

SECTION 02225
EARTHWORK FOR STRUCTURES AND PIPELINES

PART 1 - GENERAL

1.1 DESCRIPTION OF WORK

A. Structure excavation and foundation preparation shall consist of necessary excavating, removal, and satisfactory disposal of all material within the limits hereinafter stipulated and preparing the foundation for the installation or construction of bridges, culverts, underdrains, and other structures not otherwise provided for by TDOT Standard Specifications all in accordance with TDOT Standard Specifications and this Section and in reasonably close conformity with the lines, grades, and typical cross sections shown in the plans or established by the Engineer.

B. This Work shall also include the construction and subsequent removal of all bracing, shoring, cribbing, cofferdams, etc.; all pumping and bailing; all backfilling; and the disposal of excess or unsuitable material.

1.2 RELATED WORK SPECIFIED ELSEWHERE

Section 01050 - Field Engineering
Section 01410 - Testing Laboratory Services
Section 01560 - Project Erosion and Siltation Control
Section 02100 - Clearing and Grubbing
Section 02200 - Earthwork
Section 02210 - Embankments
Section 02350 - Piling
Section 02500 - Paving and Surfacing
Section 02720 - Storm Sewers and Drain Systems
Section 03300 - Cast-In-Place Concrete
Section 04400 - Stone Masonry

1.3 APPLICABLE SPECIFICATIONS

"STANDARD SPECIFICATIONS FOR ROAD AND BRIDGE CONSTRUCTION", Latest Revision, Tennessee Department of Transportation (TDOT)

"SUBDIVISION SPECIFICATIONS FOR STREETS AND ROADS", Latest Revision, Metropolitan Government of Nashville and Davidson County

1.4 APPLICABLE REFERENCES

"American Association of State Highway and Transportation Officials" (AASHTO), Latest Revision

"Underground Utility Damage Prevention Act of the State of Tennessee", Latest Revision

"Stormwater Management Manual" (SMM), Latest Revision, Metropolitan Government of Nashville and Davidson County

"Occupational Safety and Health Act" (OSHA), Latest Revision, State and Federal

Governments

"American Society of Testing and Materials" (ASTM), Latest Revision

1.5 CLASSIFICATION

Structure excavation and foundation preparation will be classified and paid for under the following designations:

A. Culvert Excavation (unclassified).

Structure excavation and foundation preparation performed within the limits stipulated in TDOT Standard Specifications Subsections 204.08 and 204.10 and paragraphs 4.1 and 4.3 for all box bridges, pipe culverts, sewers, conduits, all other culverts, and all minor structures of any type and description will not be measured and paid for directly but the cost will be incidental in other items unless otherwise noted in the plans.

B. Dry Excavation (bridges).

Structure excavation and foundation preparation performed above the datum line (established by elevation and definitely set out in the plans) and within the limits stipulated in TDOT Standard Specifications Subsections 204.08 (a) and 204.10 (a) and subparagraphs 4.1 A and 4.3 A and not classified as rock excavation (bridges) as indicated or directed will be classified and paid for as dry excavation (bridges).

C. Wet Excavation (bridges).

Structure excavation and foundation preparation performed below the datum line (established by elevation and definitely set out in the plans) and within the limits stipulated in TDOT Standard Specifications Subsections 204.08 (a) and 204.10 (a) and subparagraphs 4.1 A and 4.3 A and not classified as rock excavation (bridges) as indicated or directed will be classified and paid for as wet excavation (bridges).

D. Rock Excavation (bridges).

1. Structure excavation and foundation preparation performed either above or below the datum line (established by elevation and definitely set out in the plans) and within the limits stipulated in TDOT Standard Specifications Subsections 204.08 (a) and 204.10 (a) and subparagraphs 4.1 A and 4.3 A and consisting of material which cannot be economically excavated without the use of explosives also any boulder, slab, or fragment of rock having a volume of not less than one half (1/2) cubic yard, all portland cement concrete, and all masonry (dry mortar) as indicated or directed will be classified and paid for as rock excavation (bridges).

2. Cemented gravel, cemented chert, soft shale, or soft slate even though requiring the use of explosives for economical excavation will not be classified as rock.

