

## **Section 2402. Excavation for Structures**

### **2402.01 DESCRIPTION.**

- A. Remove all material necessary for construction of the work included in the contract, in conformity with the contract documents.
- B. Furnish, place, and remove all cofferdams, shoring, and bracing.
- C. Remove all surplus material.
- D. Sounding and test boring data shown in the contract documents were accumulated for design and estimating purposes. Their appearance in the contract documents does not constitute a guarantee that conditions other than those indicated will not be encountered in the excavation or in material penetrated by piling.

### **2402.02 MATERIALS.**

As required in [Article 2402.03](#).

### **2402.03 CONSTRUCTION.**

Provide a safe slope for construction in the conditions encountered.

#### **A. Clearing and Grubbing.**

- 1. Remove all trees, stumps, and brush existing on the site of the work which shall be removed for completion of the work. As part of the contract for a structure, the Engineer may order trees and stumps which are near, but not on, the site of the work to be removed, if:
  - Their presence will interfere with completion of adjacent parts of the improvement of which the structure is a part, and
  - Their later removal by usual methods would endanger the structure.
- 2. No blasting within 50 feet (15 m) of any completed part of the structure.
- 3. Refer to [Section 2101](#) for the work and payment for clearing and grubbing.

#### **B. Elevations and Dimensions of Footings.**

Under normal construction conditions, construct footings to elevations shown in the contract documents. The Engineer may order, in writing, changes necessary in dimensions or elevations of footings to secure a satisfactory foundation.

#### **C. Treatment of Foundations.**

- 1. If a footing on rock is specified, perform excavation in a manner to allow the rock to be exposed and prepared according to [Article 2405.03, C](#). If the footing shall rest on firm earth, take special care not to disturb the bottom of the excavation. If the footing excavation bottom is wet, wait until just before placing the footing to complete final finishing.

2. Control drainage in the foundation area to reduce moisture and mud problems to a practical minimum. Prepare and maintain the area in an acceptable condition prior to and during placement of concrete. The Engineer may require improved drainage, removal of mud, filling with suitable material, or other procedures to obtain a reasonably suitable condition in the area. This requirement is not to be construed as an order for foundation treatment material or as a basis for extra compensation.
3. If the foundation material is unsuitable, the Engineer may direct that the foundation be over excavated and backfill consisting of granular surfacing materials approved by the Engineer be placed. Place backfill material according to [Article 2402.03, H](#).

**D. Construction of Cofferdams.**

Construct cofferdams according to [Article 2405.03, A](#).

**E. Removal of Cofferdams.**

Unless shown otherwise in the contract documents, remove cofferdams, sheeting, and bracing.

**F. Inspection of Excavation.**

1. After each excavation is completed, notify the Engineer, who will inspect the depth of excavation and character of foundation material.
2. Do not place concrete until after the Engineer has approved the depth of excavation and character of foundation material.
3. The Contracting Authority will be responsible for delays caused by failure to make inspection within 24 hours after the Contractor has given notice to the Engineer.

**G. Removal of Excavated Material.**

1. Use all material excavated for bridge and culvert work suitable for placing backfill material or foreslope construction for that purpose. If material is unsuitable due to excessive moisture, dry it prior to placement.
2. Do not use unsuitable material for either placing backfill materials or in approach fills. Remove excess material from the project according to [Article 1104.08](#).

**H. Placing Backfill Materials.**

1. Place backfill material next to completed structures according to the following provisions or according to [Section 2506](#). Use excavated material when flowable mortar or granular backfill material is not specified in the contract documents. Place backfill to natural ground line unless there is an inadequate quantity of suitable excavated material. If

there is an inadequate quantity of suitable excavated material, continue placing backfill until the suitable material is depleted.

