk of a new rural or urban facility, or

   b. such a structure for an existing rural facility where all existing pavement is to be replaced.

2. **Type 2.** This type should be specified for a location as follows:
   
a. longitudinal or transverse structure placed under, or within 5 ft of, the back of paved shoulder or back of sidewalk for an existing urban facility where all existing pavement is to be replaced;

   b. longitudinal or transverse structure placed under, or within 5 ft of, the back of paved shoulder or back of sidewalk for a rural or urban facility where undisturbed existing pavement is to remain; or

   c. precast-concrete three-sided or four-sided structure with height of cover of 2 ft or greater.

3. **Type 3.** This type should be specified for use behind a mechanically-stabilized-earth retaining wall.

4. **Type 4.** This type should be specified for a location as follows:
   
a. trench where a utility line is present; or

   b. behind a reinforced-concrete slab-bridge end bent.

5. **Type 5.** This type should be specified for a location as follows:
a. precast-concrete three-sided or four-sided structure with height of cover of less than 2 ft;

b. filling voids in an underground facility;

c. filling in an abandoned pipe or structure; or

d. other application that does not require excavation

17-2.08(02) Information to be Shown on Plans

Structure backfill is a separate pay item. The pay-item name should include the type. The pay unit is square yard. In estimating the quantity of structure backfill, the following should be considered.

1. **Drainage Structure.** Section 17-3.0 discusses the procedure for estimating structure-backfill quantities for a drainage structure.

2. **Abutment.** The quantity of structure backfill should be determined and shown similarly to that for a concrete retaining wall, i.e., 1:1 backslope to a point 1.5 ft outside the neat lines of the abutment footing. See Section 17-5.05(01).

3. **Retaining Wall.** The quantity of structure backfill should be determined and shown on the cross sections at each retaining-wall location. Section 17-5.05(02) provides additional information regarding retaining-wall structure backfill.

17-2.09 Flowable Backfill

Flowable backfill is a separate pay item. It is required for backfilling behind the end bents of a reinforced-concrete slab bridge, or behind the wingwalls of a precast-concrete three- or four-sided structure. It is also required for backfilling a new cross-culvert placed under an existing roadway.

Flowable backfill for use other than as structure backfill should be specified as either removable flowable or non-removable flowable backfill. R should be entered in Structure Data sheet’s Flowable Backfill column if the material is removable. N should be entered in the column if the material is non-removable.
17-3.0 DETERMINING PIPE BACKFILL QUANTITIES

The determination of pipe-backfill quantities is based on the pipe shape, pipe-interior designation, backfill method, and backfill material.

For additional guidance on determining pipe-backfill quantities, see the INDOT Standard Specifications or the INDOT Standard Drawings, or contact the Production Management Division’s Design Resources Team.

17-3.01 Background Information

17-3.01(01) Pipe Shape

The pipe shape is either circular or deformed.

17-3.01(02) Pipe Interior Designation

The interior of a pipe is either smooth or corrugated. For most pipe structures and pipe types, the contractor will have a choice of pipe materials, of either interior designation. For the purpose of determining backfill quantities, a corrugated interior should be assumed.

17-3.01(03) Backfill Method

The standard backfill methods are described below, and also shown on the INDOT Standard Drawings.

1. **Method 1.** This method should be used for a structure to be placed under a new- or replacement-roadway mainline or public road approach, for a structure to be placed under a median embankment, or for a new structure to be placed under an existing roadway mainline or public road approach.

2. **Method 2.** This method should be used for a structure to be placed under a drive in new or replacement work, or under an existing drive.

3. **Method 3.** This method should be used for a structure to be placed under a new- or replacement-roadway’s median trench.
17-3.01(04) Backfill Material

Unless instructed otherwise, structure backfill is required for each culvert or storm-drain structure, except a field-entrance culvert which is to be backfilled with suitable excavated material.

The contractor may substitute coarse aggregate as an option for structure backfill for backfilling a concrete culvert, pipe, structural plate pipe, pipe-arch, or arch. However, the backfill material should always be identified as structure backfill. If coarse aggregate is used, the ends and top of the trench are to be capped with geotextile as shown on the INDOT Standard Drawings. The geotextile is not a separate pay item.

A specific backfill type should be specified only if, for example, a pipe is to be placed in the vicinity of utilities. Then, flowable backfill should be specified. If structure backfill or flowable backfill are both acceptable alternates, the material should be identified and quantified as structure backfill.

See the INDOT Standard Drawings to determine the appropriate backfill materials for the structure based on the backfill method required.

17-3.02 Hand Calculation of Backfill Quantities

Figure 17-3A identifies the values described below which are required for determining backfill quantities.
17-3.02(01) Circular Pipe, Earth Foundation

\( C_t = \) corrugations thickness = 0.5 in.

\[ B_c = H_c = \frac{\text{Inside Dia.} + 2C_t}{12} \]

\( T_c = \) trench cover depth over pipe

\( V_c = 1 \text{ ft for } B_c \leq 1.5 \text{ ft, or } 1.5 \text{ ft for } B_c > 1.5 \text{ ft} \)

For backfill method 1 or 2, \( L_B = 2(5) + \text{Pvmt. Width} + 2[2(T_c + H_c)] \),
where \( T_c = V_c \). The pavement width is that of the travel lanes plus shoulders.

For backfill method 3, or method 1 in a median embankment,
\( L_B = \text{Median Width} - 2[2(T_c + H_c)] - 2(5) \). The median width excludes the shoulder widths.

\[ A_c = \frac{\pi (B_c)^2}{4} \]

\( W = 0.3B_c \) or 0.75 ft, whichever is greater

\( W_b = 2W + B_c \)

\( K = 2W + B_c + \frac{2H_c}{12} \)

For backfill method 3, \( K_3 = 2W + B_c + \frac{2(H_c + V_c)}{12} \)

\( W_t = K + \frac{2T_c}{12} \)

All methods, backfill quantity, \( B_{BC} \), per linear foot from trench bottom to pipe crown:

\[ B_{BC} = \frac{[0.5H_c(W_b + K)] - A_c}{27} \]
Method 1 or 2 backfill quantity, $B_{CT}$, per linear foot from pipe crown to top of trench:

$$B_{CT} = \frac{T_c(K + W_c)}{54}$$

Method 3 backfill quantity, $B_{CV}$, per linear foot from pipe crown to top of $V_c$ dimension:

$$B_{CV} = \frac{V_c(K + K_3)}{54}$$

Method 3 backfill quantity, $B_{VT}$, per linear foot from top of $V_c$ dimension to top of trench:

$$B_{VT} = \frac{(T_c - V_c)(K_3 + W_c)}{54}$$

Method 1 backfill per linear foot = $B_{BC} + B_{CT}$.
Method 1 total backfill quantity = $L_B(B_{BC} + B_{CT})$.

For backfill method 2, $B_{BC}$ and $B_{CT}$ each represent different materials, so the quantities should not be added. The total quantity for method 2’s $B_{BC}$ material is $(L_B)(B_{BC})$. The total quantity for method 2’s $B_{CT}$ material is $(L_B)(B_{CT})$.

For backfill method 3, $B_{BC}$ and $B_{CT}$ are the same material, so the total method 3 quantity of this material is $L_B(B_{BC} + B_{CV})$. $B_{VT}$ represents a different material, so it should not be added to $B_{BC} + B_{CV}$. The total quantity for method 3’s $B_{VT}$ material is $(L_B)(B_{VT})$.

17-3.02(02) Circular Pipe, Rock Foundation

The total backfill quantity is that required for an earth foundation plus the foundation backfill required below the pipe. The additional volume is determined as follows:

$$A = 8 \text{ in. or } 2/3 \text{ ft.} \quad \text{The entry in the formula below for } W_F \text{ must be made in feet.}$$

$$W_F = 2W + B_c - \frac{2A}{12}$$

Backfill quantity, $B_F$, per linear foot of foundation area:
\[ B_F = A\left( \frac{W_b + W_F}{2} \right) \]

Total foundation-backfill quantity = \((L_B)(B_F)\)

17-3.02(03) Deformed Pipe, Earth Foundation

\[ C_t = \text{corrugations thickness} = 0.5 \text{ in.} \]

\[ B_c = \frac{\text{Span} + 2C_t}{12} \]

\[ H_c = \frac{\text{Rise} + 2C_t}{12} \]

For backfill method 1 or 2, \(L_B = 2(5) + \text{Pvmt. Width} + 2\left[2(T_c + H_c)\right]\), where \(T_c = V_c\). The pavement width is that of the travel lanes plus shoulders.

For backfill method 3, or method 1 in a median embankment, \(L_B = \text{Median Width} - 2\left[2(T_c + H_c)\right] - 2(5)\). The median width excludes the shoulder widths.

\[ A_c = \frac{(\text{Pipe Opening})(C_t)(P)}{12} \]

\[ W = 0.3B_c \text{ or } 0.75 \text{ ft, whichever is greater} \]

\[ W_b = 2W + B_c \]

\[ K = 2W + B_c + \frac{2H_c}{12} \]

All methods, backfill quantity, \(B_{BC}\), per linear foot from trench bottom to pipe crown:
\[ B_{BC} = \frac{0.5H_c(W_b + K) - A_c}{27} \]

Method 1 or 2 backfill quantity, \( B_{CT} \), per linear foot from pipe crown to top of trench:

\[ B_{CT} = \frac{T_c(K + W_j)}{54} \]

Method 3 backfill quantity, \( B_{CV} \), per linear foot from pipe crown to top of \( V_c \) dimension:

\[ B_{CV} = \frac{V_c(K + K_3)}{54} \]

Method 3 backfill quantity, \( B_{VT} \), per linear foot from top of \( V_c \) dimension to top of trench:

\[ B_{VT} = \frac{(T_c - V_c)(K_3 + W_j)}{54} \]

Method 1 total backfill per linear foot = \( B_{BC} + B_{CT} \).

Method 1 total backfill quantity = \( L_B(B_{BC} + B_{CT}) \).

For backfill method 2, \( B_{BC} \) and \( B_{CT} \) each represent different materials, so the quantities should not be added. The total quantity for method 2’s \( B_{BC} \) material is \( (L_B)(B_{BC}) \). The total quantity for method 2’s \( B_{CT} \) material is \( (L_B)(B_{CT}) \).

For backfill method 3, \( B_{BC} \) and \( B_{CV} \) are the same material, so the total method 3 quantity of this material is \( L_B(B_{BC} + B_{CV}) \). \( B_{VT} \) represents a different material, so it should not be added to \( B_{BC} + B_{CV} \). The total quantity for method 3’s \( B_{VT} \) material is \( (L_B)(B_{VT}) \).

**17-3.02(04) Deformed Pipe, Rock Foundation**

The total backfill quantity is that required for an earth foundation plus the foundation backfill required below the pipe. The additional volume is determined in the same manner as for a circular pipe.
17-3.03  Computer Program for Determining Backfill Quantities

The computer program, Backfill Calculation Software, is now available on the Department’s website at www.in.gov/dot/div/contracts/standards/07Bkfl-qt.xls. Use of the program precludes the need for hand-calculations for cross-structures as shown in the INDOT Standard Drawings.

For a circular pipe, the input data include pipe diameter, pavement or median width as required, and $T_c$.

For a deformed pipe, the input data include pipe size, pavement or median width as required, $T_c$, span, rise, and perimeter $P$. Span, rise, and $P$ can be determined from the reference sheets included with the program.

The following backfill quantities calculation examples are included with the program.

1. Method 1, Circular Corrugated Pipe, Rock Foundation
2. Method 1, Deformed Smooth-Interior Pipe, Earth Foundation
3. Method 1, Circular Smooth-Interior Pipe, Earth Foundation
4. Method 2, Circular Corrugated Pipe, Earth Foundation
5. Method 2, Circular Corrugated Pipe, Structural-Plate Metal, Rock Foundation
6. Method 2, Deformed Corrugated Pipe, Earth Foundation
7. Method 3, Circular Corrugated Pipe, Earth Foundation
8. Method 3, Deformed Corrug. Pipe, Structural-Plate Aluminum Alloy, Earth Foundation
9. Method 3, Deformed Corrugated Pipe, Structural-Plate Steel, Rock Foundation

17-3.04  Video Inspection

Video inspection will be required for each pipe that is inaccessible for visual inspection, or for which visual inspection is impossible. This includes each location considered to be in a confined space. Commercial- and private-drive pipes will not be video inspected. This is a pay item, and should be applied as necessary to each non-underdrain pipe pay item, without regard to INDOT Standard Specifications reference number.

17-3.05  Information to be Shown on Plans

The backfill method, material, and quantity; geotextile quantity if applicable; and video-inspection quantity if applicable, should be shown in the Structure Data table for each pipe structure.
17-4.0 ROADWAY QUANTITIES

17-4.01 Pavement Materials

Chapter 304 discusses INDOT pavement design criteria. It also provides information for quantity determinations of subgrades, asphalt materials, concrete materials, underdrains and geotextile wraps. Figure 17-4A, Roadway Factors, provides factors that can be used to determine asphalt pavement and other roadway quantities.

The following method should be used to determine quantities for shoulder corrugations. For an Interstate route, it is sufficient to multiply the number of shoulders requiring corrugations, usually four, by the gross project length in yards. For another type of facility, it is acceptable to multiply the number of shoulders that require corrugations by the gross project length in yards by 0.8 to account for the gaps in the intermittent corrugation pattern. It is not necessary to subtract the length of gaps at bridge approach slabs and bridge decks, driveways, median crossovers, or public road approaches when calculating the quantity. It is also not necessary to subtract the length of non-corrugated shoulder less than 7 ft wide adjacent to a roadside barrier.

17-4.02 Subgrade Treatment

Subgrade information is included in INDOT Standard Specifications section 207. The subgrade is defined as the top surface of a roadbed upon which the pavement structure and shoulders are constructed. The subgrade area should be computed for all areas of new pavement or shoulders, including cuts and fills. The width of the treatment is between points which are 2 ft, or as determined, outside the edges of paved shoulders or back faces of curbs, as shown in Chapter 304, or as instructed by the Office of Geotechnical Services. The lateral limits and type of subgrade treatment should be shown on the Typical Cross Sections on the plans.


Where subgrade treatment other than that described below is recommended by the Office of Geotechnical Services, a special provision is required.

The subgrade treatment methods are as follows:

1. **Type I.** This treatment consists of 24 in. of compacted soil.

2. **Type IA.** Effective Sept. 2014, Type IA has been deleted from the Standard Specifications.
3. **Type IB.** This treatment consists of 14 in. chemical soil modification. Chemical soil modification should not be used where groundwater is within 5 ft of the proposed subgrade treatment elevation. Due to equipment limitations, chemical soil modification should be limited to subgrade widths equal to or greater than 8 ft.

4. **Type IC.** This treatment consists of 12 in. of subgrade excavated and replaced with coarse aggregate No. 53.

5. **Type II.** This treatment consists of 6 in. of the subgrade excavated and replaced with coarse aggregate No. 53.

6. **Type IIA.** This treatment consists of 8 in. chemical soil modification. Chemical soil modification should not be used where groundwater is within 5 ft of the proposed subgrade treatment elevation. Due to equipment limitations, chemical soil modification should be limited to subgrade widths equal to or greater than 8 ft.

7. **Type III.** This treatment consists of in-place compaction.

8. **Type IIIA.** Effective Sept. 2014, Type IIIA has been deleted from the Standard Specifications.

9. **Type IV.** This treatment consists of 12 in. of the subgrade excavated and replaced with coarse aggregate No. 53 on Type IB geogrid.

10. **Type IVA.** This treatment consists of 12 in. of coarse aggregate with Geocell Confining System.

11. **Type V.** This treatment consists of 3 in. of subgrade excavated and replaced with 3 in. coarse aggregate No. 53.

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**17-4.02(02) Subgrade Treatment Type Determination**

1. **Project With Subgrade Treatment Type Determined per Former Practice.** The designer should transmit a memorandum to the Office of Geotechnical Services. Such memorandum should request that the Office of Geotechnical Services review the pavement design to determine the subgrade treatment type or types required as described herein. Once the Office of Geotechnical Services transmits its determination to the designer, the designer must revise the plans, pay items, and pay quantities accordingly.
A project that did not require subgrade treatment per former practice will likely do so now.

2. Project With Subgrade Treatment Type Yet to be Determined. The preliminary field check plans should include projected AADT figures and subgrade treatment areas tabulated for each survey line as shown in Figure 17-4B. During the field check, the Office of Geotechnical Services should be informed of possible shallow utilities, temporary pavement, need for a temporary runaround, or night construction so that it can make suitable recommendations for subgrade type. Such considerations should be documented in the field check minutes.

The type or types of subgrade treatments described in Section 17-4.02(01) to be used will be specified in the Geotechnical Report. If the Geotechnical Report does not specify the subgrade treatment type, the designer should send a memorandum requesting the subgrade treatment to the Office of Geotechnical Services.

The field check may have already been conducted, but the Geotechnical Report may not yet have been received by the designer. For this situation, the designer should submit to the Office of Geotechnical Services the tabulation and information regarding shallow utilities, temporary pavement, need for a temporary runaround, or night construction so that it can make suitable recommendations for subgrade type.

17-4.02(03) Determining Pay Items and Quantities

A divided highway may have parallel but separate subgrade treatment areas, likely of the same type, depending upon the width of the median. An isolated area such as that on an S-line, median crossover, or possibly a portion of the mainline, may be of a different treatment type than that of the mainline. Quantities should be determined for each required subgrade treatment pay item.

17-4.03 Placing Pipe Under Existing Pavement

Pay quantities for backfill and pavement replacement work at an installation or replacement of a pipe, culvert, structure, or utility line placed either transversely or longitudinally under an existing paved roadway alignment will be determined as described below.
17-4.03(01) Determining the Longitudinal Pay Limits of the Pavement Replacement

The following equations, along with the INDOT *Standard Drawings*, should be used to determine the longitudinal pay limits, \( L \), in linear feet, of the pavement replacement.

1. **Structure of 30 in. Diameter/Span or Smaller.**

\[
L = 5.5 + \frac{d}{6} + \frac{B_c}{12} \quad \text{[Equation 17-3.1]}
\]

where \( d \) = vertical distance from flow line to profile grade, feet
\( B_c \) = inside diameter or span, inches

2. **Structure of Diameter/Span of Greater Than 30 in.**

\[
L = 4 + \frac{d}{6} + 0.13B_c \quad \text{[Equation 17-3.2]}
\]

17-4.03(02) Determining Pavement Quantities

The pavement material to be placed should match the existing pavement section as closely as possible. If the existing section is shallower than the minimum section shown on the INDOT *Standard Drawings*, such minimum section should be specified. The designer will determine the existing pavement section from the most recent approved pavement design or existing typical cross sections details. If the existing asphalt pavement section cannot be determined, the minimum HMA section shown on the INDOT *Standard Drawings* with 440 lb/yt\(^2\) HMA Base should be specified. If the existing concrete pavement section cannot be determined, a minimum PCCP section of 9 in. depth should be specified. The same new pavement section should be used for both travelway and shoulders.