E. Bridge Excavation (unclassified).

Bridge excavation (unclassified) shall be structure excavation and foundation preparation performed either above or below the datum line (established by elevation and definitely set out in the plans) as stipulated in TDOT Standard Specifications Subsections 204.08 (a) and 204.10 (a) and subparagraphs 4.1 A and 4.3 A regardless of the nature of the material excavated.

F. Rock Drilling (bridges).

Rock drilling as herein set out covers the drilling or sinking of test holes through or in rock in order to verify the condition of the foundation.

G. Bedding Material for Support for Pipe Culverts.

Class A - portland cement concrete Class A.
Class B - specially selected granular soil.

PART 2 - MATERIALS

2.1 FOUNDATION FILL MATERIAL

Material for foundation fill material shall consist of suitably graded sand, gravel, slag, or stone as approved by the Engineer.

2.2 BEDDING MATERIAL

A. Material for Class B bedding for pipe culverts shall consist of sand or a natural sandy soil all of which passes a three-eighths (3/8) inch sieve and not more than ten (10) percent passes a no. 200 sieve, or stone, gravel, chert, or slag meeting the grading requirements for either grading C, D, or E in TDOT Standard Specifications Subsection 903.05.

B. In rock cuts or other areas designated by the Engineer where a free drainage bedding or backfill material is required the material shall be crushed stone, crushed slag, or washed gravel meeting the requirements in TDOT Standard Specifications Subsection 903.17 and Section 02720 - Storm Sewers and Drain Systems.

2.3 CONCRETE

Concrete shall conform to the requirements in TDOT Standard Specifications Section 604 and Section 03300 - Cast-In-Place Concrete. Unless otherwise shown in the plans or in the special provisions Class A concrete shall be used for foundation seals and shall meet the requirements in TDOT Standard Specifications Subsection 604.19 and Section 03300 - Cast-In-Place Concrete. Concrete for culvert pipe cradles shall be Class A.

2.4 BACKFILL MATERIAL

A. Material for backfill shall be fine compactable soil selected from structure excavation if approved by the Engineer as being suitable. Additional material needed shall be obtained from roadway or borrow excavation as described in TDOT Standard Specifications Section 203 and Section 02200 - Earthwork.

- B. Granular backfill material for structures shall be Class A aggregate, grading D meeting the requirements in TDOT Standard Specifications Subsection 903.05

2.5 FLOWABLE FILL

When required by the plans backfill material (flowable fill) will be placed at locations shown in the plans or as directed by the Engineer. Flowable fill shall be of such consistency and strength as to not settle and of such consistency and strength that it can be removed without the use of heavy equipment after final set.

- A. Materials used in the placement of flowable fill shall meet the following requirements:

<u>Material</u>	<u>TDOT Subsection</u>	<u>Public Works Section</u>
portland cement, type I	901.01	03300
fine aggregate*	903.01	03300
fly ash (Class C or Class F)	AASHTO M 295	03300
water	918.01	03300
air entraining admixtures**	918.09	03300

* Any clean fine aggregate with one hundred (100) percent passing a three-eighths (3/8) inch mesh sieve and not more than fifteen (15) percent passing a no. 200 sieve may be used.

**High air generators or forming agents may be used in lieu of conventional air entraining admixtures and may be added at jobsite and mixed in accordance with manufacturers recommendation.

- B. Flowable fill is a mixture of portland cement, fly ash, fine aggregate, air entraining admixture, and water and contains a low cementitious content for reduced strength development. Submit mix designs to the Engineer for approval. The following are suggested mix guides for excavatable and non-excavatable flowable fill:

<u>Material</u>	<u>Excavatable Per Cubic Yard</u>	<u>Non-Excavatable Per Cubic Yard</u>
portland cement, type I	75 lbs. - 100 lbs.	75 lbs. - 150 lbs.
fly ash (Class C or Class F)	none	150 lbs. - 600 lbs.
water	*	*
air**	5% - 35%	5% - 15%
28 day compressive strength**	100 psi max.	125 psi min.
unit weight (wet)**	90 lbs - 110 lbs.	100 lbs. - 125 lbs.

* Mix designs shall produce a consistency that will result in a flowable self leveling product at time of placement.