2. Use backfill material free from organic material, boulders, or broken concrete over 8 inches (200 mm) in the greatest dimension; or frozen material.
3. Ensure moisture content for soil is suitable for compaction at the time it is placed for backfill material. When compaction with moisture control is required by the contract documents, increase or reduce the moisture content in backfill material, as necessary, to bring the moisture within the designated moisture limits prior to and during placement and compaction.
4. When granular backfill material is specified, use backfill material meeting the requirements of [Section 4133](#). When the volume of material excavated exceeds that of backfill material required by the contract documents, increase the quantity of granular backfill material furnished to provide backfill material for the excess volume of excavation. Place granular backfill material in layers no more than 8 inches (200 mm) thick. Thoroughly tamp or vibrate each layer to insure compaction. The Engineer may require granular backfill material to be moistened with water while being placed.
5. Except as provided in [Article 2403.03, N](#), allow at least 14 calendar days to elapse after concrete has been placed before placing backfill material against:
  - Concrete culverts, abutments, piers, arches, and wingwalls, or
  - Timber abutments or wingwalls which depend on cast-in-place concrete anchors.
6. Do not place backfill material against timber abutments or wingwalls until all required anchor rods are in place and ready to function. Do not place backfill material against timber abutment or wingwall designed to gain support from a superstructure until the superstructure is in place and permanently fastened to the substructure.
7. Backfill material may be placed in water only when removal of water from the area in which backfill material is to be placed is impractical, for example:
  - Around piers or abutments located within the waterway, or
  - In other deep excavations where removal of cofferdams is required before placing backfill material, and such removal prevents dewatering.
8. Backfill material placed in water need not be consolidated. Use granular backfill material when placing material under water and over which an embankment is to be placed.
9. When placing backfill material above the water line, place it in layers no more than 8 inches (200 mm) in loose thickness. Thoroughly compact

each layer material before the next layer is placed. Except as noted below, accomplish all compaction by rolling with an approved roller or by tamping with a mechanical tamper. Operate pneumatic tampers according to the manufacturer's recommendations.

10. Place backfill material in layers no more than 8 inches (200 mm) in loose thickness when moisture control is required by the contract documents. Level and thoroughly compact each layer before the next layer is placed. Use a tamping type roller described in [Article 2001.05, A](#). Compact at no less than one roller passage per inch (25 mm) of loose thickness. In areas inaccessible to the roller, use a mechanical tamper described in [Article 2001.04](#) for each layer. Excavate to a width to accommodate the roller to be used and provide a reasonably level area for the roller operation for the first and all subsequent layers.
11. Where backfill material is required on both sides of a concrete wall, abutment, or other monolithic structure, fill on both sides of the structure simultaneously so that the two fills are kept at approximately the same elevation at all times. For the purposes of this paragraph, consider concrete boxes, arches, and circular culverts and rigid frame bridges, except wingwalls, to be monolithic structures.
12. Where backfill material is to be placed on one side only of retaining walls, or wingwalls of culverts 8 feet (2.5 m) high or more, do not perform rolling operations within 3 feet (1 m) of the wall face. Compact the 3 feet (1 m) closest to these walls or wing faces using pneumatic or hand tampers only.
13. Remove material excavated for concrete culvert construction as provided in [Article 2402.03, G](#), and within 7 working days after concrete can be subjected to flexural stresses as provided in [Article 2403.03, N, 2](#). Prepare the site for placing the adjacent embankment. The Engineer may extend the time period for removing excavated material if the extension will not interfere with work of others or the public. For culvert extensions on roads open to traffic, complete backfill material placement to the top of the culvert within 14 working days after the curing period has expired.

**I. Embankments Adjacent to Bridges, Culverts, or Structures.**

Apply [Article 2107.03, O](#), when the contract requires construction of an embankment adjacent to a bridge, culvert, or other structure unless the contract documents require the placement of flowable mortar according to [Section 2506](#).