1. **Asphalt Pavement.** Hot mix asphalt (HMA) pavement quantities should be determined for Surface, Intermediate, or Base courses. The thickness of each course should approximate that in place with consideration given to current practice in determining course thicknesses. If a thicker section than the minimum is required, the additional thickness should consist of HMA Base 25.0 mm. The courses and lay rates should be shown on the plans.
The pay unit is ton. The type should be determined as described in Section 304-8.02. Quantities should be determined for each course and summed to obtain a total quantity of HMA for structure installation to be shown on the plans on the Structure Data sheet in the Pavement Replacement, HMA columns.

2. **Concrete Pavement.** The required portland cement concrete pavement (PCCP) quantity is the travelway and shoulder widths times $L$ as determined above. The pay unit is square yard. The same pay item should be specified without regard to the required pavement depth. The required depth should be shown on the plans. The new subbase should match the existing thickness and type, whether the existing subbase is open graded or dense graded. The PCCP quantity should be shown on the plans on the Structure Data sheet in the Pavement Replacement, PCCP column.

3. **Composite Asphalt over Concrete Base.** HMA of the thickness in place should be placed on PCCP of the minimum or greater thickness if required. The HMA material should consist of HMA for Structure Installation as required. The new subbase should match the existing thickness and type, whether the existing subbase is open graded or dense graded. The quantities should be determined and shown on the plans as described in Items 1 and 2 above.

### 17-4.03(03) Determining Backfill Quantities

Quantities for backfill should be determined based on the section shown in the INDOT Standard Drawings, and as described in Section 17-3.01(03). The backfill quantities should be shown on the Structure Data sheet in the appropriate Backfill column. If no Structure Data sheet is included with the plans, the backfill quantities should still be shown on the plans.

### 17-4.03(04) Determining Underdrain Quantities

Underdrains, if present where placing a pipe under existing pavement, should be perpetuated. The only pay quantity will be for the linear measure of underdrains based on the existing configuration. The pay item is Underdrain, Patching and the pay unit is linear foot. Quantities should not be determined for underdrain pipe, aggregate for underdrains, geotextile for underdrains, HMA for underdrains, outlet protector if required, video inspection for underdrains, and all other incidentals for underdrains. This work is included in the cost of the pay item Underdrain, Patching.
17-4.04 Subbase and Underdrains for Cement Concrete Pavement

17-4.04(01) Subbase

The subbase under portland cement concrete pavement (PCCP) consists of two aggregates, Coarse Aggregate No. 8 on top of Coarse Aggregate No. 53. The INDOT *Standard Specifications* provides the criteria for thickness of these aggregates. The bottom layer of this composite subbase should be designated on the plans as a separation layer. Include this separation layer in a PCCP mainline, S-line, or approach pavement except a drive. For estimating and payment purposes, combine the quantities for both aggregate types and designate them together as Subbase for PCCP. For additional guidance, see Chapter 304 and the INDOT *Standard Specifications*, section 302.

17-4.04(02) Underdrains

Underdrains are required under new pavement. Locate the underdrain in the pavement structure as shown in Chapter 304 and provide a detail in the construction plans. For additional guidance, see Chapter 304 and the INDOT *Standard Specifications*. Where underdrains are used, include the following pay items.

1. Underdrain. The underdrain will consist of the pay items as follows:
   
   a. Pipe, Type 4, Circular, *(size)* in.;
   
   b. Geotextile for Underdrains; and
   
   c. Aggregate for Underdrains. Only the aggregate placed below the subgrade is included as aggregate for underdrains.

2. Underdrain Outlets. Underdrain outlets will consist of the pay items as follows:
   
   a. Pipe Underdrain Outlet, *(size)* in.;
   
   b. Outlet Protector, *(type)*; and
   
   c. Delineator Post.
**17-4.05 Non-Standard Concrete Median Barrier**

A non-standard concrete median barrier may be required on a horizontal curve, superelevation transition, or other locations where the barrier height varies from the standard dimensions, or where the median barrier is attached to a concrete footing or wall cap. Identify these locations on the plans and include the pay items Concrete, Class A and Reinforcing Steel, on the plans. Also, include a special provision in the contract.

A short length of irregular concrete median barrier section used in conjunction with the standard shape, a barrier at an approach to a bridge pier, sign foundation, or other similar support should be considered concrete median barrier and quantified as concrete barrier.

**17-4.06 Curb Ramp and Detectable Warning Surface [Rev. Apr. 2016]**

The pay limit for a curb ramp should include the ramp, blended transition, turning space, flared side and return curb as required. Where a turning space is shared by more than on curb ramp the turning space should only be measured for payment once.

Quantities for curb or combined curb and gutter within the curb ramp limits should not be included in the curb ramp quantity. These quantities should be incorporated into the project’s appropriate curb or curb-and-gutter quantities. Quantities for sidewalk required outside the curb ramp pay limit, should be incorporated into the project concrete sidewalk quantities. If flared sides are sod instead of concrete, such sodding should be incorporated into the project sodding quantities. The following pay items apply to curb ramps.

1. **Curb Ramp, Concrete (SYS).** Include the area of the ramp, blended transition, turning space, flared side, and return curb.

2. **Detectable Warning Surface (SYS).** Include the area of the detectable warning surface for the full width of the ramp, or blended transition, or turning space, as appropriate.

The pay item Detectable Warning Surface, Retrofit, should be included where a detectable warning surface is replaced or placed without construction of a new curb ramp. The pay limits of the detectable warning surface, retrofit should only include the detectable warning surface area. The Detectable Warning Surface, Retrofit pay item will include the removal, disposal, and replacement of portions of the concrete ramp, concrete base, including border, detectable warning surface, thin set mortar, and fine aggregate (where required) for filling joints.

Figure 17-4D, Quantities for Curb Ramp, illustrates the pay limits for curb ramps.
17-4.07 Sodded, Paved, or Riprap Ditch

A longitudinal-ditch slope of flatter than 1% will be seeded. A slope of 1% or steeper but flatter than 3% will require sodding. A slope of 3% or steeper will require a paved side ditch or riprap lining. However, in an area of poor soil, a slope of flatter than 3% may be paved or lined with riprap. A riprap ditch is typically used in a rural area and should be avoided in an urban area. The final ditch-protection type will be determined at the field check in consultation with the district office. The following discusses how to estimate the quantities for each ditch type.

17-4.07(01) Sodded Ditch

A standard sodded ditch is that which is parallel to the pavement profile grade line. A special sodded ditch is that which varies in elevation with respect to the pavement profile grade line. Depending on the side slopes, either ditch type may be used within the clear zone. Do not use a ditch with side slopes of 3:1 or steeper within the clear zone.

A ditch should be sodded to a point 1 ft above the flow line. Figure 17-4E, Sodded Ditch Quantities, provides the factors that can be used to determine the sodding quantities for a 4-ft wide sodded ditch based on various side slopes.

17-4.07(02) Paved Side Ditch

The INDOT Standard Drawings and Figure 17-4F, Paved Side Ditch, illustrate the types of paved side ditch used by the Department. To determine the type of paved side ditch, use the criteria provided in Section 30-3.03(02).

When computing quantities, the designer should consider the following.

1. **Limits.** Where a paved side ditch meets a sodded or unsodded ditch flowing in the same direction, extend the limits of the paved side ditch 25-ft beyond the theoretical point of termination. A longer distance may be required under special circumstances.

2. **Measurement.** Paved side ditch is measured from station to station in meters. For a grade of 20% or flatter, increase the measured distance from the plans by 5% to compensate for grade. For a grade steeper than 20%, increase the measured distance by 10%.

3. **Transition.** A paved-side-ditch transition is required at an intersection with an earth ditch or pipe culvert. Convert the transition to an equivalent length of the type of paved side
A transition of 10 ft or shorter is also required between two different types of paved side ditches. The transition is provided for in the pay length of the larger type of paved side ditch type specified.

4. **Cutoff Wall.** A cutoff wall is required at the beginning and end of each paved side ditch. Each cutoff wall is considered to be equivalent to 8 ft of the paved-side-ditch type specified at a location. Therefore, add an additional 8 ft to the measured paved-side-ditch quantity for each cutoff wall required.

5. **Lug.** A lug is provided to prevent sliding on a steep slope. Each lug is considered equivalent to 8 ft of the paved-side-ditch type specified at a location. Therefore, add an additional 8 ft to the measured paved-side-ditch quantity for each lug required. Lugs should be provided at the locations as follows:
   
   a. 10 ft downslope from a grade change;
   
   b. 10 ft downslope from the intersection of two different types of paved side ditches;
   
   c. at the downslope end of a transition between two different types of paved side ditches; or
   
   d. at the intervals shown in Figure **17-4G**, Lug Intervals.

6. **Sodding.** Provide sodding next to a paved side ditch as shown in Figure **17-4F**, Paved Side Ditches. To determine the sodding quantity, use a factor of 2.6 yd² per linear foot of paved side ditch. This factor is applicable for all paved-side-ditch types.

**17-4.07(03) Riprap-Lined Ditch**

When designing a riprap-lined ditch, consider the following:

1. Revetment riprap may be used for a slope of 3% or steeper, but 10% or flatter. Class I or class II riprap should be used for a slope steeper than 10%.

2. At a bridge cone, use the riprap type specified for the bridge cone.

3. Where a riprap ditch meets a sodded or unsodded ditch flowing the same direction, extend the limits of the riprap 25 ft beyond the theoretical point of termination.
4. Place geotextile under the riprap.

5. Show the ditch details on the plans.

6. Use uniform riprap for a ditch which is within the clear zone.

17-4.08 Mailbox Assembly and Mailbox Approach

A project on a rural non-Interstate-route will require mailbox assemblies. Section 51-11.0 provides guidance on the design and location of a mailbox approach. If mailbox locations are not shown on the topographic survey, the designer should not assume that mailboxes are not present on the route. In the absence of survey information, the designer should check for mailboxes at the field check review. The use of the videolog will also aid in determining the location and number of mailboxes.

Figure 17-4H, Mailbox Summary Table, illustrates the mailbox quantities that should be used. If the designer is certain that mailboxes are not located within the project limits, there is no need to include the work in the plans.

17-4.09 Monuments [Rev. Apr. 2016]

17-4.09(01) General [Rev. Apr. 2016]

A monument is set to perpetuate the location of a disturbed public land survey or grant corner within a right of way, to reestablish an alignment monument that may be disturbed during construction or created from a PR line, or to establish and define a vertical reference point. Monuments used by the Department are shown in the INDOT Standard Drawings series E 615-SCMN, E 615-SLBM, and E 615-SLMN and are defined as follows.

1. **Monument Type A.** Use this type with vitrified brick or asphalt surface on concrete base.

2. **Monument Type B.** Use this type with an asphalt pavement.

3. **Monument Type C.** Use this type where a monument is required outside the pavement area.

4. **Monument Type D.** Use this type with a concrete pavement.
5. **Benchmark Post.** Use this type to establish a Department benchmark.

6. **Section Corner Monument.** Use this type to perpetuate the location of a public land survey or grant corner.

It is the responsibility of the designer to select the type of monument that best suits the location where a monument is required.

**17-4.09(02) Section Monuments [Rev. Apr. 2016]**

The following will apply.

1. **Location.** Provide a monument at each section corner, quarter-section corner, and grant corner that lies within the right of way for a new facility, or for a facility to be reconstructed except as described in item 2 below.

2. **Responsibilities.** The district office will request the county surveyor to establish each public land survey and grant corner located within the right of way that is not already defined by a monument at the time of construction. If the county surveyor fails to establish each such point as requested, the district office will eliminate each monument provided for this purpose from the contract. Those section corner, quarter-section corner or grant corners that lie within the right of way that were previously monumented, but will be destroyed during construction, must be re-established.

3. **Plans.** Designate each monument by type and show it on the plans with an arrow to its approximate location.

**17-4.09(03) Survey Line Control Point [Rev. Apr. 2016]**

A survey or design alignment is used as the basis for the descriptions of acquired right of way. With respect to right-of-way descriptions, it is as significant as a section corner. A survey line control point and survey and design alignment monuments must be set by an Indiana registered land surveyor. A partial 3R project or a project not requiring additional right of way is exempt from this requirement. The following will apply.

1. **Monumenting PI, PC, and PT.** The following will apply.
a. Where a PI appears within the right of way, provide a monument at the PI.

b. Provide a monument for each PC and PT.

c. Designate each monument by type and show it on the plans with an arrow to its approximate location.

d. Place a monument at the intersection of the main line with the “S” line.

2. Monumenting Beginning and End Point of Project. Place a monument on the survey and/or design alignment centerline at each of these points.

3. Monumenting POT and POC. The following will apply.

a. It is not necessary to monument each POT and POC. These intermediate points are to be monumented as necessary so the maximum interval between adjacent monuments does not typically exceed one quarter mile.

b. Where practical, a monument required to define a POC or POT should coincide with a POC or POT established during the original survey.

c. Designate each POC and POT monument by type and station and show it on the plans with an arrow to its approximate location.

17-4.09(04) INDOT Benchmark [Rev. Apr. 2016]

One benchmark should be provided at least every 1.5 mile. Benchmarks should be located as follows.

1. Structure. Include a benchmark tablet on each bridge. Where twin structures or dual structures are constructed in the same vicinity, a benchmark is only required on one structure. Benchmark tablets should be installed at locations with continuous, deep foundations such as abutment, pier or pile cap. Avoid locations such as curbs, sidewalks, bridge decks, and railings. Location must accommodate the establishment of an accurate elevation of the benchmark. Benchmark tablets set as noted above or in a benchmark post should not be paid for directly.
2. **Non-Structure.** Where the spacing of structures is in excess of 1.5 miles, show benchmark posts on the plans and space them such that the maximum spacing between benchmarks is 1.5 miles. Benchmark posts should be paid for per INDOT *Standard Specifications*.

3. **Plans.** Designate each benchmark post or tablet on the plans with a note as follows:

   Benchmark Post (or Tablet) Required
   Station _______ + _______
   Offset distance ________ Direction (Lt. or Rt.) _______

**17-4.09(05) Correcting Plans [Rev. Apr. 2016]**

The district construction engineer will notify the district Capital Program Manager, project manager, and district Survey Manager in which the project is located, for approval prior to any monument being eliminated from the contract or if the location of a monument is proposed to be changed. The as-built plans are to reflect any changes made to the monument locations shown in the construction plans.

**17-4.09(06) Right-of-Way Marker**

See Section 85-7.0 for information.

**17-4.09(07) National Geodetic Survey Benchmark**

Each National Geodetic Survey (NGS) benchmark disturbed by highway construction must be re-established. It is the responsibility of the Contractor to secure the replacement disk for such a benchmark. In addition, the construction plans should include the note as follows:

   N.G.S. Benchmark Post No. ____________,
   Station ____________, (Rt.) (Lt.) shall be re-established by the Contractor.

Procedures for re-establishing soon-to-be disturbed or destroyed benchmarks should follow the guidelines established in the NGS *Bench Mark Reset Procedures* document and can be obtained at the link provided below:

17-4.09(08) NGS Horizontal Control Point [Rev. Apr. 2016]

The designer is responsible for notifying the NGS if a NGS horizontal control point (formerly triangulation point) will be destroyed due to proposed highway construction. This notification will be made by the Highway Design and Technical Support Division director and should be made at the time the plans are sent to the district office. Sufficient detail of the mark should be provided with notification to ensure positive identification. Said notifications will be made to the following:

NOAA, National Geodetic Survey, N/NGS43
Bldg. SSMC3, Room 8545
1315 East-West Highway
Silver Spring, MD 20910
Phone: 301-713-3242

It is not necessary to show a monument in the plans for use in re-establishing a NGS horizontal-control point.


Each United States Geological Survey (USGS) benchmark disturbed by highway construction must also be re-established. Information on resetting such may be obtained by contacting the following:

National Spatial Data Infrastructure Partnership Office
U.S. Geological Survey
Ohio Mapping Partnership Office
6480 Doubletree Avenue
Columbus, OH 43229
Phone: (614)-430-7768

17-4.10 Seeding and Sodding [Rev. May 2016]

Permanent seeding and sodding requirements can be found in the INDOT Standard Specifications, section 621.

17-4.10(01) Seeding for Grading and Paving Project [Rev. May 2016, Sep. 2016]

The following will apply.
1. **Rural Area of 1 ac or Larger.** An area within the right of way that is not sodded or paved should be seeded as follows.
   
   a. **Seeding.** Use Seed Mixture R as specified in the INDOT *Standard Specifications*. Estimate the quantity assuming an application rate of 205 lb/ac.
   
   b. **Mulching.** Use the pay item Mulching Material and estimate it at a rate of 2 T/ac.
   
   c. **Fertilizer.** For estimating purposes, assume an application rate of 800 lb/ac. Use the pay item Fertilizer and include the supplemental description “for permanent seeding.”

2. **Urban Area of 1 ac or Larger.** An area within the right of way that is not sodded or paved should be seeded as follows.
   
   a. **Seeding.** Use Seed Mixture U as specified in the INDOT *Standard Specifications*. Estimate the quantity assuming an application rate of 200 lb/ac.
   
   b. **Mulching.** Use the pay item Mulching Material and estimate it at a rate of 2 T/ac.
   
   c. **Fertilizer.** For estimating purposes, assume an application rate of 800 lb/ac. Use the pay item Fertilizer and include the supplemental description “for permanent seeding.”

3. **Rural Area of Smaller Than 1 ac.** For an area within the right of way which is not sodded or paved, use the pay item Mulched Seeding R. Estimate the area and pay quantity in square yards.

4. **Urban Area of Smaller Than 1 ac.** For an area within the right of way which is not sodded or paved, use the pay item Mulched Seeding U. Estimate the area and pay quantity in square yards.

**17-4.10(02) Seeding for Grading Project[Rev. May 2016, Sep. 2016]**

The following will apply.

1. **Shoulder Point to Shoulder Point.** The area between the outside shoulder points should be seeded as follows.
a. Seeding. Use Seed Mixture P as specified in the INDOT Standard Specifications. Estimate the quantity assuming an application rate of 130 lb/ac.

b. Fertilizer. For estimating purposes, assume an application rate of 400 lb/ac. Use the pay item Fertilizer and include the supplemental description “for permanent seeding.”

2. Shoulder Point to Right-of-Way Line. The area between the outside shoulder point and the right-of-way line should be seeded according to the requirements for a grading and paving project as discussed in Section 17-4.10(01).

17-4.10(03) Seed Mixture Type D [Added May 2016]

Seed Mixture Type D is intended for ditch applications where seasonal or chronic saturated soils exist. Estimate the quantity assuming an application rate of 16 lb/ac. Fertilizer is not used. This mixture should be specified for use only on maintenance contracts. The use on other contract types should be coordinated with the Environmental Services Division landscape architect.

17-4.10(04) Seeding for Environmental Mitigation [Rev. May 2016]

Where environmental mitigation is required by the environmental document, or as determined from a field check, specify one of the following seed mixtures.