**The requirements for percent air, compressive strength, and unit weight are for laboratory designs only and are not intended for jobsite acceptance requirements.

Fine aggregate shall be proportioned to yield one cubic yard (1 yd³).

C. The above proportions may be adjusted by the Engineer to obtain the consistency required for satisfactory flow. Consistency shall be determined as follows: place an open ended cylinder (pipe) three (3) inches in diameter by six (6) inches in height in an upright position on a smooth level surface. Fill the cylinder with a representative sample of the flowable fill proposed for use. Remove the cylinder by lifting it straight up thus allowing sample to diffuse on the smooth level surface. The flowable fill should diffuse into a circular shape having an approximate diameter of not less than eight (8) inches.

D. Each consistency test shall represent up to one hundred (100) cubic yards of flowable fill at each installation.

E. Use flowable fill manufactured at plants that qualify as approved sources in accordance with the "Standard Operating Procedure for Ready-Mix Concrete". Revolution counter requirements are waived.

F. Deliver flowable fill using concrete construction equipment. Place flowable fill by chute, pumping, or other methods approved by the Engineer. Tremie flowable fill through water.

G. Use straps, soil anchors, or other approved means of restraint to ensure correct alignment when flowable fill is used as backfill for pipe or where floatation or misalignment may occur.

1. Protect flowable fill from freezing for a period of thirty-six (36) hours after placement.

2. Place flowable fill to the designated fill line without vibration or other means of compaction. Do not place flowable fill during inclement weather, e.g. rain or ambient temperature below forty (40) degrees Fahrenheit.

3. Take all necessary precautions to prevent any damages caused by the hydraulic pressure of the fill during placement prior to hardening. Provide the means to confine the material within the designated space.

H. Acceptance of flowable fill will be based on a minimum temperature of flowable fill at the point of delivery of fifty (50) degrees Fahrenheit.

I. The Contractor shall furnish certification that all flowable fill delivered to the project contains the relative proportions of solid materials specified above.

PART 3 - EQUIPMENT

All equipment necessary for the satisfactory performance of this Work shall be on the project and approved before the Work will be permitted to begin.

PART 4 - EXECUTION

4.1 EXCAVATION

A. Bridges, Box Culverts and Other Major Structures.

Before excavation is started the Engineer or Contractor when required will set stakes locating and outlining the structure and cross section for excavation computations. No excavation shall be started prior to that time.

1. All structure excavation shall be cut to the lines and elevations indicated in the plans or as directed by the Engineer. Working variations outside the neat lines will be permitted however only that excavation outlined under TDOT Standard Specifications Subsection 204.12 and paragraph 5.1 below will be measured for payment.

2. No excavated materials shall be deposited or disposed of outside the construction lines unless directed by the Engineer.

3. When solid rock is encountered in roadway cut sections and channel sections under bridges presplitting operations shall be performed in accordance with the provisions in TDOT Standard Specifications Subsection 203.04. Hole spacing along bridge abutment sites shall not exceed twelve (12) inches.

4. Inclined surfaces of rock used as foundation shall be excavated either level or in steps. When necessary as determined by the Engineer to obtain good bond the surface of rock foundation shall be roughened or suitable anchors installed.

5. Existing concrete foundations, boulders, or ledge streaks of rock projecting into the bottom of the excavation shall be removed to a depth of six (6) inches below foundation elevation and the space backfilled with approved material and thoroughly compacted.

6. Excavation below bridge foundation elevations as given shall be done only upon direction of the Engineer. All materials moved without such authority shall be replaced by the Contractor without compensation by constructing a sub-footing of the same materials as the footing of the structure unit and six (6) inches wider on every side.

B. Pipe Culverts.

In addition to any of the foregoing provisions that are applicable the following procedures will be required:

1. in excavating for pipe culverts the width of the pipe trench shall be sufficient to permit satisfactory jointing of the pipe and thorough tamping of the bedding material under and around the pipe.

2. when rock, hardpan, or other unyielding material is encountered in the pipe trench it shall be removed below the foundation grade for a depth of six (6) inches or as directed by the Engineer.