**J. Classification of Excavation.**

Excavation for structures will be classified as Class 20, Class 21, Class 22, Class 23, or Class 24, as follows:

**1. Class 20 Excavation.**

Includes excavation for bridges above the excavation classification line shown in the contract documents and not classified as Class 22 excavation. Also includes all excavation for culverts not classified as

Class 22, 23, or 24 excavation. None of the excavation for culverts is to be classified as Class 21 excavation.

**2. Class 21 Excavation.**

Includes excavation for bridges below the excavation classification line shown in the contract documents and not classified as Class 22 excavation.

**3. Class 22 Excavation**

Includes the measured volume of granite, trap, quartzite, chert, limestone, sandstone, hard shale, or slate in natural ledges. Also includes the estimated or measured volume of rock fragments or boulders having a volume of 1 cubic foot (0.03 m<sup>3</sup>) or greater.

**4. Class 23 Excavation.**

Includes excavation included in the definitions of Classes 20, 21, and 22 and any other material encountered regardless of its nature, except for removal of old structures or parts of structures.

**5. Class 24 Excavation.**

Includes the additional excavation necessary to provide material for backfills, approach fills, berms, or a roadway over the structure when material resulting from other classes of excavation for the structure is of insufficient quantity or of unsatisfactory quality for these purposes.

**2402.04 METHOD OF MEASUREMENT.**

**A. General.**

1. If a single contract involves both channel excavation and excavation for structures, excavation included within the volume limits of channel excavation, as shown in the contract documents, will not be included in measurement of excavation for structures.
2. Excavation for structures to the limits indicated in this article is for pay quantities only.
3. Quantities of Class 20, 22, 23, and 24 excavation will be measured in cubic yards (cubic meters) by the cross section method or other appropriate method. Boulders may be measured after excavation. Class 21 excavation will be computed in cubic yards (cubic meters) within the boundaries specified and from data shown in the contract documents.
4. When the location of part or all of an existing structure scheduled to be removed falls within the planes describing the excavation volume for either structures or culverts ([Article 2402.04, B and C](#)), the volumes of excavation performed for payment on the new structure will include any volume of excavation performed as part of the removal of the existing structure which is:
  - Above the elevation of the bottom of footings, and
  - Within the excavation limits described below.

5. All other excavation performed in conjunction with removal of structures will be considered incidental to removal. Additional payment will not be made. Reduction in excavation quantity will not be made for portions of existing structures removed from the excavation limits of new structures.

## **B. Excavation for Structures.**

1. The quantity of Class 21 excavation measured, unless modified in [Article 2402.05](#), will be shown in the contract documents.
2. For other classes of excavation, the quantity measured for payment will be that actually removed except as provided in this article for culverts. Unless required by the contract documents or ordered by the Engineer, measurement will not be made of material removed outside areas bounded by vertical planes parallel to the boundaries of the structure or part of structure and located as follows:
  - a. For concrete structures and parts of structures without footings, 36 inches (1 m) outside the horizontal projection of the structure.
  - b. For concrete structures with footings, 36 inches (1 m) outside the footings.
  - c. For timber abutments and wingwalls, 24 inches (0.6 m) behind the backing plank.
  - d. For anchor rods, 12 inches (0.3 m) on each side of the rod.
  - e. For buried anchors, the face of the buried anchor on one side and 24 inches (0.6 m) outside the buried anchor on the other face.
3. For roadway pipe culverts, the amount of excavation measured for payment will be computed from an excavation centered on the center line of the pipe, to the required depth, length, and a width of 42 inches (1 m) plus the specified diameter of the pipe in inches (millimeters). The vertical plane as described above will be changed to a 1:1 slope from the bottom of the excavation sloping away from the structure. When the 1:1 slope is used, it is to extend the length of the structure unless indicated otherwise in the contract documents. This does not apply to culvert extensions unless indicated in the contract documents. Modification will not be made in the quantity shown in the contract documents for variations in wall thickness of the pipe. Modification will be made for changes in location or flow line as provided in this section.
4. For cast-in-place culverts the amount of excavation measured for payment will be computed from an excavation centered on the center line of the culvert, to the required depth, length, and a width 2 feet (0.6 m) greater than the width of the footing. The vertical plane as described above will be changed to a 1:1 slope from the bottom of the excavation sloping away from the structure. When the 1:1 slope is used, it will extend the length of the structure unless otherwise indicated in the contract documents. This does not apply to culvert extensions unless indicated in the contract documents. Modification will be made for changes in location or flow line as provided in this section.
5. When moisture control is required by the contract documents, the amount of excavation measured for payment will be computed for an

excavation to the required depth and length and a width extending 6 feet (2 m) beyond the limits of the structure.