1. Seed Mixture Grass. The following will apply.

   a. Type 1. Specify this mixture where a special grass is required in addition to the regular seed mixture. The pay item is Seed Mixture Grass Type 1. For estimating purposes, assume an application rate of 235 lb/ac.

   b. Type 2. This mixture is to be furnished at the contractor’s expense instead of the regular seed mixture in an urban area that has been disturbed beyond the construction limits.

2. Seed Mixture Legume. The following will apply.

   a. Type 1. Specify this mixture where a special legume mixture is required in addition to the regular seed mixture. The pay item is Seed Mixture Legume Type 1. For estimating purposes, assume an application rate of 230 lb/ac.
b. Type 2. This mixture is to be furnished at the contractor’s expense instead of the regular seed mixture in a rural area that has been disturbed beyond the construction limits.

c. Signs. Include “Do Not Spray” signs where this mixture is specified.

17-4.10(05) Wildflower Seed Mixture

Where a wildflower seed mixture is specified, prepare the necessary special provisions so that at least three alternatives of equal cost, type, and growing condition are available for the contractor to select. These alternates may be designated by alternate vendors’ formulations, by the designer’s own non-proprietary formulations, or any combination thereof that results in three equal alternatives. Ensure that alternate component varieties for non-proprietary formulations allow the contractor to make substitutions for component varieties that may be in short supply. If the designer has any questions regarding application rates, method of measurement, or pay item descriptions, he or she should contact the Production Management Division’s landscape architect.

17-4.10(06) Sodding

In determining the need for sodding, the designer should consider the following.

1. **Sod.** Sod should be included as described as follows:
   
   a. in an earth ditch with longitudinal slope of 1% or steeper but flatter than 3%;
   
   b. along a paved side ditch (see INDOT Standard Drawings);
   
   c. at a bridge-cone area near a bridge structure as shown in Figure 17-5 I, Riprap and Sodding Limits with Barrier Transitions on Bridge, or Figure 17-5 J, Riprap and Sodding Limits with Barrier Transitions on RCBA;
   
   d. in a median ditch of a divided highway; see Figure 17-4 I, Sodding Locations; and
   
   e. at side-slope break points; see Figure 17-4 I.

2. **Nursery Sod.** Nursery sod will be required for all exposed surfaces within the right of way of a developed area (i.e., commercial, industrial, residential). A maintained lawn expected to be disturbed by construction a rural area will also require nursery sod.
3. **Estimates.** Estimate the area of sod and nursery sod in square yards.

4. **Water.** To estimate the amount of additional water required for sod and nursery sod, assume a rate of 4 gal./yd². The pay unit is kilogallon, symbol kGAL.

**17-4.10(07) Mobilization and Demobilization for Seeding**

If pay items for seeding are required, at least one each of the pay item Mobilization and Demobilization for Seeding is required. If the project includes a temporary runaround, add at least one additional unit to the estimate. Additional units may be added as required for the likely progression of work (e.g., for the various construction phases).

**17-4.11 No-Passing-Zone Pavement Markings**

If a no-passing zone extends beyond the project limits, striping quantities should include required solid-yellow lines and adjacent broken-yellow lines to the ends of such no-passing zone.

**17-4.12 Spare Parts Package for Guardrail End Treatment or Impact Attenuator [Del. May 2019]**

**17-4.13 Temporary Traffic Barrier (TTB)**

The total pay quantity of each type of TTB should be computed only once, regardless of how many traffic-maintenance phases it is to be used in, or how many times it must be moved.

The length of the longitudinal portion of TTB should be taken from the beginning point of where it is required to the ending point of where it is required. Gaps required to accommodate public road approaches or drives should be subtracted out. The length of each such gap should be taken as the approach or drive width plus its radii. The lengths of each flared portion should be measured along the flare.

A construction-zone energy-absorbing terminal, if required for use with TTB type 1 or type 3, is a separate pay item to be quantified only once, regardless of how many traffic-maintenance phases it is to be used in, or how many times it must be moved. The length of each construction-zone energy-absorbing terminal, if required for use with TTB type 2 or 4, should be taken as 37.58 ft.
where used along an outside shoulder, or 12.5 ft where used along a median shoulder. Such lengths should be included in the linear quantities of TTB.

Delineation, and anchoring or other means required to control deflection, are included in the TTB quantities, so they should not be considered when determining the pay quantities.

17-4.14 High-Tension Cable Barrier System (CBS)

1. Plans. The longitudinal and transverse CBS locations should be shown on the plans. A geotechnical investigation of the soil conditions will be required for the approximate locations of the safety terminal and the representative locations of the intermediate line-post foundations at the respective sites throughout the entire length of the proposed barrier installation. The geotechnical-investigation results should be incorporated into the contract documents.

2. Quantities. The length of each end terminal should be included in the quantities for CBS. A safety terminal should be included for each end of each CBS run. One spare-parts set should be included. The plans should show all necessary linear-grading work to be done in the median. The quantities should be included in a pay item for linear grading. A traffic-control plan should be included, along with a pay item for maintaining traffic.

17-5.0 BRIDGE QUANTITIES

17-5.01 Structural Concrete Quantities

17-5.01(01) Cast-In-Place Concrete

Measure concrete quantities, in cubic yards, based on the theoretical volume for the class and use specified. Do not deduct for the volume of piles, joint material, or reinforcing steel within the concrete.

17-5.01(02) Concrete Structural Members

Prestressed I beams and bulb-tee beams will be measured by the linear foot. There is no measurement per each or lump sum. Prestressed box beams will be measured by the square yard.

17-5.01(03) Surface Seal
The manner of showing the limits of surface seal on the plans, and the pay quantity of surface seal, should be determined based on attached Figure 17-5A(0). The quantity in square feet (square meters) should be shown where appropriate on the Bridge Summary of Quantities.

For a bridge with concrete structural members, the tops of all such members, and the outside faces of the fascia members should also be surface sealed. This quantity is included in the concrete-structural-member quantities. It should not be calculated, nor included in the surface-seal quantity shown on the Bridge Summary of Quantities.

17-5.02 Excavation Quantities

Structure excavation can consist of several types of excavation. In addition to the INDOT Standard Specifications, Figure 17-5A, Structure Excavations, and the following discuss the various structure-excavation types and how to determine the applicable quantities.

1. **Class X Excavation.** Specify the pay item Excavation, X, where solid rock, loose stones, boulders of more than 0.5 yd³ in volume, concrete footings from old structures not shown on the plans, timber grillages, piles, or other similar materials are encountered within the limits of foundation excavation. The volume of class X excavation is determined as follows:

   \[
   \text{Class X Excavation} = \frac{(L)(W)(D)}{27}
   \]

   Where:
   
   \[L = \text{length of footing, ft}\]
   \[W = \text{width of footing, ft}\]
   \[D = \text{depth of class X excavation, ft} \text{ (See Figure 17-5A)}\]

   D extends from the bottom of the footing to the top of the rock elevation.

2. **Wet Excavation.** Specify the pay item Excavation, Wet, where foundation excavation is encountered below a horizontal plane designated on the plans as the upper limit of wet excavation. The limits for wet excavation quantities are defined as the theoretical volume bounded by the bottom of the footing, the upper limit of wet excavation and vertical planes which are 1.5 ft outside the neat lines of the footing and parallel thereto. The elevation of the upper limit of wet excavation is the low-water elevation plus 1 ft. The volume of wet excavation is determined as follows:
Wet Excavation = \( \frac{(L+3)(W+3)D}{27} \)

Where: 
- \( L \) = length of footing, ft
- \( W \) = width of footing, ft
- \( D \) = depth of wet excavation, ft (See Figure 17-5A)

Additional quantities may be required outside these limits for the following conditions.

a. The plans show a cofferdam with dimensions that exceed 1.5 ft outside the footing and the cofferdam is not a pay item. The theoretical volume for wet excavation will be based on the dimensions of the cofferdam as shown in the plans.

b. A foundation seal is required. The wet-excavation limits will be extended to the bottom elevation of the foundation seal.

c. The volume of any class X excavation encountered within the limits of wet excavation is not to be subtracted from the wet excavation. The volume of class X excavation should be included as a separate pay quantity.

If a portion of the present structure lies wholly or partially within the limits of wet excavation, do not alter the pay quantities for wet excavation.

3. **Dry Excavation.** The volume of dry excavation is the amount of excavation required from the top of wet excavation to the top of proposed ground line. Only include the pay item Excavation, Dry, if the quantity exceeds 250 yd³. Where dry excavation is not included as a pay item, the quantity is included the concrete quantity. The volume of dry excavation is determined as follows:

\[
\text{Dry Excavation} = \frac{(L+3)(W+3)D}{27}
\]

Where: 
- \( L \) = length of footing, ft
- \( W \) = width of footing, ft
- \( D \) = depth of dry excavation, ft (See Figure 17-5A)

4. **Waterway Excavation or Common Excavation.** The volume of waterway or common excavation is the amount of excavation required from the existing ground line to the proposed ground line. If this excavation is in the main-channel area, the pay item is Excavation, Waterway. Otherwise it is Excavation, Common. If it is as common
excavation, add this quantity to the previously computed quantity for the road work. If extensive channel work is required, compute the waterway excavation separately.

5. **Foundation Excavation (Unclassified).** If there are no other types of structure excavation, the excavation pay item required at each end bent is Excavation, Foundation, Unclassified. The volume of foundation excavation (unclassified) is determined as follows:

\[
\text{Foundation Excavation (Unclassified)} = \frac{(L + 3)(W + 3)D}{27}
\]

Where:
- \(L\) = length of footing or end bent cap, ft
- \(W\) = width of footing or end bent cap, ft
- \(D\) = depth of excavation from the natural ground line to bottom of the foundation, ft

17-5.03 Piling [Rev. Jan. 2011]

17-5.03(01) Test Piles [Added Jan. 2011]

The geotechnical report will specify the test method for determining the nominal driving resistance of a driven pile as dynamic formula, dynamic-pile load, or static load. If the number of hours required before restriking can occur is not provided in the geotechnical report, 0 should be entered in the appropriate recurring special provision’s appropriate blank.

The appropriate test-piling-related pay items are as follows.

1. **Dynamic-Formula Method, INDOT Standard Specifications Section 701.05(a).**
   a. Test Pile, Indicator, Production. One such pile per support is required.
   b. Test Pile, Indicator, Restrike. A quantity of one each is required for each test pile.

   If the geotechnical report does not specify a number of hours before restrike can occur, the pay items for indicator test pile and indicator test pile restrike are not required.

   In addition to the criteria shown in the INDOT Standard Specifications, the designer should consider the following.
2. **Dynamic Pile-Load Test, INDOT Standard Specifications Section 701.05(b).**
   
   a. Test Pile, Dynamic, Production. The required number and locations of such piles per support or structure will be shown in the geotechnical report.
   
   b. Test Pile, Dynamic, Restrike. A quantity of one each is required for each test pile.
   
   c. Dynamic Pile Load Test. A quantity of one each is required for each test pile.

3. **Static-Load Test, INDOT Standard Specifications Section 701.05(c).**
   
   a. Test Pile, Static Load, pile size, Non-Production. The required number of such piles per support or structure will be shown in the geotechnical report.
   
   b. Static Pile Load Test. A quantity of one each is required for the test pile.

   If this test method is specified, the static-load test-pile location area should be shown on the plans. The geotechnical report will also specify the dynamic-pile-load test for the same piles. The pay items for test pile, dynamic restrike, and dynamic pile load test will also be required.

   If the geotechnical report specifies epoxy-coated or reinforced-concrete-encased piling, the portion of the production test pile that is to be so treated should be quantified as an epoxy-coated or reinforced-concrete-encased pile. The remainder of the pile length should be quantified as a test pile, as described above.

   Quantities should not be included for restock piling. This is for construction-oversight personnel use at the conclusion of pile-driving operations.

**17-5.03(02) Permanent Piles [Added Jan. 2011]**

1. **Exposed or Buried Piles.** Piles which consist of an exposed portion and a buried portion should be measured as two pay items. The buried portion of a steel-pipe pile is Pile, Steel Pipe, *(pipe-well thickness)* in, *(diameter)* in. The exposed portion is Pile, Steel Pipe, Epoxy Coated, *(pipe-well thickness)* in, *(diameter)* in.

2. **Pay Items.** The pay items defined in the INDOT Standard Specifications should be used. The pay item names will include information on the pile diameter or size, the type of encasement, reinforcing-steel requirements, and the wall thickness of the steel shell.
3. **Measurement.** The minimum pile tip elevation shown on the General Plan sheet for a stream crossing is established to provide adequate penetration to protect against scour and does not necessarily indicate the penetration needed to obtain the required bearing. The estimated elevation needed to obtain the required bearing is shown only in the Geotechnical Report. The billed length of piling should be computed based on the lower of the minimum tip elevation shown on the General Plan sheet or the estimated bearing elevation shown in the Geotechnical Report.

4. **Incidental Items.** Do not include separate pay items for pile encasement, reinforcing steel, or concrete filling. These are included in the pay items for the piles.

5. **Oversized Predrilled Pile Holes.** For an integral end bent structure, include a special provision to define the additional payment breakdown required for oversized predrilled holes and uncrushed gravel backfill. The piles themselves should be measured as described in the INDOT *Standard Specifications*. Include the special provision where the blow count (N) exceeds 35 blows per foot within the 10-ft interval below the bottom of the cap.

### 17-5.04 Steel Sheet Piling

Steel sheet piling required for railroad protection should be shown on the plans. Sheet piling with a higher section modulus than that specified may be required by the railroad company or by the contractor’s bearing design. Sheet piling is cut to 10 ft below the final ground elevation, and left in place after construction is complete. The sheeting is not required for permanent support, but disturbance caused by its removal may be damaging. Steel sheet piling to be left in place is measured by the square foot.

The specified section modulus should be included in the pay item name.

### 17-5.05 Backfill for a Structure

#### 17-5.05(01) Backfill at Bridge Support

1. **End Support.**
   a. Beam or Girder Type Superstructure. Backfill behind an end bent should consist of coarse aggregate wrapped in a geotextile as shown in the INDOT *Standard
Drawings. An end bent drain pipe should also be included. A structure over water should have the outlet located on the downstream side wherever possible.

b. Reinforced Concrete Slab Bridge. Flowable backfill should be used to backfill behind an end bent as shown in the INDOT Standard Drawings. End bent drain pipes will not be required.

2. Interior Support.

a. Railroad or Roadway Grade Separation Structure. The area to a point 1.5 ft outside the neat lines of each footing should be backfilled with structure backfill as shown on the INDOT Standard Drawings. The neat-line limits and estimated quantities should be shown on the Layout sheet for each support location.

b. Bridge Over Waterway. The area to a point 1.5 ft outside the neat lines of each footing should be backfilled with common fill or borrow material.

17-5.05(02) Backfill for Retaining Wall

Chapter 410 provides the design criteria and warrants for the placement of a retaining wall.

Figure 17-5B, Cast-in-Place Concrete Retaining Wall Earthwork Quantities Limits; Figure 17-5C, MSE Retaining Wall Earthwork Quantities Limits; and Figure 17-5D, MSE Retaining Wall Earthwork Quantities Limits Showing Foundation Treatment, each illustrate the typical pay limits for excavation and backfill material quantities for a retaining wall. The contractor may select an alternate wall design. However, the earthwork quantities should be calculated based on the outermost neat-line construction limits for the wall type shown on the plans.

All excavation quantities required for placement of retaining walls should be incorporated into the project’s earthwork quantities tabulation and balancing. The required pay items for a cast-in-place concrete wall are common excavation and structure backfill. The required pay items for an MSE wall are common excavation, structure backfill, and B borrow.

17-5.06 Roadway Items

Where bridge construction is to be included within road-project limits, the bridge designer should provide the road designer with a Layout sheet and a General Plansheet indicating the proposed roadway construction near the bridge. In addition, the bridge designer will be responsible for
providing the road designer with the quantities for the pay items listed in Figure 17-5E, Bridge Pay Items in Road Plans, so that they can be included with the roadway quantities.

17-5.07 Pavement Markings

A bridge project should include pay items and quantities for traffic-lane stripes, edge lines, and signs. A detail or a table illustrating permanent pavement-marking limits and quantities should be shown in the plans; see INDOT Typical Plan Sheets. The designer should consider the following.

1. **Edge and Center Lines.** Determine the quantity for solid-white edge lines and for broken-yellow center lines directly from the plans.

2. **No-Passing Zones.** The quantity for solid-yellow lines to denote a no-passing zone is an undistributed item. New solid-yellow lines for a no-passing zone should be provided for the entire no-passing zone, even if the no-passing zone extends beyond the limits of the bridge project. Approximate lengths may be determined during the field check. However, actual limits will be determined by the district Office of Traffic.

17-5.08 Regulatory or Warning Traffic Signs

The designer, in conjunction with district-office personnel during the field check review, should determine whether new traffic signs will be required or if the present ones can be reset.

The method of determining quantities for new regulatory or warning traffic signs is as follows.

1. **Posts.** Sign posts are measured by the linear ft and specified by type.

2. **Signs.** Sheet signs are measured by the area, in square feet, according to the sheeting type and thickness.

Figure 17-5F, Sign Post and Sheet Sign Summary (Bridge Project), illustrates the signing tables that should be placed on the Bridge Summary sheet or on the Approach Details sheet. For a project with a small number of signs, the totals may be omitted.

Sign codes, description, size, location, post length, and type are listed in the tables according to the guidelines in the Manual on Uniform Traffic Control Devices, the INDOT Standard Drawings and Section 502-1.0. The type and quantity of posts should be determined as shown on the INDOT Standard Drawings.
17-5.09  Reinforced Concrete Bridge Approach (RCBA) [Rev. July 2012, Apr. 2016]

17-5.09(01)  Miscellaneous Requirements [Rev. July 2012, Apr. 2016]

The designer should provide complete RCBA details on the bridge plans.

1. **Dimensions.** The RCBA length, width, skew, thickness, and bill of materials should be determined and shown on the plans. The length and width should be also shown on the General Plan sheet. INDOT *Standard Drawings* Series E 609-RCBA contains information on the spacing of reinforcement and connection to the bridge deck. The *Standard Drawings* are intended for new construction. The RCBA width should equal the bridge clear-roadway width and RCBA extensions utilized as needed.

2. **Anchoring.** The RCBA should be anchored to the end of the superstructure where integral end bent construction is used. Where a bridge deck expansion joint is used at the end of the superstructure, an alternate anchoring detail should be utilized.

3. **Polyethylene Fabric.** Two layers of polyethylene fabric, each of minimum thickness 0.02 in., should be placed between the RCBA and the dense-graded subbase where the RCBA is anchored to the superstructure.

4. **Terminal Joint.** If the approach roadway is PCCP, a terminal joint as shown on INDOT *Standard Drawings* Series E 503-BAJT should be provided at the roadway end of the RCBA. No such joint is required if the approach roadway pavement is HMA.

5. **Extension for Bridge-Railing Transition.** An extension should be provided under each bridge-railing transition as shown on INDOT *Standard Drawings* Series E 609-TBAE. The extension should be considered part of the RCBA, and not part of the transition.