6. The Engineer may require a 48 hour notice prior to beginning excavation so necessary measurements of the existing ground may be made. Payment will not be made for material removed before these measurements are made.
7. In the case of two or more footings supporting a pier or similar structure which is continuous between footings at any elevation below the excavation classification line, the planes described above will be located as if the footings were continuous and of the width of the footings to be built.
8. When the quantity of Class 20 excavation is based on the assumption that prior Class 10 excavation by a grading contractor will be made, the depth of Class 20 excavation, if removed by the bridge contractor, will be increased by the depth of Class 10 excavation (grading) not completed prior to commencement of the Class 20 excavation, if the Class 10 excavation is not in actual progress or completed by the starting date of the bridge contract. This increase will not apply if the projects involving Class 10 (grading) and Class 20 (bridge) excavation are part of the same contract.
9. The estimated quantities of excavation are computed from data available when plans are prepared. Unless contract quantities are agreed to, estimated quantities are not to be used as the measured quantity, except for Class 21 excavation and as specified below for culvert excavation.

#### **C. Excavation for Culverts.**

1. When a culvert is built without a change in location, dimensions, or elevation, the quantities of Class 24 and Class 20 or Class 23 excavation as shown in the contract documents will be the quantity for which payment is made.
2. When the location, width, length, or flow line elevation of a culvert has been changed from that specified in the contract documents, the quantities of excavation will be measured by the Engineer as indicated above.

#### **D. Embankments.**

1. Construction of embankments adjacent to bridges, culverts, or structures will not be measured for payment, but will be considered incidental to the type of excavation specified.
2. Materials removed from old fills or embankment for the convenience of the Contractor to facilitate use of rolling or hauling equipment will not be measured for payment.

**E. Granular Backfill.**

1. The quantity of granular backfill material shown in the contract documents will be the quantity for which payment is made.
2. Granular backfill material required and furnished for structural concrete placement at bridge abutments will not be measured separately for payment.

**F. Foundation Treatment Material.**

1. The Engineer will compute the quantity of excavation for foundation treatment material measured for payment in cubic yards (cubic meters).
2. Foundation treatment material not ordered placed by the Engineer or quantities in excess of the quantity ordered placed by the Engineer will not be measured for payment.

**G. Compaction with Moisture Control (Structures).**

Compaction with moisture control (structures) will be the number of cubic yards (cubic meters) of backfill material placement or embankment, or both, placed with moisture control, as required, regardless of the class of excavation.

**H. Flowable Mortar.**

When flowable mortar is specified in the contract documents, it will be measured as specified in [Section 2506](#).

**2402.05 BASIS OF PAYMENT.**

**A. General.**

1. Payment for the quantities of Class 20, Class 21, Class 22, Class 23, and Class 24 excavation, measured as provided above, will be the contract unit prices per cubic yard (cubic meter) except as provided in the following Paragraphs B, C, D, and E.
2. Payments in all cases are full compensation for:
  - Removing, transporting, and cleaning up all excavated material as provided above,
  - Pumping,
  - Placing and removing all cofferdams except as provided in [Article 2402.05, B and C](#),
  - Shoring and bracing,
  - Placing and consolidation of backfill material, including granular backfill material and foundation treatment material, and
  - Leveling and shaping abutment berms to the elevation and dimensions shown in the contract documents.