17-5.09(02)  Quantities [Rev. July 2012]

Quantities for the following pay items should be included on the Bridge Summary sheet, in the Summary of Bridge Quantities table, separate from other bridge quantities.

1. RCBA of the required thickness, including extensions for bridge railing transitions, per square yard.
2. Epoxy-coated reinforcing bars in the RCBA and extensions, per pound.

3. Dense-graded subbase placed under the RCBA and extensions, per cubic yard.

17-5.10  Riprap and Sodding Limits at Bridge Cone

Figure 17-5 I, Riprap and Sodding Limits with Barrier Transitions on Bridge, and Figure 17-5J, Riprap and Sodding Limits with Barrier Transitions on RCBA, illustrate the placement of riprap and sodding at a bridge cone to control erosion. Figure 17-5 I illustrates the placement where the barrier transitions are on the bridge and Figure 17-5J where they are on the RCBA. Riprapping the surfaces of the bridge cones and fill slopes adjacent to the RCBA is recommended for a new bridge at a stream crossing. Where mowing equipment experiences difficulty traversing riprap drainage turnouts for a grade separation structure (e.g., at an interchange), the bridge cone surfaces may be sodded instead.

For a bridge rehabilitation project, the designer should review proposed erosion control techniques (e.g., erosion control mat, riprap drainage turnout, sodded flume, curb inlet/piping) with the Bridges Division Bridge Rehabilitation Department and the district office.


If possible, the number of bridge sites in one contract should be limited to three or four. This will result in more contracts, but it should result in more-competitive bidding. It will also provide a better opportunity of completing the contract within the temperature and humidity restrictions and within the construction season.

17-5.11(01)  Cleaning and Painting Existing Structural Steel Members

Bridge cleaning and partial-bridge cleaning on an existing bridge are designated by QP type. The QP designation refers to the contractor’s certification level. If the structure was built in 1995 or later, the QP-1 designation should be used. If all or a portion of the structure to be cleaned was built in 1994 or earlier, the QP-2 designation should be used. The Department’s Bridge Inventory Log Book’s year built should be used to determine the QP type.
17-5.11(02) New Structural Steel Members

Regardless of whether the steel is regular or weathering, cleaning and painting of new structural-steel members is included in the furnishing of new structural steel. No painting-related pay items should be specified.

For weathering steel, the portions of new structural-steel members to be caulked and painted are shown in Standard Drawings.

17-5.11(03) Paint Colors

Standard paint colors are provided in the Standard Specifications. After consultation with the project manager, one of these colors should be specified for the final coat, and the color number from the Standard Specifications placed in the appropriate blank on the Bridge Painting Locations and Information table, Figure 17-5K. Light blue or light green is typically specified. Colors not listed in the Standard Specifications should be specified only after consultation with the project manager. Reasons for using non-standard colors include a request from an LPA, desire to match surroundings, etc. A non-standard color requires a longer lead time for the contractor to procure the paint and for the paint to be tested.

An editable version of the Bridge Painting Locations and Information table, Figure 17-5K is available on the Department’s Editable Documents website, at www.in.gov/dot/div/contracts/design/dmforms/, under Bridges. The completed table should be included on the plans.

17-5.11(04) Quantities Determination

Pay items for cleaning and painting structural-steel members should be specified only for existing structural steel. If only the bearings, end diaphragms, beam ends, etc., are to be cleaned and painted, such work should be identified on the plans. The pay items specified should be those regarding partial painting. The pay unit for cleaning bridge steel, painting bridge steel, or painting bridge steel, partial, is lump sum.

A pay item for maintaining traffic should be included. Corresponding pay items for other traffic maintenance appurtenances, such as construction signs, temporary traffic barrier, attenuator truck, etc., should also be included. The designer should discuss the need for the inclusion of other site-specific work such as clearing, tree trimming, guardrail removal and replacement, working
platform, or other unique items that may be required, with the district Office of Construction’s project engineer or supervisor who typically handles painting contracts.

17-6.0  TEMPORARY EROSION AND SEDIMENT CONTROL [Add. Apr. 2016]

17-6.01  Temporary Seeding and Temporary Mulch [Rev. Apr. 2016]

The designer should be alert to recognize each work area where soil will be disturbed by construction operations, and is likely to remain in an uncovered state, especially on a multi-phase project, for an extended period of time. Temporary seeding and mulch are used to reduce erosion and sedimentation damage by means of stabilizing a disturbed area where additional work is not scheduled for at least 7 calendar days. The cost of the items will be included in the total dollar amount for Storm Water Management Budget. The following will apply.

1. **Seeding.** The quantity for Temporary Seed Mixture should be estimated assuming an application rate of 150 lb/ac. The area used for the temporary seeding should be determined based on the contract type as follows:
   a. Bridge Contract. The quantity is based on 1.5 times the area of permanent seeding
   b. Road Contract. The quantity is based on 2 times the area of permanent seeding.
   c. Maintenance, Traffic, or Preservation. A pay quantity should not be included unless soil disturbance is known. Quantities should then be based on the same area as the permanent seeding.

2. **Mulching.** The quantity for Temporary Mulch should be estimated using the same area used for temporary seeding. Estimate the quantity assuming an application rate of 2.5 tons/ac.

On a slope of 3:1 or steeper but flatter than 2:1 Temporary Mulch Stabilization, Type A, B or C is required in addition to Temporary Mulch. On a slope of 2:1 or steeper, a Manufactured Surface Protection Product is required. See section 205 of the INDOT *Standard Specifications* for the various types of mulching stabilization and manufactured surface protection products.

17-6.02  Storm Water Quality Management Budget [Add. Apr. 2016]
Most contracts will include two pay items Storm Water Quality Management Budget and Storm Water Quality Control Plan (SWQCP). Once the necessary temporary and erosion and sediment control measures and quantities are determined, the established prices should be applied to each item and the total dollar amount entered as the Storm Water Management Budget pay item. Establish prices are included in RSP 205-R-636 until such time as the RSP is incorporated into the Standard Specifications. Specialty measures that do not have established prices, such as turbidity curtains, will require a unique special provision, and should be included in the contract as individual pay items.

For contracts that are anticipated to extend over a single construction season, the dollar amount should be increased by 10% for each season.

**17-6.03 Storm Water Quality Control Plan (SWQCP) Preparation and Implementation [Add. Apr. 2016]**

The SWQCP Preparation and Implementation pay item includes all narrative information, plan sheets, sequencing, and implementation information necessary for storm water management utilized on the contract. The SWQCP Preparation and Implementation also includes the costs for the Storm Water Quality Manager (SWQM), at level indicated for the contract, and the costs for weekly Storm Water inspections for the contract.

Guidelines for quantifying SWQCP Preparation and Implementation Pay Items Associated with RSP 205-R-636

In the absence of more accurate data, the following should be used for estimating purposes. The total should be entered as the lump sum amount for the SWQCP Preparation and Implementation pay item.

<table>
<thead>
<tr>
<th>Storm Water Quality Control Plan</th>
<th>$15,000</th>
</tr>
</thead>
<tbody>
<tr>
<td>Storm Water Management inspections</td>
<td>$400 per week of the contract term</td>
</tr>
<tr>
<td>Attendance of SWQM at scheduling meetings</td>
<td>$400 per each 2-week period from beginning of the contract to the intermediate completion date.</td>
</tr>
</tbody>
</table>
| SWQM Level 1 or Level 2           | $500 for SWQM Level 1  
                                         $1000 for SWQM Level 2 |
17-7.0 MATHEMATICAL FORMULAS

Figure 17-7A provides mathematical formulas to be used for various quantity determinations.
This figure deleted [Oct. 2017]

Figure 17-1A, Proprietary Material Transmittal Memorandum has been deleted as an IDM figure. The document is available from the Department’s Editable Documents webpage at http://www.in.gov/dot/div/contracts/design/dmforms/, under Proprietary Materials.

PROPRIETARY MATERIAL TRANSMITTAL MEMORANDUM
Figure 17-1A
This figure deleted [Mar. 2016]

The current Approved Proprietary Materials list can be found on the Department’s website at [http://www.in.gov/indot/2684.htm](http://www.in.gov/indot/2684.htm)

**APPROVED PROPRIETARY MATERIALS**

Figure 17-1B
These figures deleted [Oct. 2017]

Figures 17-1C, 17-1D, 17-1E, and 17-1F, related to requests for proprietary material use have been deleted. These documents are available from the Department’s Editable Documents webpage at http://www.in.gov/dot/div/contracts/design/dmforms/, under Proprietary Materials.

**PROPRIETARY MATERIAL USE**
Figures 17-1C, 17-1D, 17-1E, and 17-1F
These figures deleted [Oct. 2017]

Figures 17-1C, 17-1D, 17-1E, and 17-1F, related to requests for proprietary material use have been deleted. These documents are available from the Department’s Editable Documents webpage at http://www.in.gov/dot/div/contracts/design/dmforms/, under Proprietary Materials.

**PROPRIETARY MATERIAL USE**

Figures 17-1C, 17-1D, 17-1E, and 17-1F
These figures deleted [Oct. 2017]

Figures 17-1C, 17-1D, 17-1E, and 17-1F, related to requests for proprietary material use have been deleted. These documents are available from the Department’s Editable Documents webpage at http://www.in.gov/dot/div/contracts/design/dmforms/, under Proprietary Materials.

PROPRIETARY MATERIAL USE

Figures 17-1C, 17-1D, 17-1E, and 17-1F
These figures deleted [Oct. 2017]

Figures 17-1C, 17-1D, 17-1E, and 17-1F, related to requests for proprietary material use have been deleted. These documents are available from the Department’s Editable Documents webpage at http://www.in.gov/dot/div/contracts/design/dmforms/ , under Proprietary Materials.

PROPRIETARY MATERIAL USE
Figures 17-1C, 17-1D, 17-1E, and 17-1F
# Earthwork Computation

<table>
<thead>
<tr>
<th>STATION</th>
<th>AREA CUT (ft²)</th>
<th>AREA FILL (ft²)</th>
<th>CUT, SUM END AREAS (ft²)</th>
<th>FILL, SUM END AREAS (ft²)</th>
<th>LENGTH (ft)</th>
<th>VOL. CUT (cys)</th>
<th>VOL. FILL (cys)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
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</tr>
</tbody>
</table>
END AREA TEMPLATE
Figure 17-2B
Recommended shrinkage factor to be used for divided-roadway project:

- $0 < \text{cys} < 1000 / 100 \text{ lft} = 25\%$
- $1000 \leq \text{cys} < 2000 / 100 \text{ lft} = 20\%$
- $\geq 2000 \text{ cys} / 100 \text{ lft} = 15\%$

Recommended shrinkage factor to be used for two-lane-roadway project:

- $0 < \text{cys} < 500 / 100 \text{ lft} = 25\%$
- $500 \leq \text{cys} < 1000 / 100 \text{ lft} = 20\%$
- $\geq 1000 \text{ cys} / 100 \text{ lft} = 15\%$

The recommended shrinkage factor to be used for a shoulder-widening project is 30% to 35%.

The recommended swell factor to be used for a rock fill is 30% to 35%.

**SHRINKAGE AND SWELL FACTORS**

Figure 17-2C
Earthwork Balance

Fill + ___①② _________ cys

Common Excavation②③④⑤ _________ cys

Unclassified Excavation②③④⑤ _________ cys

Rock Excavation②③④⑤ _________ cys

Borrow or Waste _________ cys

Peat Excavation _________ cys

Benching②③④⑤ _________ cys

Notes:
① For shrinkage and swell factors to be used, see Figure 17-2C.

② When the project is on new alignment, increase both the excavation and fill quantities to include any benching required. See Figure 107-6B for typical benching procedures.

③ Where benching is required for construction of a new embankment over an existing embankment, no direct payment is made for benching.

④ Excavation for subgrade treatment is not included in the excavation quantities.

⑤ If applicable, include a note that the _______ excavation quantity includes ______ cys of unsuitable material and/or ______ cys of benching.

EARTHWORK BALANCE TABLE
(Road Project)

Figure 17-2D
Earthwork Tabulation

<table>
<thead>
<tr>
<th>Description</th>
<th>Quantity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fill +20%</td>
<td>_______ cys</td>
</tr>
<tr>
<td>Common Excavation ①</td>
<td>_______ cys</td>
</tr>
<tr>
<td>Usable Waterway Excavation (______ %) ②</td>
<td>_______ cys</td>
</tr>
<tr>
<td>Surplus Foundation Excavation ③</td>
<td>_______ cys</td>
</tr>
<tr>
<td>Borrow or Waste</td>
<td>_______ cys</td>
</tr>
<tr>
<td>Total Waterway Excavation④</td>
<td>_______ cys</td>
</tr>
<tr>
<td>Benching (Estimated) ⑤</td>
<td>_______ cys</td>
</tr>
</tbody>
</table>

① Excavation for subgrade treatment is not included in the above excavation quantities.

② Show the actual usable portion on the plans (______ %). Estimate the percentage during the field check. If no other information is available, use 70%.

③ Includes earth volume displaced by substructure concrete or structure backfill at foundation excavations. If this volume < 100 cys, do not include it in the earthwork tabulation.

④ Include all material excavated to shape the channel under the structure, reduced by the estimated concrete volume of existing piers or abutments above the channel-clearing line. Abutment backfill above the clearing line should be included in waterway excavation.

⑤ Benching is to be shown on the cross sections. Benches are to be 8 ft to 10 ft wide where practical. Volume should be estimated and shown in the earthwork tabulation. The benching quantity is not included in the common-excavation quantity.

EARTHWORK TABULATION,
BRIDGE PROJECT

Figure 17-2E
Notes:
1. Area $A_c$ is the pipe area to the outside edge of the corrugations.
2. For a circular pipe, $B_c = H_c$.
3. For backfill method 1 or 2, $V_c = T_c$.

**BACKFILL AREA PER LINEAR FOOT OF PIPE, EARTH FOUNDATION**

Method 1: Structure or flowable backfill as required, $B_{bc} + B_{cw} + B_{vt}$

Method 2: Structure or flowable backfill as required, $B_{bc}$
   Compacted earth backfill, $B_{cw} + B_{vt}$

Method 3: Structure or flowable backfill as required, $B_{bc} + B_{cw}$
   Compacted earth backfill, $B_{vt}$

**BACKFILL AREA PER LINEAR FOOT OF PIPE, ROCK FOUNDATION**

Method 1: Structure backfill, $B_f$
   Structure or flowable backfill as required, $B_{bc} + B_{cw} + B_{vt}$

Method 2: Structure backfill, $B_f$
   Structure or flowable backfill as required, $B_{bc}$
   Compacted earth backfill, $B_{cw} + B_{vt}$

Method 3: Structure backfill, $B_f$
   Structure or flowable backfill as required, $B_{bc} + B_{cw}$
   Compacted earth backfill, $B_{vt}$

**VALUES REQUIRED FOR DETERMINING BACKFILL QUANTITIES**

Figure 17-3A
<table>
<thead>
<tr>
<th>Pavement Thickness</th>
<th>Factor</th>
<th>Aggregate Thickness</th>
<th>Factor</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 in.</td>
<td>110 lb/yd² = 0.055 T/yd²</td>
<td>3 in.</td>
<td>0.167 T/yd²</td>
</tr>
<tr>
<td>1.25 in.</td>
<td>140 lb/yd² = 0.070 T/yd²</td>
<td>4 in.</td>
<td>0.222 T/yd²</td>
</tr>
<tr>
<td>1.5 in.</td>
<td>165 lb/yd² = 0.083 T/yd²</td>
<td>5 in.</td>
<td>0.278 T/yd²</td>
</tr>
<tr>
<td>1.65 in.</td>
<td>180 lb/yd² = 0.090 T/yd²</td>
<td>6 in.</td>
<td>0.333 T/yd²</td>
</tr>
<tr>
<td>2 in.</td>
<td>220 lb/yd² = 0.110 T/yd²</td>
<td>7 in.</td>
<td>0.389 T/yd²</td>
</tr>
<tr>
<td>2.25 in.</td>
<td>250 lb/yd² = 0.125 T/yd²</td>
<td>8 in.</td>
<td>0.444 T/yd²</td>
</tr>
<tr>
<td>2.5 in.</td>
<td>275 lb/yd² = 0.138 T/yd²</td>
<td>9 in.</td>
<td>0.500 T/yd²</td>
</tr>
<tr>
<td>2.75 in.</td>
<td>300 lb/yd² = 0.150 T/yd²</td>
<td>12 in.</td>
<td>0.667 T/yd²</td>
</tr>
<tr>
<td>3 in.</td>
<td>330 lb/yd² = 0.165 T/yd²</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### B Borrow for Draintile

<table>
<thead>
<tr>
<th>Pipe Dia.</th>
<th>Factor</th>
</tr>
</thead>
<tbody>
<tr>
<td>3.25 in.</td>
<td>0.180 T/yd²</td>
</tr>
<tr>
<td>3.5 in.</td>
<td>0.193 T/yd²</td>
</tr>
<tr>
<td>4.5 in.</td>
<td>0.248 T/yd²</td>
</tr>
<tr>
<td>8 in.</td>
<td>0.440 T/yd²</td>
</tr>
<tr>
<td>Asphalt for Prime Coat</td>
<td>0.63 gal./yd² = 0.0028 T/yd²</td>
</tr>
<tr>
<td>Asphalt for Tack Coat</td>
<td>0.08 gal./yd² = 0.00025 T/yd²</td>
</tr>
</tbody>
</table>

### Aggregate for Underdrains

<table>
<thead>
<tr>
<th>Pipe Dia.</th>
<th>Factor</th>
</tr>
</thead>
<tbody>
<tr>
<td>6 in.</td>
<td>0.257 yd³/lft</td>
</tr>
<tr>
<td>8 in.</td>
<td>0.269 yd³/lft</td>
</tr>
<tr>
<td>10 in.</td>
<td>0.278 yd³/lft</td>
</tr>
</tbody>
</table>

### Riprap

<table>
<thead>
<tr>
<th>Riprap</th>
<th>Factor</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.5 T/yd³</td>
<td>0.090 yd³/lft</td>
</tr>
</tbody>
</table>

### Water for Sodding

<table>
<thead>
<tr>
<th>Water</th>
<th>Factor</th>
</tr>
</thead>
<tbody>
<tr>
<td>8 in.</td>
<td>0.110 yd³/lft</td>
</tr>
<tr>
<td>10 in.</td>
<td>0.136 yd³/lft</td>
</tr>
</tbody>
</table>

### Pavement Markings

<table>
<thead>
<tr>
<th>Permanent Broken Centerline</th>
<th>Factor</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.25 lft/ft</td>
<td>Flat Terrain</td>
</tr>
<tr>
<td>Rolling Terrain</td>
<td>30.2 T/mi</td>
</tr>
<tr>
<td>Hilly Terrain</td>
<td>35.5 T/mi</td>
</tr>
</tbody>
</table>

### Shoulder Drains

**ROADWAY QUANTITIES FACTORS**

Figure 17-4A
<table>
<thead>
<tr>
<th>Line</th>
<th>Design-Year AADT</th>
<th>Treatment Area, SYS</th>
</tr>
</thead>
<tbody>
<tr>
<td>“A”</td>
<td>20,000</td>
<td>10,000</td>
</tr>
<tr>
<td>“S-1-A”</td>
<td>300</td>
<td>500</td>
</tr>
<tr>
<td>“S-2-A”</td>
<td>400</td>
<td>950</td>
</tr>
</tbody>
</table>

EXAMPLE TABULATION OF SUBGRADE TREATMENT INFORMATION TO ACCOMPANY MEMORANDUM TO MATERIALS AND TESTS DIVISION

Figure 17-4B
Figure 17-4D

CURB RAMP PAY ITEMS

LEGEND

TS
Turning Space

Detectable Warning Surface

Area to be paid for as
Curb Ramp, Concrete

Ramp

CURB RAMP, CONCRETE

LEGEND

TS
Turning Space

Detectable Warning Surface

Area to be paid for as
Detectable Warning Surfaces or
Detectable Warning Surfaces, Retrofit

Ramp

DETECTABLE WARNING SURFACE

CURB RAMP PAY ITEMS

Figure 17-4D
<table>
<thead>
<tr>
<th>Foreslope</th>
<th>Backslope</th>
<th>Sodding Factor (syd/lft)</th>
</tr>
</thead>
<tbody>
<tr>
<td>6:1</td>
<td>4:1</td>
<td>1.56</td>
</tr>
<tr>
<td>4:1</td>
<td>4:1</td>
<td>1.33</td>
</tr>
<tr>
<td>4:1</td>
<td>3:1</td>
<td>1.22</td>
</tr>
<tr>
<td>3:1</td>
<td>3:1</td>
<td>1.11</td>
</tr>
<tr>
<td>3:1</td>
<td>2:1</td>
<td>1.00</td>
</tr>
</tbody>
</table>

Notes:

1. Sodding factor assumes a 4-ft wide ditch bottom.
2. Sodding factor assumes sodding is placed to a height of 1 ft above the flow line.
3. For sodding next to a paved side ditch, use a sodding factor of 0.3 syd/lft.

SODDED-DITCH QUANTITIES

Figure 17-4E
Note: Do not use 2:1 side slopes within the clear zone.

PAVED SIDE DITCHES

Figure 17-4F
### Grade Range Interval

<table>
<thead>
<tr>
<th>Grade Range</th>
<th>Interval</th>
</tr>
</thead>
<tbody>
<tr>
<td>3% ≤ Grade &lt; 5%</td>
<td>200 ft</td>
</tr>
<tr>
<td>5% ≤ Grade &lt; 8%</td>
<td>150 ft</td>
</tr>
<tr>
<td>8% ≤ Grade &lt; 10%</td>
<td>100 ft</td>
</tr>
<tr>
<td>10% or greater</td>
<td>50 ft</td>
</tr>
</tbody>
</table>

**LUG INTERVALS**

*Figure 17-4G*
<table>
<thead>
<tr>
<th>LOCATION</th>
<th>DESCRIPTION</th>
<th>WIDTH (ft)</th>
<th>MAILBOX ASSEMBLIES REQUIRED</th>
</tr>
</thead>
<tbody>
<tr>
<td>LT</td>
<td>Paved Shoulder, Mailbox Beyond Drive</td>
<td>10</td>
<td>--</td>
</tr>
<tr>
<td>RT</td>
<td>Paved Shoulder, Mailbox Before Drive</td>
<td>10</td>
<td>1</td>
</tr>
<tr>
<td>LT</td>
<td>Paved Shoulder, Mailbox Beyond Drive</td>
<td>8</td>
<td>2</td>
</tr>
</tbody>
</table>

* See the *INDOT* Standard Drawings.

**SAMPLE MAILBOX SUMMARY TABLE**

*Figure 17-4H*
SODDING LOCATIONS
Figure 17-41
1. Class "X" Excavation
2. Wet Excavation
3. Dry Excavation
4. Waterway Excavation or Common Excavation

Note: See Section 17-4.02 and INDOT Standard Specifications for additional guidance

**STRUCTURE EXCAVATION**

Figure 17-5A
BRIDGE WITH STRUCTURAL MEMBERS

LIMITS OF SURFACE SEAL TO BE SHOWN ON PLANS

Figure 17-5A (0)
CAST-IN-PLACE CONCRETE RETAINING WALL EARTHWORK QUANTITIES LIMITS

Figure 17-5B
MSE RETAINING WALL EARTHWORK QUANTITIES LIMITS

Figure 17-5C
<table>
<thead>
<tr>
<th>Spec. Ref.</th>
<th>Item</th>
<th>Unit</th>
<th>Quantity</th>
</tr>
</thead>
<tbody>
<tr>
<td>203</td>
<td>Excavation, Waterway</td>
<td>cyd</td>
<td></td>
</tr>
<tr>
<td>211</td>
<td>B Borrow</td>
<td>cyd</td>
<td></td>
</tr>
<tr>
<td>211</td>
<td>Structure Backfill</td>
<td>cyd</td>
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</tr>
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<td>211</td>
<td>Flowable Backfill</td>
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</tr>
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<td>302</td>
<td>Dense Graded Subbase</td>
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</tr>
<tr>
<td>503</td>
<td>Terminal Joint</td>
<td>lft</td>
<td></td>
</tr>
<tr>
<td>601</td>
<td>Bridge Railing Transition, TGB</td>
<td>each</td>
<td></td>
</tr>
<tr>
<td>601</td>
<td>Bridge Railing Transition, WGB</td>
<td>each</td>
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</tr>
<tr>
<td>609</td>
<td>Reinforced Concrete Bridge Approach, _____ in.</td>
<td>syd</td>
<td></td>
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<tr>
<td>703</td>
<td>Reinforcing Steel</td>
<td>lb</td>
<td></td>
</tr>
<tr>
<td>704</td>
<td>Grates, Basins, and Fittings, Cast Iron</td>
<td>lb</td>
<td></td>
</tr>
<tr>
<td>715</td>
<td>Pipe, Type 4, Circular, 6 in.</td>
<td>lft</td>
<td></td>
</tr>
<tr>
<td>715</td>
<td>Pipe, Type 5, Circular, 12 in.</td>
<td>lft</td>
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</tr>
<tr>
<td>203</td>
<td>Surplus Foundation Excavation [not a pay item]</td>
<td>cyd</td>
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</tbody>
</table>

**BRIDGEB PAY ITEMS IN ROAD PLANS**

*Figure 17-5E*
### SIGN POST SUMMARY

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<tr>
<th>SIGN CODE</th>
<th>LOCATION</th>
<th>NO. OF POSTS</th>
<th>POST TYPE</th>
<th>TOTAL LENGTH (ft)</th>
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<tbody>
<tr>
<td></td>
<td>STATION AND LINE</td>
<td>LT. or RT.</td>
<td></td>
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<table>
<thead>
<tr>
<th>TOTAL A</th>
<th>TOTAL B</th>
<th>TOTAL 1</th>
<th>TOTAL 2</th>
</tr>
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<tbody>
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<td></td>
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</tbody>
</table>

Note: Sign location and post lengths are approximate. Exact location and length to be determined in the field in accordance with the Manual on Uniform Traffic Control Devices.

### SHEET SIGN SUMMARY

<table>
<thead>
<tr>
<th>SIGN CODE</th>
<th>SIGN DESCRIPTION</th>
<th>NO. OF SIGNS</th>
<th>SHEETING TYPE*</th>
<th>THICKNESS (in.)</th>
<th>TOTAL AREA (sft)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
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<table>
<thead>
<tr>
<th>TOTAL I</th>
<th>0.080</th>
</tr>
</thead>
<tbody>
<tr>
<td>TOTAL II</td>
<td>0.080</td>
</tr>
<tr>
<td>TOTAL I</td>
<td>0.100</td>
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<td>TOTAL II</td>
<td>0.100</td>
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<tr>
<td>TOTAL I</td>
<td>0.125</td>
</tr>
<tr>
<td>TOTAL II</td>
<td>0.125</td>
</tr>
</tbody>
</table>

*Type I – “Enclosed lens” reflective sheeting
Type II – “Encapsulated lens” reflective sheeting

### SIGN POST AND SHEET SIGN SUMMARIES

(Bridge Project)

Figure 17-5F
This figure deleted [Mar. 2016]

See INDOT Standard Drawing Series E 609-RCBA

RCBA
Figure 17-5G, -5G(1), and -5G(2)
This figure deleted [Mar. 2016]

See INDOT Standard Drawing Series E 609-RCBA

RCBA
Figure 17-5G, -5G(1), and -5G(2)
This figure deleted [Mar. 2016]

See INDOT Standard Drawing Series E 609-RCBA

RCBA
Figure 17-5G, -5G(1), and -5G(2)
RIPRAP AND SODDING LIMITS WITH BARRIER TRANSITIONS ON BRIDGE

Figure 17-5I
RIPRAP AND SODDING LIMITS WITH BARRIER TRANSITIONS ON APPROACH SLAB

Figure 17-5J
## Bridge Painting Locations and Information

<table>
<thead>
<tr>
<th>Contract Structure Number</th>
<th>Route Number</th>
<th>Structure Number</th>
<th>NBI Number</th>
<th>Ref. Post</th>
<th>County</th>
<th>Feature Crossed</th>
<th>Location</th>
<th>No. of Spans</th>
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<td></td>
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</table>

### Drainage

<table>
<thead>
<tr>
<th>Contract Structure Number</th>
<th>Lengths of Strl.-Steel Spans ft-in. *</th>
<th>Existing Primer Type</th>
<th>Year Last Painted</th>
<th>Year Built</th>
<th>Tons of Strl. Steel **</th>
<th>Surf. Area Strl. Steel, ft² **</th>
<th>New-Paint Color (name)</th>
<th>New-Color No. (5-digit no.)</th>
<th>Clean &amp; Paint Castings, each</th>
<th>Roadway Drain Casting Extensions, each</th>
</tr>
</thead>
<tbody>
<tr>
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</tbody>
</table>

* Length shown is approximate.  
** The quantities shown are approximate only. The Contractor shall determine the quantities upon which to base its bid.

**BRIDGE PAINTING LOCATIONS AND INFORMATION**

*Figure 17-5K*
### Right Triangles

\[
\begin{align*}
\sin A &= \frac{a}{c} = \cos B \\
\csc A &= \frac{c}{a} = \sec B \\
\cos A &= \frac{b}{c} = \sin B \\
\sec A &= \frac{c}{b} = \csc B \\
\tan A &= \frac{a}{b} = \cot B \\
\cot A &= \frac{b}{a} = \tan B \\
a &= c \sin A = c \cos B = b \tan A = b \cot B = \sqrt{c^2 - b^2} \\
b &= c \cos A = c \sin B = a \cot A = a \tan B = \sqrt{c^2 - a^2}
\end{align*}
\]

### Oblique Triangles

<table>
<thead>
<tr>
<th>Given</th>
<th>Sought</th>
<th>Formula</th>
</tr>
</thead>
</table>
| A, B, a | b, c | \( b = \frac{a}{\sin A} \times \sin B \)  \\
| A, a, b | B, c | \( c = \frac{a}{\sin A} \times \sin (A + B) \)  \\
| C, a, b | \( \frac{1}{2} \) (A + B), \( \frac{1}{2} \) (A - B) | \( \frac{1}{2} (A + B) = 90° - \frac{1}{2} C \)  \\
| | | \( \tan \frac{1}{2} (A - B) = \frac{a - b}{a + b} \times \tan \frac{1}{2} (A + B) \)  \\
| a, b, c | A | Given \( s = \frac{1}{2} (a + b + c) \), then:  \\
| | | \( \sin \frac{1}{2} A = \sqrt{\frac{(s - b)(s - c)}{bc}} \)  \\
| | | \( \cos \frac{1}{2} A = \sqrt{\frac{s(s - a)}{bc}} \)  \\
| | | \( \tan \frac{1}{2} A = \sqrt{\frac{(s - b)(s - c)}{s(s - a)}} \)  \\
| | | \( \sin A = \frac{2 \sqrt{s(s - a)(s - b)(s - c)}}{bc} \)  \\
| | | Area = \( \sqrt{s(s - a)(s - b)(s - c)} \)  \\
| C, a, b | Area | Area = \( \frac{1}{2} ab \sin C \)  

**MATHEMATICAL FORMULAS**

Figure 17-7A  
(page 1 of 3)
**Nomenclature**

- $A$ = total surface area
- $d$ = distance
- $h$ = height
- $p$ = perimeter
- $r$ = radius
- $s$ = side (edge) length, arc length
- $V$ = volume
- $\theta$ = vertex angle, in radians
- $\phi$ = central angle, in radians

### Circle

- $p = 2\pi r$
- $A = \pi r^2 = \frac{p^2}{4\pi}$

### Circle Segment

- $A = \frac{1}{2} r^2 (\phi - \sin \phi)$  \hspace{1cm} (\phi in rad)
- $\phi = \frac{S}{r} = 2 \left( \arccos \frac{r - d}{r} \right)$

### Circle Sector (1)

- $A = \frac{1}{2} \phi r^2 = \frac{1}{2} sr$  \hspace{1cm} (\phi in rad)
- $\phi = \frac{S}{r}$

### Circle Sector (2)

- $\cos \phi = \frac{r - x}{r}$

#### Area of Triangle

- $A_1 = \frac{1}{2} (r - x)(r \sin \phi)$  \hspace{1cm} (\phi in deg)

#### Area of Circle Sector

- $A_2 = \frac{\phi}{360^\circ} \pi r^2$

### External Area

- $t = \frac{r}{\tan \frac{\theta}{2}}$
- $\phi = 180^\circ - \theta$  \hspace{1cm} (\phi, \theta in deg)

#### Total Area

- $rt = \frac{r^2}{\tan \frac{\theta}{2}}$

#### Area of Circle Sector

- $\frac{\phi}{360^\circ} \pi r^2$

#### External Area

- $r^2 \left[ \frac{1}{\tan \frac{\theta}{2}} - \frac{\phi}{360^\circ} \right]$
<table>
<thead>
<tr>
<th>Number of Sides</th>
<th>Name of Polygon</th>
<th>Triangle</th>
</tr>
</thead>
<tbody>
<tr>
<td>3</td>
<td>triangle</td>
<td>A = ( \frac{1}{2} bh )</td>
</tr>
<tr>
<td>4</td>
<td>rectangle</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>pentagon</td>
<td></td>
</tr>
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<td>6</td>
<td>hexagon</td>
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<td>8</td>
<td>octagon</td>
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<td>9</td>
<td>nonagon</td>
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<tr>
<td>10</td>
<td>decagon</td>
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</tbody>
</table>

**Trapezoid**

\[ p = a + b + c + d \]

\[ A = \frac{1}{2} h (a + b) \]

If \( c = d \), the trapezoid is isosceles.

**Parallelogram**

\[ p = 2(a + b) \]

\[ d_1 = \sqrt{a^2 + b^2 - 2ab\cos\phi} \]

\[ d_2 = \sqrt{a^2 + b^2 + 2ab\cos\phi} \]

\[ d_1^2 + d_2^2 = 2(a^2 + b^2) \]

\[ A = ah = ab\sin\phi \]

If \( a = b \), the parallelogram is a rhombus

**Regular Polygon**

\( \text{(n equal sides)} \)

\[ \phi = \frac{2\pi}{n} \] (\( \phi \) in rad)

\[ \theta = \frac{\pi(n-2)}{n} \] (\( \theta \) in rad)

\[ p = ns \]

\[ s = 2r \left[ \tan\left(\frac{\phi}{2}\right) \right] \]

\[ A = \frac{1}{2} nsr \]

**MATHEMATICAL FORMULAS**

Figure 17-7A

(page 3 of 3)
CHAPTER 19


NOTE: This chapter is currently being re-written and its content will be included in Chapter 108 in the future.
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<th>Title</th>
</tr>
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<tbody>
<tr>
<td>19-3A</td>
<td>Example of a Restrictive Type Unique Special Provision</td>
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<tr>
<td>19-3B</td>
<td>Example Special Provision which Directly Revises the Standard Specifications</td>
</tr>
<tr>
<td>19-3C</td>
<td>Example Special Provision which Does Not Directly Revise the Standard Specifications</td>
</tr>
<tr>
<td>19-3D</td>
<td>Unique Special Provision Process</td>
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CHAPTER 19

STANDARD CONTRACT DOCUMENTS AND UNIQUE SPECIAL PROVISIONS

Chapter 14 provides the Department’s procedures for the preparation of construction plans. This Chapter describes the Department’s standard contract documents, including the Standard Specifications, Supplemental Specifications, Standard Drawings, Recurring Special Provisions, Recurring Plan Details, and Schedule of Pay Items. This Chapter also provides guidelines for preparing Unique Special Provisions if the standard documents do not address the needs of the project.

19-1.0 GENERAL

19-1.01 Standards Committee

The mission of the Department’s Standards Committee is to develop, review, and recommend for approval all substantive additions and revisions to the Department’s standard documents used for design and construction of projects. These documents include this Manual, the INDOT Standard Specifications and the INDOT Standard Drawings.

The Standards Committee meets regularly to review and act on proposed changes to the standard documents. The Committee consists of representatives from the Department entities as follows:

1. Director, Construction Management Division – Committee Chairperson
2. Contract Administration Division
3. Construction Management Division, Office of Materials Management
4. Construction Management Division, Office of the State Construction Engineer
5. Construction Management Division, Office of Construction Technical Support
6. One representative from a district construction office
7. One representative from a district production office
8. Highway Operations Division, Office of Traffic Engineering
9. Planning Division, Office of Pavement Engineering
10. Production Management Division, Office of Roadway Services
11. Production Management Division, Office of Structural Services
12. Construction Management Division, Specifications Engineer – Secretary (non-voting)
A Federal Highway Administration representative is present to provide comments on proposals for use on the National Highway System. The FHWA representative is a non-voting member. A proposal for consideration by the Standards Committee may be submitted through the Secretary for possible inclusion on the Committee’s agenda.

19-1.02 Contract Documents

All bid and contract documents should complement and agree with each other to provide a clear, concise package that can be readily understood by bidders, contractors, and field personnel. A conflict between contract documents can result in change orders and claims which can delay construction and increase project cost.

In developing and assembling the contract documents for a project, the designer should ensure that all the documents are compatible. If the designer believes one of the standard documents may cause a conflict, the Project Manager should be notified.

19-1.03 Hierarchy of Contract Documents

The Standard Specifications, Supplemental Specifications, Standard Drawings, Special Provisions, Recurring Plan Details, construction plans, and supplementary documents are essential parts of the contract. A requirement occurring in one is as binding as though occurring in all. They are intended to compliment each other and are used to describe and provide complete instructions for the work to be accomplished.

The designer should perform quality control checks to reduce or eliminate discrepancies between the contract documents. However, discrepancies between documents will occur. The Standard Specifications define the following contractual hierarchy of relationships between the documents in order of precedence, as follows:

1. Instructions to Bidders and description of pay items listed in the Schedule of Pay Items;
2. Special Provisions;
3. Plans, including Standard Drawings and Recurring Plan Details;
4. Supplemental Specifications;

If there is a discrepancy in dimensions, calculated dimensions govern over dimensions scaled from the plans.
The order of precedence is from the least-standardized document to the most-standardized document. Each group of documents is discussed in detail below, listed from most standardized to least standardized, since each successive document type may represent a modification of the previous documents.