3. When the contract documents do not provide for payment for removal of old structures or parts of structures, this removal is considered as extra work and payment will be as provided in [Article 1109.03, B](#).
4. Payment for dressing of slopes outside the area of the structure not disturbed by the Contractor's operations will be as provided in [Article 1109.03, B](#).

**B. Extra Depth Excavation for Structures Other than Culverts.**

1. Upon written order of the Engineer, excavate for footings to depths below those shown in the contract documents. When the extra depth of excavation does not exceed 6 feet (1.8 m), payment will be made for extra depth at percentages shown in Table 2402.05-1 of the contract unit price for the excavation to the footing elevation shown in the contract documents.

**Table 2402.05-1: Percentages for Payment for Extra Depth**

Depth	Excavation Above Classification Line	Excavation Below Classification Line
First foot (0 to 0.3 m)	100%	100%
Second foot (0.31 m to 0.60 m)	120%	140%
Third foot (0.61 m to 0.9 m)	130%	160%
Fourth foot (0.91 m to 1.2 m)	140%	180%
Fifth foot (1.21 m to 1.50 m)	150%	200%
Sixth foot (1.51 m to 1.80 m)	160%	220%
Note: If the bridge plans fail to show an excavation line, low water elevation as shown in the contract documents is to be considered as the excavation classification line for the above purpose.		

2. When the extra depth excavation exceeds 6 feet (1.8 m), all excavation below the elevation of the bottom of the footing, as shown in the contract documents, payment will be as extra work as provided in [Article 1109.03, B](#).
3. When the extra depth excavation necessitates removal and reconstruction of a cofferdam which complied with [Article 2405.03, A](#), the cost of removal of the old cofferdam and construction of the new one will be paid for as provided in [Article 1109.03, B](#).

**C. Excavation for Changes in Horizontal Dimensions of Footings.**

On written order of the Engineer, construct footings having horizontal dimensions other than those shown in the contract documents. When such a change necessitates removal and reconstruction of a cofferdam which complies fully with the requirements of [Article 2405.03, A](#), the cost of removal of the old cofferdam and construction of the new ones will be paid for as provided in [Article 1109.03, B](#). Payment for excavation will be made at

the same unit prices as if there had been no change in dimensions of the footings.

**D. Overhaul.**

1. Material from classes of excavation other than Class 24 will ordinarily be deposited within 200 feet (60 m) from the point of excavation as directed by the Engineer. Payment for overhaul beyond the free haul limit of 200 feet (60 m) will be as provided in [Article 1109.03, B](#).
2. Payment for overhaul on Class 24 excavation will be as provided in Section 2108, except the free haul limit will be 500 feet (150 m).

**E. Unexpected Rock Excavation.**

1. When the contract documents provide unit prices for Class 20 and Class 21 excavation, but do not provide a price for Class 22 excavation, payment for any material required to be excavated which conforms to the definitions for Class 22 excavation will be at 3.5 times the contract unit price for the class of excavation in which it is encountered, subject to the provisions for extra depth as provided in [Article 2402.05, B](#).
2. When the contract provides a unit price for Class 23 excavation only, payment will not be made for unexpected rock.

**F. Foundation Treatment Material.**

Payment for foundation treatment material furnished according to [Article 2402.03, C](#), will be at the Contractor's unit delivered cost ton (Mg) plus the applicable contract unit price per cubic yard (Mg) for the class of excavation performed.

**G. Granular Backfill.**

Payment for granular backfill material will be at the contract unit price per cubic yard or ton (cubic meter or megagram). The cost of granular backfill material required and furnished for structural concrete placement at bridge abutments is included in the contract unit price for the structural concrete.

**H. Compaction with Moisture Control (Structures).**

Payment for the quantity of backfill material or embankment, or both, placed with moisture control, will be the contract unit price per cubic yard (cubic meter).

**I. Flowable Mortar.**

When flowable mortar is specified in the contract documents, payment will be according to [Section 2506](#).