**19-1.03(01) Standard Specifications**

The *Standard Specifications* consist of the standard contract language adopted by the Department for a construction project. They are incorporated into each contract by reference. They provide the Department’s criteria for the following:

1. the contractor’s duties;
2. control of material quality;
3. the contractor’s and Department’s contractual relationship; and
4. measurement and payment for pay items.

The *Standard Specifications* are published by the Construction Management Division and are available either from the Department’s website or on CD. The Department also prints a limited number of copies for use by Department field personnel only. New editions are not published on a regular schedule. They are instead issued as warranted due to the number of changes authorized by the Standards Committee. If a new edition is issued, it will be published in March and become effective beginning with contracts let on or after September 1 of that year. The designer is responsible for ensuring that contract documents are developed using the edition of the *Standard Specifications* applicable to the project based on the contract letting date.

**19-1.03(02) Supplemental Specifications**

Supplemental Specifications are revisions to the *Standard Specifications* which have been adopted by the Department since the last publication of the *Standard Specifications*. The intent is that they will be incorporated into the *Standard Specifications*’ next revision. Complete sets of Supplemental Specifications are added to the contract documents for each project and are intended for general use.

Beginning with the *Standard Specifications* 2008 edition, Supplemental Specifications are not being used. Instead, required revisions to the *Standard Specifications* necessary before the next edition is published are incorporated into contracts through Recurring Special Provisions.
19-1.03(03) Plans

Plans include the approved construction plans, profiles, typical cross sections, working drawings, the Standard Drawings, and applicable Recurring Plan Details, or exact reproductions thereof, which show the location, character, dimensions, and details of the work to be done on a project.

1. Recurring Plan Details. Recurring Plan Details are either standard details that have been adopted since the last update of the Standards Drawings or are details that are included in a contract to complement a Recurring Special Provision.

As new or revised Standard Drawings are adopted by the Department, they will be included in contracts as Recurring Plan Details. The Department will determine for which letting the Recurring Plan Details will become effective. The Recurring Plan Details will then be included in the next update of the Standard Drawings set and will be deleted as Recurring Plan Details.

Recurring Plan Details that are included in a contract to complement a Recurring Special Provision may never become part of the Standard Drawings. Such Recurring Plan Details are discussed further in Section 19-1.03(04), item 1.

2. Standard Drawings. The Standard Drawings provide standardized construction details for various elements that are consistent from project to project (e.g., guardrail, fencing, drainage details, bridge elements, signs). They provide information on how to lay out or construct the various design elements. The complete set of Standard Drawings is included by reference as part of the plans in each construction contract. The Standard Drawings are typically updated once each year with the new set becoming effective for contracts let on or after September 1 of each year.

Standard Drawings are available on the Department’s website. Plan details required for a project which are not included in the Standard Drawings must be developed by the designer for inclusion in the plans.

19-1.03(04) Special Provisions

Special provisions are specifications in addition to the Standard Specifications that describe conditions and requirements for special situations on a specific project. Special provisions are added to the contract documents for a specific project and are not binding for a contract other than the one for which they are included.
A special provision serves one of two functions in the contract documents as follows:

1. directly modifies the existing *Standard Specifications* by adding, deleting, or revising language in an existing section, or by adding a new section; or

2. adds a stand-alone specification to the contract that does not directly modify the *Standard Specifications*.

The two distinct types of special provisions are Recurring Special Provisions, which are further subdivided into Standard Recurring Special Provisions and Contract-Specific Recurring Special Provisions; and Unique Special Provisions.

1. **Recurring Special Provision.** A Recurring Special Provision is a specification created by the Department to describe work not included in the *Standard Specifications*. It is typically used in multiple contracts over a period of time. A Recurring Special Provision is typically created as a revision to the *Standard Specifications* as the result of action by the Standards Committee. Passage of a *Standard Specifications* revision by the Committee will often result in the need to issue the revision as a Recurring Special Provision prior to the next edition of the *Standard Specifications*, at which time the Recurring Special Provision may be adopted into the *Standard Specifications*.

A Recurring Special Provision may require the inclusion of a Recurring Plan Detail in the contract to complement the special provision. The Department maintains a menu of all current Recurring Special Provisions and Recurring Plan Details that is updated as new provisions are adopted and existing provisions are revised or deleted. The Special Provision Menu is available on the Department's website and includes a basis for use for each provision.

In preparing a project for submittal of plans and contract documents, the designer is responsible for calling out the appropriate Recurring Special Provisions and Recurring Plan Details from the menu. The designer must ensure that the provisions selected are applicable for the specific project before their inclusion in the contract documents. Section 19-2.0 provides further guidance on the use of the Special Provision Menu.

a. **Standard Recurring Special Provision.** A Standard Recurring Special Provision can either be a direct modification of the *Standard Specifications* or a completely new specification for work not addressed in the *Standard Specifications*. Standard Recurring Special Provisions are not to be modified by the designer and are included in a contract, in their entirety, as the Department-approved version for the contract letting date. If the language of a Recurring Special Provision must be revised to suit
a specific contract need, the designer must submit the revised provision as a Unique Special Provision.

b. Contract-Specific Recurring Special Provision. A Contract-Specific Recurring Special Provision, or fill-in-the-blanks special provisions, requires project-specific information to be entered by the designer. Each Contract-Specific Recurring Special Provision has defined fields to be completed by the designer with information specific to that project. No other portion of the provision is to be edited by the designer. As with a Standard Recurring Special Provision, if the language in the non-editable fields of a Contract-Specific Recurring Special Provision must be revised, the designer must submit the revised provision as a Unique Special Provision.

2. Unique Special Provision. A Unique Special Provision is a specification that pertains only to a specific situation on a project that is not covered by an existing standard document. A Unique Special Provision is intended only for a single use in a specific contract. The Department tracks the use of Unique Special Provisions and considers creation of a new Recurring Special Provision if the same general specification requirements begin to occur in several Unique Special Provisions.

If a project-specific situation that is not described by an existing standard document, a Unique Special Provision must be written and submitted by the designer. Section 19-3.0(01) discusses guidelines for preparing a Unique Special Provision.

19-1.03(05) Instructions to Bidders and Schedule of Pay Items

Instructions to Bidders are formal instructions issued to bidders as part of or by reference in the bidding documents. These include instructions regarding the procedures for the bidder to follow in preparing and submitting a bid, as well as other special requirements. The instructions are set based on Departmental needs and State and Federal codes. They should be understood by the designer, but the designer is typically not responsible for preparing or revising such instructions. If a contract-specific instruction is required (e.g., mandatory pre-bid meeting), the designer should add this as a Unique Special Provision.

The Contract Information book’s Schedule of Pay Items includes the description of each pay item in the contract and the unit of measure for the pay item. Each pay item listed in the Schedule of Pay Items should have a related specification in the contract documents that uses the same pay-item description and the same unit of measure as the pay item shown in the Schedule of Pay Items. It is the designer’s responsibility to ensure this compatibility of pay items and specifications.
19-2.0 INSTRUCTIONS FOR USING SPECIAL PROVISIONS AND RECURRING PLAN DETAILS

The Special Provision Menu is maintained by the Department and is available on the Department’s website. The Menu lists each current approved Recurring Special Provision and Recurring Plan Detail. A basis for use is included for each provision and plan detail to define the conditions that warrant the inclusion of a Recurring Special Provision or Recurring Plan Detail in a contract.

For each provision on the Menu, the date on which the provision was either adopted or revised, and the first letting date for which the provision is effective, is included. If a provision is listed twice, it will have two different effective letting dates. This occurs if an older version is being replaced by a newer version, but the new version’s effective letting date has not yet passed. Once the new letting effective date has passed, the older version will be removed from the Menu. The designer should ensure that the correct version of a Recurring Special Provision or Recurring Plan Detail is selected based on the scheduled letting date for the contract.

A “How to Use” document that provides further details on use of the Menu is included on the Department’s website along with the Special Provision Menu.

19-2.01 Standard Recurring Special Provisions and Recurring Plan Details

Provisions listed in the Menu’s Section I – Standard Recurring Special Provisions and Recurring Plan Details, are intended to appear in the contract as shown on the Department’s website. If such a provision is required, place an X in the Place In Contract box that corresponds to the desired provision or detail. The designer should not submit a copy, electronic or printed, of a Standard Recurring Special Provision or Recurring Plan Detail that is to be included in the contract. Some provisions or plan details are required in every contract. The check box for Place In Contract will be pre-selected and will not open for editing by the designer.

19-2.02 Contract-Specific Recurring Special Provisions

Provisions listed in the Menu’s Section II – Contract-Specific Recurring Special Provisions, will require an attachment to be submitted. For each such provision, place an X in the Place In Contract box that corresponds to the desired provision. The Attach. Req’d. box will be pre-selected and will not open for editing by the designer. The designer must submit an electronic copy of the provision with the blank fields completed.
Instructions for use of the Recurring Special Provisions and Recurring Plan Details Menu are included with the Menu on the Department’s website.

19-2.03 Unique Special Provisions

The Unique Special Provisions Summary Sheet is reserved for the designer to list each Unique Special Provision being submitted for the contract. The designer must enter the title of each Unique Special Provision and the Standard Specification section it is most closely related to. The Unique Special Provisions should be listed in Standard Specifications Section numerical order. An electronic copy of each provision must be submitted. The Summary Sheet is available on the Department’s website.

19-2.04 Finalization of Menu and Special Provisions

The completed Special Provision Menu must be submitted to the Contract Administration Division. Regardless of the number of Des numbers associated with a contract, only one menu is required. If multiple menus are submitted, they will be returned to the designer to combine them.

Contract-Specific Special Provisions attachments should be placed into one electronic file, in the order in which they are listed in the Menu’s Section II. Unique Special Provisions should be placed into another electronic file, in the order in which they are listed on the Unique Special Provisions Summary Sheet.

The Contract Administration Division uses the submitted menu to assemble the Standard Recurring Special Provisions, Recurring Plan Details and Contract-Specific Special Provisions that will be included in the Contract Information Book. The approved versions of the provisions and details, as maintained by the Department, will then be placed in the Contract Information book. Information required for Contract-Specific Recurring Special Provisions will be copied from the attachments submitted by the designer and placed into the Department-approved version of the special provision. Unique Special Provisions, as submitted by the designer and approved by the Department, will also be included in the Contract Information book.

19-3.0 INSTRUCTIONS FOR UNIQUE SPECIAL PROVISION USE

A Unique Special Provision is required if the items of work, methods, materials, sequence of operations, or other restrictions or requirements necessary for completion of the project cannot be described completely by a Recurring Special Provision, a Recurring Plan Detail, the Standard
If a Unique Special Provision is required for a project, the use of a provision that specifies a proprietary product is discouraged. However, the use of a proprietary product may be justified if it will enhance safety, control costs, or otherwise improve the project. In specifying a proprietary product, the designer must provide a written explanation that describes why the proprietary item is necessary and what the benefits of the product are. Section 17-1.05 provides guidance concerning use of and approval of proprietary products.

For a product or material to not be considered proprietary, those of at least three vendors must be available. If only one or two are known, the product or material is considered proprietary. The procedure described in Section 17-1.05 should then be followed.

Example unique special provision phraseology is as follows.

Incorrect: Product A, as manufactured by vendor A or approved equal, shall be used.
Correct: Product A, as manufactured by vendor A; product B, as manufactured by vendor B; or product C, as manufactured by vendor C, shall be used.

A Unique Special Provision should not be written to correct grammatical, typographical, or other errors that can exist in the Standard Specifications or Recurring Special Provisions. If one of these is discovered, it should be brought the attention of the Contract Administration Division.

### 19-3.01 Preparing a Unique Special Provision

A Unique Special Provision can be written to satisfy one of two basic purposes.

A constructive special provision is used to define a portion of the actual construction work, including materials, equipment, methods, measurement, and payment.

A restrictive special provision sets out specific restrictions or requirements that must be followed by the contractor. An example of a restrictive-type Unique Special Provision is illustrated in Figure 19-3A.

The focus of this Section is to provide guidelines for preparing a constructive-type Unique Special Provision.
1. **Define Need.** Review existing *Standard Specifications, Standard Drawings, Recurring Special Provisions, and Recurring Plan Details* to determine if an existing document adequately addresses the situation. A Unique Special Provision be prepared only if a situation is not adequately addressed in an existing document.

2. **Research.** Research the topic so that complete and detailed information is available before writing the provision. This may require contacting manufacturers, contractors, or suppliers for the latest information. Local conditions and problems should also be fully investigated.

3. **Structure and Format.** Prepare a Unique Special Provision in the same structure and format as the *Standard Specifications* (i.e., Description, Materials, Construction Requirements, Method of Measurement, and Basis of Payment). Section 19-3.01(02) provides guidance for the structure, and Section 19-3.01(03) provides guidance for the format that should be used for a Unique Special Provision.

4. **Type.** Analyze the type of construction to be addressed in the provision to determine the type of specification to prepare. A specification can be written as either a method specification or a performance-based specification. A method specification describes the exact methods, materials, or procedures to be used to construct the work. A performance-based specification describes the quality of the materials to be used and the required end result of the work. A performance-based specification is preferred to encourage innovation and efficiency by the contractor. A method specification should only be used if the method is critical to achieving the desired result.

5. **Outline.** Develop an outline that addresses the basic requirements of the work to be completed. It should define the essential physical characteristics of the work (e.g., material requirements, dimensional limitations, time, strength, weight, size, shape, configuration, etc.). The contractor’s responsibilities should be clearly stated. Organize all relevant factors under each appropriate heading.

6. **Write the Unique Special Provision.** Once the outline has been developed and all research has been completed, prepare the first draft. The designer should review existing Recurring Special Provisions for guidance on format and language. The following provides grammatical recommendations for preparing a Unique Special Provision:

   a. **Voice.** Use passive voice and indicative mood: “A rubbed finish shall be applied to the exposed surfaces.” instead of “Apply a rubbed finish to exposed surfaces.”
b. **Sentences.** Use simple language and words. Keep sentences short, to 20 words or less, unless complexity is unavoidable. Avoid the use of too many commas in a sentence.

c. **Paragraphs.** Limit paragraphs to three to four sentences if possible.

d. **Terminology.** Words should be used consistent with their exact meaning. The same word should be used throughout. Do not use synonyms. Avoid words which have more than one meaning. Section 19-3.01(03) provides the recommended terminology that should be used. Nonessential words and phrases should be omitted.

e. **Pronouns.** Avoid the use of pronouns, even if this results in frequent repetition of nouns.

f. **Punctuation.** Use the minimum number of punctuation marks consistent with the precise meaning of the language. Do not use a semicolon to separate related though distinct clauses. Instead, use a period to effect distinct sentences. Ensure that there can be no doubt regarding the meaning of a sentence.

g. **Capitalization.** The only phrases which require full capitalization are the special provision title and subsection headings. The only words which require an initial capital letter without regard to their location in the sentence are Department, Engineer, Contractor, titles of reference publications, traffic sign copy, or other proper nouns if their use is required.

h. **Parentheses.** Avoid the use of parentheses for other than metric-measure equivalents. Instead, use commas or rewrite the sentence.

i. **Numbers.** It is unnecessary to write numbers both in words and figures, e.g., “Use four (4) bolts”. Each number, including 0 or 1, should be written numerically, unless it must be used to begin a sentence. In writing dimensions, numbers should be used, e.g., ¼ in., 10 ft, 3 gal. Do not write 2 in. x 4 in., but instead, 2 in. by 4 in. Times and dates should be written numerically. Decimals of less than one should be preceded by the zero (e.g., 0.02 ft). Do not begin a sentence with a numeral. Either write the number in words, or rewrite the sentence by placing the numeral within the sentence.

j. **Units of Measure.** Write out units of measure within a sentence where not accompanied by a quantity. Symbolize units of measure where used in a tabular form or where accompanied by a quantity.
k. Emphasis. All parts of a specification are equally important contractually. Do not use all capitals, underlines, italics, bold type, larger pitch, different font, punctuation, etc., to emphasize words, sentences, pay items, or pay units.

l. Percentages. Where a percent is preceded by a number, the % symbol is used. Where percent is used in a sentence without a number preceding it, the word percent is spelled out.

7. Clarity. To ensure that the provision is clearly written, the designer should review the following.

a. Give directions, not suggestions.

b. Do not assume that the reader understands your intent.

c. Limit the use of phrases such as “as approved by the Engineer,” “at the discretion of the Engineer,” or “as directed by the Engineer” in place of definite workmanship requirements. Such phrases may lead to confusion or misunderstanding. The contractor may not know what the engineer is thinking.

d. Avoid conflicting or ambiguous requirements. Every specification statement should have only one meaning.

e. Disclose known difficulties or hazards.

f. Use the standard abbreviations listed in Standard Specifications.

8. Conciseness. A Unique Special Provision should be as concise as practical. In reviewing a provision, the designer should consider the following.

a. Avoid duplications between the Unique Special Provision and other contract documents, including the Standard Specifications.

b. Do not give reasons for a specification requirement.

c. Do not provide additional information which is unnecessary for the preparation of bids and the accomplishment of the work.
d. Once stated, do not repeat an instruction, requirement, direction, or piece of information provided elsewhere in the provision you are writing, or elsewhere in the contract documents.

e. Do not include mandatory provisions that are required in general by the contract.

f. Write the specification in a positive form (e.g., use “shall” instead of “shall not”).

g. Do not include instructions to the Department.

h. Do not include design information that is not necessary for the performance of the work.

9. Completeness. Ensure that the essentials have been included and that each requirement is definitive and complete. The Unique Special Provision should not be vague or open to differing interpretations.

10. Correctness. To ensure that a Unique Special Provision is written correctly, the designer should consider the following.

a. Check all references to the Standard Specifications or other contract documents to ensure that the references are correct.

b. Where practical, independently cross-check every factual statement.

c. Do not include conditions that cannot be required or enforced.

d. Ensure that the provision does not punish the contractor or supplier. Penalties or liquidated damages may be included, but the conditions that will result in penalties or liquidated damages must be clearly defined.

e. Ensure that the provision does not unintentionally exclude an acceptable product, construction method, or equipment.

f. Ensure that the provision does not change the basic design of the work.

g. Do not specify impossibilities. The practical limits of workers, equipment, and materials must be known and recognized.

h. Specify standard sizes and patterns where practical.
i. Avoid personal whims and favorite requirements.

j. Ensure that sufficient attention has been provided to assessing the durability or reliability of the material or procedure discussed. The use of recognized standards should be quoted to ensure that the specified performance or characteristics are achieved.

k. Make a careful, critical examination of manufacturer- or trade-association recommendations, and require supporting evidence to be submitted by the contractor.

l. Ensure that the provision gives directions to the contractor that are consistent with standard industry practice and current Department policies and procedures.

m. Ask a colleague to review the provision. What may seem clear to one person may not be clear to someone else.

11. **Submittal.** Submit the completed draft Unique Special Provision for review and approval. Section 19-3.02 discusses the submittal of a Unique Special Provision for review and approval.

19-3.01(01) **Structure of a Unique Special Provision**

Prepare a Unique Special Provision using the same structure as the *Standard Specifications*, including subsection layouts. The use of the standardized structure of the *Standard Specifications* provides a common outline for special provisions that helps to ensure that all the necessary information is included in a provision. The designer should review the *Standard Specifications* before writing a Unique Special Provision in order to become familiar with the structure and typical phrasing used throughout.

The standard structure consists of the “Big Five”: Description, Materials, Construction Requirements, Method of Measurement, and Basis of Payment.

1. **Description.** Briefly, but completely describe the scope of work to be performed, with references to specifications, plans, or other recurring special provisions that further define the work. Where necessary or desirable for clarity, describe the relationship of this work to other work or other phases of construction. Do not editorialize.
2. **Materials.** List the materials to be used in the work and clearly indicate the criteria for acceptance of the materials. Define the specifications and properties of each material and the method of tests for acceptance. Use references to the *Standard Specifications*’ materials section as much as possible. References may be made to AASHTO, ASTM, or other recognized specifications if the materials are not addressed in the *Standard Specifications*. Ensure that references to AASHTO, ASTM, or other specifications or test methods from agencies outside of INDOT are accurate and up to date. If a certification is required, ensure that the certification type fits the situation and that information required in the certification is clearly defined.

A prime consideration in establishing materials requirements is whether the material will be tested by the Department and if the Department has the capability to perform the test. The Office of Materials Management can provide guidance for specifying materials testing and acceptance criteria.

3. **Construction Requirements.** The construction requirements should be written in the logical order in which field operations are anticipated to proceed. Clearly define the requirements for general conditions, types of construction, and quality of workmanship. Do not leave the contractor in doubt as to what is required.

Describe the sequence of construction operations (method specification) or the desired end product (performance-based specification) as described in Section 19-3.01, item 4. Where practical, a performance-based specification is preferred. The construction requirements should define tolerances, limits, restrictions, preparations, or other criteria related construction of the work that must be satisfied for an acceptable product. These requirements can include, but are not limited to, dimensions, on-site test criteria, weather conditions, traffic condition, or time limits.

4. **Method of Measurement.** Describe the components of the completed work that will be measured to determine the pay quantity for the pay item as it will be described in the Schedule of Pay Items. Define the units of measurement and whether the item will be measured in original position, in transporting vehicles, or in the completed work. Designate modifying factors or other requirements needed to establish a definitive, measurable unit. A prime consideration for method of measurement should be the degree of difficulty that field personnel will encounter in making measurements.

5. **Basis of Payment.** Define the measured units for which payment will be made. Include the pay item name as it will appear in the Schedule of Pay Items and define the scope of work included in payment. Determine and identify which work is to be paid for as an individual pay item, what work is to be included in the cost of that pay item and what work is to be
included in the cost of other pay items. The Basis of Payment must clearly identify to the contractor what work is and is not to be included in the unit cost of the pay item. For work that is not included in the pay item in the provision, the designer must then determine and clearly state where the cost of such work is to be placed.

19-3.01(02) Format of Unique Special Provision

The format of a Unique Special Provision will depend on whether it directly modifies the Standard Specifications or not.

A provision that directly modifies the Standard Specifications must identify the section and line numbers in the applicable edition that is being modified and clearly indicate the modifications being made. The following guidelines should be used in preparing a Unique Special Provision that directly modifies the Standard Specifications.

1. Identify the section and line numbers being revised. Place distinct revisions within a section in line numerical order. For example:

   SECTION 101, LINE 13, INSERT AS FOLLOWS:
   SECTION 101, BEGIN LINE 176, DELETE AS FOLLOWS:
   SECTION 101, DELETE LINES 525 THROUGH 548.
   SECTION 101, AFTER LINE 1083, DELETE AND INSERT AS FOLLOWS:

2. Where more than one section is revised in a single Unique Special Provision, place the revised sections in numerical order. For example:

   SECTION 205, DELETE LINES 52 THROUGH 86.
   SECTION 404, AFTER LINE 1448, INSERT AS FOLLOWS:
   SECTION 609, BEGIN LINE 990, DELETE AND INSERT AS FOLLOWS:

3. Spaces in the Standard Specifications between paragraphs count as lines. Also, horizontal lines shown in tables count as lines.

4. Show revisions to Standard Specifications text by using strikethroughs to show deleted text and italics for inserted text. Delete, then insert. Do not insert, and then delete. Do not use a “track changes” feature in word-processing software to indicate revisions.

5. Retain all unrevised existing Standard Specification text in the sentence for clarity of the revision. Show entire sentences, even if only one word in the sentence is revised.
6. Include all text shown in each line involved in the revision. This includes sentence fragments not involved in the revision which may appear in the first or last line involved.

7. Where four or more lines of the existing text are entirely deleted without insertions, the deleted copy need not to be shown as overstruck. Indicate the deleted section and lines as follows:

SECTION 101, DELETE LINES 267 THROUGH 288.

8. In making a revision which inserts new text after an existing paragraph, identify the space after the paragraph as the line to begin after.

Do not develop a provision that revises the Standard Specifications solely to correct typographical, spelling, grammatical, or other errors. If such errors are evident, bring them to the attention of the Office of Contracting.

Figure 19-3B, Example Special Provision which Directly Modifies the Standard Specifications, illustrates the outline and layout that should be used for such a provision.

A provision that does not directly modify the Standard Specifications is formatted differently than that which does. Figure 19-3C, Example Special Provision which Does Not Directly Modify the Standard Specifications, illustrates the format to use for a stand-alone Unique Special Provision.

19-3.01(03) Terminology

Phraseology and terminology used in a Unique Special Provision should be consistent with that used in the Standard Specifications. In addition, the designer should consider the following.

1. **Amount, quantity.** Use “amount” when writing about money only. If writing about measures of volume, such as ft³, gal., etc., use “quantity.”

2. **And/Or.** Use “and” alone, or “or” alone. Do not use “and/or”.

3. **Any, all.** The word “any” implies a choice and may cause confusion. In place of “any,” the term “all” should be used. For example, “Correct all defects.”

4. **As per.** Instead, use “as stated,” “as shown,” “in accordance with,” or another similar phrase.
5. **As shown on the plans.** Use this phrase instead of “as shown in the plans,” “as detailed on the plans,” “as shown on the detail sheets,” “as shown on the Standard Drawings,” or “as shown on sheet __ of the plans.”

6. **At the contractor’s expense.** Instead of this phrase, use “____ shall be included in the costs of _________.”

7. **Balance, remainder.** “Balance” should be used if referring to money. “Remainder” should be used to describe something or material left over.

8. **Broken, skip line.** Use “broken line” rather than “skip line.”

9. **Coarse, course.** Use “coarse” to describe a texture. Use “course” for a layer.

10. **Conform.** Use the word “conform” to refer to dimensions, sizes, or fits that must be strictly adhered to (e.g., “cut bolt threads conforming to ASA Standards, Class 2 fit, coarse thread series”). Where a better product is acceptable, use the phrase “in accordance with...” (e.g., aggregates in accordance with the specification requirements if tested in accordance with AASHTO T 27.)

11. **Contractor.** Use the word “Contractor” in place of the word “Bidder.” “Bidder” should only be used in a proposal. If referring to the contractor by means of a pronoun, use “it” rather than “he.”

12. **Department.** Use “Department” in place of “Indiana Department of Transportation.” The abbreviation INDOT should not be used in the contract documents.

13. **Engineer.** Use of "the Engineer" refers to the Chief Engineer of the Department acting directly or through a duly authorized representative. If used in this context, "Engineer" is always capitalized.

14. **Ensure.** Do not use “insure” or “assure,” but instead use “ensure.”

15. **Guardrail.** Spell “guardrail” as one word rather than as two.

16. **In accordance with.** Use the phrase “in accordance with” in place of “in conformance with.”

17. **May.** Use “may” for contractor’s operations that are optional.

18. **Milling.** Do not use “scarifying,” but instead use “milling” or “surface milling.”
19. **Or equal.** Do not use this phrase without clearly defining what is “equal”.

20. **Pay item.** Use this phrase instead of “bid item,” “item,” or “line item.”

21. **Proposal.** The word “proposal” should not be used where the word “contract” is intended. The term “proposal” should only be used to describe requirements during the bidding process.

22. **Resisting, resistant.** Do not use “corrosion-resisting,” but instead use “corrosion-resistant.”

23. **Said.** Do not use “said pipe,” “said aggregates” but instead, use “this pipe,” “these aggregates.”

24. **Same.** Do not use “same” to replace a pronoun like “it” or “them” standing alone, such as “connected to same,” “specified for same,” “same will be given consideration,” “conforming to requirements for same.” The sentence should be rewritten to clearly describe what is meant.

25. **Schedule of Pay Items.** Use this phrase instead of “Itemized Proposal” or “Proposal” in referring to the list of pay items.

26. **Shall.** Use “shall” to define what the contractor is required to do. Do not use “may” unless the contractor has an option under the specification.

27. **State.** The term “State” is preferred over the “State of Indiana” or “Indiana.”

28. **Such.** Do not end a sentence with the word “such.” “Such” usually means “of this or that kind,” or similar to something stated. Instead, state that which is actually meant, or name the work to be completed or rephrase the sentence.

29. **Symbols.** Do not use the following symbols in writing a unique special provision.

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<thead>
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<th>Symbol</th>
<th>Write Instead</th>
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<td>by</td>
</tr>
</tbody>
</table>
30. **The.** Do not eliminate “the” for brevity.

31. **Thoroughly, Carefully, Clearly, etc.** Avoid using these or other similar adverbs, e.g., thoroughly wet, shall be carefully dried, shall be clearly shown, etc., as they are unenforceable. Preferably, state the value of the intended requirements in percent, dimensions, number of passes, etc.

32. **Unit Price.** Use “contract unit price” instead of “contract unit price bid.”

33. **Will.** Use only in describing something the Department will do that affects the contractor’s performance, e.g., “The Engineer will respond in writing in 14 days” or “_______ will be accepted based on the Department’s test results.”

**19-3.02 Unique Special Provision Review Process**

Once a Unique Special Provision is developed an electronic copy is to be transmitted to the project manager for the review process. An explanation of the need for the Unique Special Provision must also be provided, along with a request for unique pay items that can be required. The project manager will transmit the provision to the appropriate offices for review and comment. Depending on the nature of the Unique Special Provision, the following offices should be afforded the opportunity to review a provision prior to inclusion in a contract.

- Central Office
  - Division of Planning
    - Office of Pavement Engineering
    - Office of Roadway Safety and Mobility
  - Division of Production
    - Office of Roadway Services
    - Office of Structural Services
    - Office of Geotechnical Engineering
    - Office of Environmental Services
  - Division of Traffic Control Systems
  - Division of Technology Deployment
  - Division of Contract Administration
    - Office of Estimating
  - Division of Construction Management
    - Office of Technical Support
    - Office of Materials Management
    - Office of the State Construction Engineer
The Unique Special Provision will be reviewed to ensure that it does not conflict with current Department policy or procedure, that it does not create unwarranted costs or inefficiencies, that it does not duplicate a description of work addressed by the Standard Specifications or Recurring Special Provisions, and that the work it describes is materially available, testable, constructible, and non-proprietary unless approved. The provision will also be checked for proper structure, language, and format.

The reviewing parties will return their comments and recommendations to the project manager for action by the designer. The designer should work through the project manager to resolve concerns or questions regarding reviewers’ comments and recommendations. Figure 19-3D shows the flow of the Unique Special Provision process.

19-3.03 Submittal of Approved Unique Special Provision

Once a Unique Special Provision has been reviewed and approved for use in a contract, the designer must submit the provision along with the other required contract documents at Stage III submission.

The Department maintains instructions for use and submittal of Unique Special Provisions on its website. These instructions are located along with the instructions for use of the Special Provision Menu.
STOCKPILED BORROW MATERIAL FOR PROJECT

The Department has stockpiled sufficient borrow material for use in the project in the southwest quadrant of the I-465 interchange with I-70 on the eastside of Indianapolis.

All borrow required for the project shall be taken from this stockpile.

EXPLANATION

1. Provision title is centered and is Courier New font, 10-pt. pitch, all capitals.

2. There are no referenced Standard Specifications sections and line numbers.


4. There are no deletions or insertions.

EXAMPLE OF A RESTRICTIVE TYPE UNIQUE SPECIAL PROVISION

Figure 19-3A
USE OF CONES IN LIEU OF DRUMS

SECTION 107, BEGIN LINE 416, DELETE AND INSERT AS FOLLOWS:

Pavements and shoulders having an edge drop of more than 3 in. (75 mm) shall be delineated with drums in accordance with 801.09. Delineation shall be at a maximum spacing of 200 ft (60 m). The use of cones in accordance with 801.08 will be permitted during daylight hours in lieu of drums.

SECTION 801, BEGIN LINE 259, DELETE AND INSERT AS FOLLOWS:

Cones shall be made of a material to withstand impact without damage to striking vehicles. They shall have a substantial base to restrict overturning. Cones and tubular markers shall be as shown on the plans.

Cones shall be used only during temporary activities where portability is advantageous and they remain in place and do not create a hazard to traffic. The use of cones in lieu of drums will be permitted during daylight hours unless otherwise directed as shown on the plans. However, cones shall not be used for Interstate-route lane restrictions.

Tubular markers shall be used for separating two-lane two-way traffic as shown on the plans or as directed.

Cones and tubular markers shall be secured in place either by weighting or adhesives. The use of metal bases will not be permitted.

EXPLANATION

1. Provision title is centered and is Courier New font, 10-pt. pitch, all capitals.

2. Referenced Standard Specifications section and line numbers are Courier New font, 10-pt. pitch, all capitals.


4. Deletions are shown by overstrike.

5. Insertions are shown in italics.

EXAMPLE SPECIAL PROVISION WHICH DIRECTLY REVISES THE STANDARD SPECIFICATIONS

Figure 19-3B
**Description**
This work shall consist of furnishing and placing lightweight aggregate fill for embankment construction in accordance with 105.03.

**Materials**
Materials shall be in accordance with the following:

The aggregate source shall submit independent laboratory test results for the quality parameters listed. The test report shall be dated not later than 18 months from the time it is submitted. Independent laboratory test results will not be required if the aggregate is supplied by a certified aggregate producer on the Department’s approved Certified Aggregate Producer List.

The lightweight aggregate shall satisfy the requirements as follows:

1. Dry Rodded Unit Weight (Mass), Max...58 pcf (929 kg/m³)
2. Gradation, AASHTO M 195.............. 1/2 in. to No. 4 (12.7 mm to 4.75 mm)
3. Finer than No. 200, Max.............. 8.0% by wet analysis
4. Wear, Max................................ 50%
5. Soundness, Max.......................... 12% loss
6. Friable Particles, Max................... 10.0%
7. Deleterious Particles, Max............ 1.0%

The source of lightweight aggregate is subject to approval of the Engineer. Aggregate that is without suitable documentation of testing by an independent testing laboratory and is not approved or is not supplied by a certified aggregate producer, will not be accepted.

Recycled materials will not be allowed in an environmentally-sensitive area.

**Construction Requirements**
After placement, this material shall be lightly compacted. Density tests will not be required after placement.

**Method of Measurement**
Lightweight aggregate for embankment will be measured in accordance with 203.27(d).

**Basis of Payment**
Lightweight aggregate for embankment will be paid at the contract unit price per ton (megagram).

Payment will be made under:

<table>
<thead>
<tr>
<th>Pay Item</th>
<th>Pay Unit Symbol</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lightweight Aggregate for Embankment..........</td>
<td>TON (Mg)</td>
</tr>
</tbody>
</table>

The costs of material, transportation, placement, and all incidentals shall be included in the cost of the pay item.
EXPLANATION

1. Provision title is centered and is Courier New font, 10-pt. pitch, all capitals.

2. There are no referenced *Standard Specifications* sections and line numbers.

3. Provision subheadings are Courier New font, 10-pt. pitch, boldface.


5. There are no deletions or insertions.

EXAMPLE SPECIAL PROVISION WHICH DOES NOT DIRECTLY REVISE THE *STANDARD SPECIFICATIONS*

Figure 19-3C
Develops USP for the contract in accordance with IDM Chapter 19

1.0 DESIGNER

Submits draft USP to PM, including explanation & requested pay items

2.0 DESIGNER

With Designer, determines appropriate reviewers for each draft USP

3.0 PROJ. MGR.

Distributes draft USP for review by appropriate parties

4.0 PROJ. MGR.

Review draft USP and return comments to PM

3.0 PROJ. MGR.

Resolves review comments thru PM; requests pay items for USP from Contracts

7.0 DESIGNER

Collects review comments and sends to Designer and District Construction

5.0 REVIEWERS

Traffic Construction

Traffic Management

OPERATIONS

DISTRICT

Roadway Services
Structural Services
Geotechnical Eng
Enviro. Services

Pm't Engineering
Rdwy Safety & Mobility

Technical Support
Materials Mgmt.
State Const. Eng.

Traffic Engineering
Pm't Preservation
Maintenance
Admin.

Traffic Control
Systems Technology
Deployment

POTENTIAL REVIEWERS

Figure 19-3D
NOTE: This chapter is currently being re-written and its content will be included in Chapter 108 in the future.
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CHAPTER 20

COST ESTIMATING

To adequately define the project scope and to ensure that sufficient construction funds are available, a construction cost estimate is required during the various stages of project development. As the project progresses, the estimate is updated to ensure the project remains cost-effective, that sufficient funds are available for construction, and that the contractor’s bid price is reasonable. This Chapter discusses the project cost estimates required and who is responsible for their preparation.

20-1.0 PROJECT ESTIMATES

20-1.01 Project Initiation Estimate

Each district is responsible for nominating projects to be included on the Department’s Multi-Year Highway Improvement Program. Two notable exceptions are major-improvement studies and the Interstate System rehabilitation program, which are nominated by the Planning Division. Once a project is nominated, the Urban and Corridor Planning Office is responsible for gathering the necessary project information before it can be included on the Program list. One part of this information-gathering includes a preliminary cost estimate for construction. The preliminary cost estimate is generally provided by the entity which nominated the project. This estimate is determined using broad units of cost (e.g., cost per mile, cost per square yard), by the type of improvement and by reviewing similar, recent projects in the area.

20-1.02 Preliminary Engineering Study Estimate

The Environmental Policy Team, with input from the district, will prepare a more-detailed cost estimate for a project requiring an Engineer’s Report. This estimate will be prepared based on the estimating procedures discussed below (e.g., cost per mile, cost per square yard). However, where quantities are available, these should be used. The Environmental Policy Team will be responsible for obtaining appropriate parametric cost estimate data.

A preliminary-study cost estimate is determined according to the following.

1. **Roadway Items.** For most roadway items, the cost estimate is determined assuming a cost per mile per roadway width. This estimate reflects the cost for earthwork, pavement
structures, drainage, or other miscellaneous items. Every effort should be made to include all anticipated work items.

2. **Structure Items.** For most structural items, the cost estimate is determined assuming a cost per square yard based on similar structure type, work type (e.g., bridge rehabilitation, replacement) and crossing type (e.g., railroad, highway, stream).

3. **Traffic-Signal Items.** For a signal installation, a cost estimate is determined assuming a cost per intersection. For a signal-interconnect system, a cost estimate is determined assuming a cost per installation. These cost estimates will be provided by the Traffic Signals Team.

4. **Traffic-Signs Items.** The cost estimate is based on the number of panel signs and cost per sign. The cost estimate will be provided by the Signing and Lighting Team.

5. **Lighting Items.** Lighting is estimated assuming a cost per mile or per interchange where lighting will be provided. The cost estimates will be provided by the Signing and Lighting Team.

6. **Traffic Maintenance.** Include an estimate for traffic maintenance for each project. This estimate is determined by parametric means with the aid of previous projects of similar size, type, and complexity. For an expansion or major-preservation project, traffic maintenance costs range from 5 to 15 percent of the roadway or bridge construction items.

7. **Right of Way.** Right-of-way costs for an expansion or major-preservation project are furnished by the Office of Real Estate, including land cost, damages, and administration costs. Right-of-way cost for another project type is provided by the Administrative Services Team based on previous land-acquisition costs of similar projects.

8. **Contingencies.** For an expansion or major-preservation project, add a contingency factor for miscellaneous and lump-sum items based on 20 to 30 percent of the roadway or bridge construction items.

9. **Preliminary Engineering.** For a road project, add a preliminary-engineering cost of 3 to 6 percent based on the total of Items 1 through 8 above, excluding Item 7. For a bridge project, use 5 to 8 percent. The preliminary-engineering cost includes environmental, survey, design, and geotechnical work.

10. **Unit Costs.** If quantities are available, these quantities in conjunction with the average weighted unit prices from Estimator or CES are used to develop the estimate.
The user should add the cost of major features that are beyond the basic assumptions used to develop the estimate. For example, the cost for a major box culvert should be added to the roadway cost per mile estimate.

20-1.03 Design Estimates

20-1.03(01) Preliminary Field Check

This is the first project stage for which the designer is responsible for preparing the cost estimate. The total from this estimate is included in the preliminary draft from the Design Summary. At this stage, the plans should be sufficiently advanced so that some of the major quantities can be approximated. The estimate should be based on these quantities and the average weighted unit prices. After entering all known quantities into Estimator or CES, the designer should include a 10 to 25 percent contingency factor based on engineering judgment for the miscellaneous items for which the quantities have not yet been determined. If the quantities are not available, the general cost estimating procedures discussed in Section 20-1.02 should be used (e.g., cost per mile per roadway width). The designer should contact the Production Management Division’s Utilities and Railroad teams, and the Office of Real Estate to obtain an estimated cost for utilities, railroads, or right of way, unless previously supplied.

For a consultant-designed project, the consultant will be required to use the computer program Estimator to determine the preliminary cost estimate. Section 20-2.01 discusses the Estimator program. As with CES, Estimator will provide an initial cost estimate based on the available quantities. The consultant will be responsible for adjusting the values to reflect the project type, location, environment, and engineering judgment.

A project may have two or more Des numbers. For example, a combination roadway and bridge project will have multiple Des numbers. For this type of project, separate cost estimates are required for each Des number based on the quantities associated with that particular work category. The Office of Contracting will combine individual estimates within a single contract.

20-1.03(02) Design Approval Plans

Most major quantities should be known at this stage. However, if this is not true, the procedures described for determining the cost estimate in Section 20-1.03(01) are also applicable. Include the final total from the cost estimate in the Final Design Summary. The Design Summary is submitted to the Production Management Division director for approval including the total estimated cost. A
complete cost estimate is required as an attachment to the Design Summary for an Interstate-route rehabilitation project, or to the Bridge Inspection Report for a bridge-rehabilitation project.

20-1.03(03) Final Check Prints

At this stage, the plans should be complete, and the preliminary cost estimate updated to a final cost estimate. All quantities should be finalized at this stage and entered into Estimator. Section 20-2.03 provides additional guidelines for determining a cost estimate based on quantities.

20-1.03(04) Final Tracings

Before submitting the final tracings, the designer must prepare a final detailed cost estimate based on the final plans and quantities. This may be an update of an earlier cost estimate. This estimate will be used by the Office of Contracting to develop the Engineer’s Estimate.

For a local-public-agency project, the Office of Contracting will review the local agency’s cost estimate and prepare the Department’s cost estimate. This may be, but is not required to be, an independent estimate. If the difference between the local agency’s cost estimate and the Office of Contracting’s cost estimate is significant, the Local Program Assistance Team will contact the local public agency and negotiate an estimate acceptable to both parties.

If the cost estimate changes after the plans have been transmitted to the Office of Contracting due to changes in the quantities, the procedures described in Section 14-1.02(03) and 14-1.02(04) should be followed.

20-1.03(05) Other Estimates

The following indicates where new or revised cost estimates may be required during the design stage of a project.

1. Project Scope Change. If the scope of the project changes, the designer is responsible for obtaining a new construction cost estimate. If major changes on a Federal-aid project are over $250,000 and if construction will occur in the current or next Federal fiscal year, forward the revised cost estimates to the Urban and Corridor Planning Office so that it can revise the Multi-Year Program. Estimates for scope of work changes are based on approximate quantities and are determined using the procedures discussed in Section 20-1.02.
2. **Project Delay.** If there has been a significant delay in the project since it was originally designed and estimated, it will be necessary to update the cost estimate.

### 20-1.04 Engineer’s Estimate

The Engineer’s Estimate will provide a basis for the Department’s evaluation of the bids for highway construction and will allow the Department to determine if the low-bid price is fair and reasonable for the work involved. This estimate and the data used to generate the estimate are confidential and are not for general distribution.

After receiving the cost estimate, the Office of Contracting will ensure that the following reviews or activities occur.

1. **Review of Estimate.** The Office of Contracting will review the designer’s estimate and check it for errors or omissions. If large discrepancies are noted, it will contact the designer to discuss and resolve differences.

2. **Review of Contract Completion Time.** The Office of Contracting will ensure that the cost estimate is compatible with the contract completion period set by the district construction personnel.

3. **Review of Cost Estimate From Office of Real Estate.** The Office of Contracting will add cost estimates from the Office of Real Estate to the designer’s estimate to determine the final Engineer’s Estimate.

4. **Prepare Plans, Specifications, and Estimates (PS&E).** For a Federal-aid-funded project, the Office of Contracting will include an estimate as part of the PS&E package submitted to FHWA.

5. **Review Pre-Bid Meeting Comments.** The Office of Contracting will review comments from the Pre-Bid Meeting to determine their effect, if any, on the cost estimate.

6. **Opening and Processing Bids.** After the public reading of the bids, the Office of Contracting will check the proposals for omissions or errors. If the low bidder satisfies all criteria and if the low bid is within a pre-established award range, the bid is forwarded for approval.
7. **Rejection of Bids.** If all bid estimates exceed the pre-established award range, the bids and contract are rejected and the re-advertising process begins. The Engineer’s Estimate is reviewed with regard to the bids received.

## 20-2.0 ESTIMATING PROCEDURES

### 20-2.01 Computer Estimates

Each construction-cost estimate must be submitted via the CES Cost Estimating System software. CES has a detailed user-guide manual that the designer should review before using the program. The manual can be obtained from the Office of Contracting or by contacting the Architecture and Application Development Division’s TRNS • PORT (BAMS) Administrator.

In order to better-estimate construction costs in the future, and to analyze work done in the past, more information must be entered into CES for an in-house-designed or consultant-designed project. All consultant-designed-project-metrics information formerly submitted on the Consultant Project Input Form should now be entered directly into CES. The Consultant Project Input Form, Excel file 0527-inf.xls will no longer be required.

The following project metrics should be entered into CES.

1. **Latitude and Longitude.** This information should be taken from the SPMS project schedule. If it is not shown there, the designer or estimator should determine the location of the midpoint of the project in degrees, minutes, and seconds. This data should be entered without units symbols. For example, 89° 59’ 34” is entered as 895934. This information is entered on the General tab, second page. Latitude or longitude information that is already present must be verified.
   
   a. For a project that includes work on more than one route, the latitude and longitude should be entered for the point closest to the geographic center of all work.

   b. For a district- or subdistrict-wide contract, the latitude and longitude should be entered for the district or subdistrict office.

2. **Project Length, Pavement Width and Depth, and Lane Miles.** This information should be entered on the General tab, first page, bottom left, in the block titled Metrics. English units should be used for a metric-units project. Each entry should be rounded to two decimal places, as appropriate.
a. The project length is the overall length of pavement, entered in miles.

b. The pavement width is the total width of new mainline pavement, excluding paved shoulders, entered in feet.

c. The pavement depth is the average depth of new mainline pavement, excluding paved shoulders, entered in inches.

d. Lane miles is the project length times the number of through travel lanes, excluding shoulders, entered in miles.

Cost estimates are based on the quantities and applicable unit prices. CES allows the designer to enter quantities or to develop cost estimates based on general estimating procedures (e.g., cost per square foot of bridge deck, cost per intersection). For Estimator, the user must input actual quantities into the program before it can generate a cost estimate. Once the quantities have been entered, the programs will automatically provide a cost estimate based on historical data from past bids. The Department is responsible for providing the base information used by the programs. This estimate may be used as-is. However, the designer should review the unit costs. Based on the proposed scope for the project, the designer should be aware of factors that may influence unit prices as follows:

1. geographic location (e.g., urban or rural, State location, district);
2. similarity of recent construction projects;
3. inflation (adjustments of past prices to reflect the current year);
4. reliability of recent construction cost data;
5. recent trends in cost of materials, labor, or equipment;
6. anticipated difficulty of construction;
7. project size relative to size of similar projects;
8. proposed project schedule;
9. anticipated construction staging;
10. expected environmental problems (e.g., hazardous wastes, wetlands);
11. use of experimental materials, which requires coordination with the Office of Research and Development; and
12. engineering judgment.
20-2.02 Coded Pay Items

20-2.02(01) General

Each pay item has an official title and code number which is tied to the Standard Specifications. These items are listed in the INDOT Catalog of Unit Price Averages for Roads - Bridges - Traffic. This document can be obtained from the Office of Contracting. These item numbers are used by the Department for tracking and as a historic data base. For most items, CES or Estimator will provide the official pay item number. However, for some specialty or new items, the construction item may not be within the computer. Therefore, the designer will be required to conduct the following.

1. **Checking.** The designer should ensure that there is an actual number for the item within the system by entering the item into CES or Estimator. Do not assume that the item is not in the system.

2. **Specifications.** The designer should review the Standard Specifications, Supplemental Specifications, or Recurring Special Provisions to determine if there is a method of payment for the item. If not, a special provision must be developed; see Section 19-2.0.

The designer should be certain that the CES or Estimator software’s pay items catalog to be used in developing the estimate of quantities and cost estimate corresponds to that which is effective for the contract letting date. Pay item names, pay units, or code numbers are periodically revised, added, or deleted. It is the designer’s responsibility to check the estimating software when these changes occur, and to be certain that they are reflected in the estimate of quantities and cost estimate throughout project development.

20-2.02(02) New Pay Item and Code Number

If an item does not exist within the CES or Estimator program, the designer may request the Office of Contracting to develop a new pay item and code number. The designer should minimize this option as much as practical. The design should instead be modified slightly in order to use an existing pay item. Where necessary, use the following procedure to request a new pay item and code number.

1. **Request.** Send or fax a memorandum requesting a new pay item to the Office of Contracting. This memorandum should include the information as follows:

   a. the proposed pay item name;
   b. the pay unit, both English and metric;
c. the applicable Standard Specifications section reference;
d. 3 copies of the special provision for the item, double spaced; and
e. where applicable, plan details.

2. Comments.  The Office of Contracting will review the request and may solicit comments from other Department entities. The written request for comments will include the information as follows:

a. the Standard Specifications section number;
b. a copy of the special provision;
c. plan details, where applicable; and
d. the Office of Contracting’s comments on the request.

Those solicited for comments will be given five work days to return their comments.

3. Response.  Upon receipt of all comments, the Office of Contracting will either approve the new pay item for use and assign it a new pay item code number, or it will recommend the use of an existing pay item by developing a supplemental description for an existing specification.

20-2.02(03) Bridge Identification in Pay Item Name

A unique identifier should be assigned to each distinct bridge in the contract if required in a pay item name. For a set of twin structures, each bridge should therefore be assigned a unique identifier.

20-2.02(04) Non-Participating Pay Items [Added Sept. 2011]

Figure 14-1C, Contract Preparation Documents to Contract Administration Division, includes a section for identification of non-participating pay items. These are pay items which FHWA cannot participate in the cost of, in an otherwise federal-aid project. The pay items should be identified as such in the cost estimate.

The most common non-participating pay items include the following.

1. Commemorative plaque on a bridge.
2. Work outside the right-of-way without permit.
3. Adjustment of private facilities not included in the right-of-way acquisition document such as signs; fences, lawn sprinklers, etc.

4. Costs incurred to salvage items for later use by the State are not eligible for federal participation. This includes transportation of materials or storage costs.

5. A betterment that is not currently part of the project. Example: excess sizing of a non-INDOT sewer for future development. The additional cost over replacement-in-kind should be borne by the owner of the facility being adjusted.

6. Purchase of equipment or supplies for retention by INDOT or an LPA that are not permanent project fixtures. Example: purchase of changeable-message signs for retention by INDOT.


For most items, CES and Estimator will provide the designer with sufficient guidance in determining the appropriate cost for a specific item. However, the designer should consider the following.

1. **Unit Cost.** The unit cost will be based upon an average price data base maintained by the Department within CES and Estimator, price books, and unit cost bid tabulations. Adjustments to the unit cost may be appropriate based on the factors listed in Section 20-2.01.

2. **Lump-Sum Pay Item.** Desirably, a lump-sum item should not be used on a project. However, this is not always practical. Where necessary, only use a lump-sum item where the scope of work for the item is clearly defined and the amount of work has a minimal chance of changing during construction. In determining the unit price for a lump-sum item, the designer should consider the following.

   a. **Components.** Most lump-sum items can be divided into individual parts for estimating purposes. For example, a temporary traffic signal structure can be divided into the pole installation, signal heads, controller, installation, maintenance, removal, etc. Once the elements have been segregated, the designer should use engineering judgment to determine the appropriate cost for each component.

   b. **Percentages.** Some lump-sum items are determined based on a percentage of the total of the contract items (e.g., mobilization and demobilization, clearing right of way). These are further discussed below.
3. **Clearing Right of Way.** This is assumed to be 1 to 2 percent of the total contract cost. Factors that should be considered include project location, rural or urban, the type of clearing required (trees or brush), concentration of clearing, and method of disposal.

4. **Temporary Bridge and Approaches.** This should be segregated into its components as discussed in Item 2.a. For example, the cost of temporary approaches should be determined according to the amount of embankment required, width of pavement, drainage systems, etc. Temporary guardrail and temporary pavement markings are separate pay items.

5. **Miscellaneous Items.** The following pay items should always be included in the cost estimate.

   a. **Field Office.** The pay unit is month. The number of months used for the final quantity and schedule of pay items is set by the district Office of Construction based on the estimated construction time.

   b. **Maintaining Traffic.** Maintaining traffic is a lump-sum item and will be determined based on its components. Elements that should be considered include traffic volume, traffic composition, peak times, number of lanes, length of construction, and type of work.

   c. **Construction Engineering.** This will be determined by the computer. Construction engineering is determined using 2% of the total contract cost. This may require revision if significant engineering may be required during construction.

   d. **Mobilization and Demobilization.** This is a lump-sum item and will be determined by the computer. Mobilization and demobilization is determined using 5% of the total contract cost including the amount for construction engineering. Mobilization and demobilization consists of preparatory work and operations necessary for the movement of personnel, equipment, supplies, and incidentals to and from the project site; for the establishment and removal of offices, buildings, and other facilities necessary for work on the project; and for all other work or operations that must be performed or costs incurred when beginning or ending work on the project.

6. **Other Cost Estimates.** Other entities will prepare their own cost estimates. The designer is responsible for ensuring that such entities receive the correct information so that they can properly prepare their estimates.
7. **Other Information.** The designer should provide the Office of Contracting with information that may influence the cost of the project (e.g., special commitments, experimental materials, special equipment, expected construction difficulties).

8. **Special Material.** Contact a supplier directly to obtain a quote for a special material. The quoted price is what a supplier hopes to receive for its product. The final price the contractor will be required to pay will be lower due to competition and negotiations between the contractor and supplier. Such an item as a discount for a large quantity, early payment, or extreme competition may impact the final price. The designer should adjust the quoted price based on these factors, previous estimates, and engineering judgment.

9. **Incidentals.** Incidental costs cover work that may or may not be addressed by a specific contract pay item. Incidental costs may include the following:

   a. work included in other items per the *Standard Specifications* or a special provision;

   b. coordination with other contractors;

   c. early completion date which demands multiple work shifts;

   d. payment of overtime;

   e. winter construction;

   f. congested work area;

   g. high-elevation work;

   h. hauling through heavy traffic, frequent railroad crossings, or traffic signals;

   i. work not adaptable to the normal equipment used which results in manual labor or renting of special equipment;

   j. location of plant sites, including costs of rental and renovation;

   k. the season during which the work will be performed;

   l. the cost of maintaining traffic including stage construction, flaggers, lights, barricades, or flashing-arrow signs; and
m. outside agencies’ rules and regulations (e.g., OSHA, EPA).

10. **Structural-Plate Pipe-Arch Unit-Price Data.** For a large-culvert location, the hydraulics recommendation letter will include a structural-plate pipe-arch sizing as well as a precast-concrete box-structure or three-sided structure sizing. If this occurs, the designer should evaluate both structures at the structure type and size stage and choose the more economical alternate. If the hydraulics recommendation letter includes the option of a small- to medium-sized structural-plate pipe-arch, a deformed pipe type 1 should be shown on the plans so that the contractor has the option of providing either a corrugated-metal or an elliptical-concrete pipe.

The Department has very little historical unit-price data for structural-plate pipe-arch structures. Data from recent bid tabulations is available from the Contract Administration Division’s Office of Contracting or at [http://www.in.gov/dot/div/contracts/pay/](http://www.in.gov/dot/div/contracts/pay/). The designer should contact pipe suppliers for additional price information for a specific size.

11. **Three-Sided-Structure or Oversize-Box-Structure Unit-Price Data.** Estimated unit price summaries may be found at [http://www.in.gov/dot/div/contracts/pay/](http://www.in.gov/dot/div/contracts/pay/).

12. **Concrete-Structural-Members Unit-Price Data.** Estimated unit price summaries may be found at [http://www.in.gov/dot/div/contracts/pay/](http://www.in.gov/dot/div/contracts/pay/). The designer should adjust unit prices based on the quantities required for the project. Unit prices may increase 20 to 50 percent for small quantities. The designer should further check with a fabricator.