C. Utilization of Excavated Materials.

All suitable excavated material shall be utilized as backfill or embankment. Excess or unsuitable material shall be disposed of in such a manner as not to obstruct the stream or otherwise impair the efficiency or appearance of the structure. No excavated material shall be deposited at any time in such a manner as to endanger a partly finished structure.

1. The Contractor shall handle and deposit excavated materials in such a manner as to furnish proper protection to materials which will be incorporated in the structure.

2. In streams the disposal of material will be subject to the laws of the U.S. Government and requirements set out in the standard permit form of the applicable government agency approving the location and plans and authorizing the construction of the structure.

4.2 PROTECTION OF EXCAVATION

The Contractor will be held responsible for protecting his excavation and shall take every precaution to maintain the excavation intact.

A. Cofferdams or cribs used in the preparation and protection of the foundation in general shall be carried well below the bottom of the footings, shall be substantially braced in all directions, and shall be of such construction as will permit them to be pumped and maintained free of water until the construction therein has been completed. Unless otherwise specifically indicated in the plans the interior dimensions of the cofferdam will be such as to give sufficient clearance to provide for the construction and inspection of forms and to provide for the handling and pumping of leakage outside of the footing area. Cofferdams or cribs which tilt or move out of position during the process of sinking shall be righted or enlarged in order to provide the necessary clearance.

B. Cofferdams or cribs shall be so constructed as to protect the foundation and the construction therein against damage from a rise in the stream.

C. Timber or bracing of a cofferdam or crib may extend into or through the substructure only with the written permission of the Engineer obtained before the construction of the cofferdam or crib has been started. In addition the cofferdams for structure widening shall not be braced off of the existing structure.

D. The Contractor shall submit drawings showing details of his proposed cofferdam or crib construction. The type and clearance of cofferdams or cribs insofar as they affect the finished structure or part thereof will be subject to the approval of the Engineer but the design and successful construction shall be the responsibility of the Contractor.

E. Cofferdams or cribs with all falsework, sheeting, bracing, etc., shall be removed by the Contractor after the completion of the substructure therein unless otherwise directed. The removal shall be affected in such a manner as not to disturb nor mar the completed work.

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- F. If the foundation excavation has become disturbed or distorted it shall be cleaned out and restored to satisfactory condition at the Contractor's expense.

4.3 FOUNDATION PREPARATION

A. Bridges, Box Culverts, and Other Major Structures.

The preparation of foundations for bridges, box culverts, and other major structures in addition to the stipulations set out in TDOT Standard Specifications Subsections 204.08 and 204.09 and this Section shall be in accordance with the following:

1. When the foundation has been completed to foundation elevation as given the Engineer shall be notified and the construction therein withheld pending his inspection and approval of the foundation.

2. When directed by the Engineer the Contractor shall test each foundation unless piles are indicated in the presence of the Engineer by sinking not less than three (3) holes nor more than six (6) holes to a depth of between six (6) feet to ten (10) feet in order to verify the apparent conditions of the foundations.

3. Should these test holes disclose unsatisfactory foundation conditions the excavation shall be carried lower as directed by the Engineer and new tests made until a satisfactory foundation is secured. The costs incurred in sinking test holes will not be paid for directly but shall be included in the Contract Unit Bid Price for other items of construction unless specified otherwise on the Contract drawings.

4. When rock is encountered in the excavation for the foundation it shall be cleared off and the Engineer notified. Test holes shall then be drilled in the rock as shown in the plans or directed by the Engineer to determine the lines of demarcation, the classification, and the stability of the rock. The excavation shall then be continued to the elevation designated by the Engineer and test holes if required by the Engineer shall again be drilled and excavation continued until a foundation approved by the Engineer is secured.

5. Rock used as foundation shall be stripped and cleaned of all overlying materials. All loose, disintegrated, or light slabby portions of the rock shall be removed.

6. In rock foundations when the rock is shattered below the foundation elevation the shattered material shall be removed and the space so created rebuilt with the same type of construction as the proposed overlying construction. The additional quantities thus made necessary shall not be included in the pay quantities for this item.

7. When the plans indicate that piles shall be driven or if after foundation excavation has been completed it becomes necessary to reinforce the foundation by driving piles therein any bulge of the foundation material caused by the driving of the piles shall be removed at the Contractor's expense to the elevation indicated or directed and the foundation trued to an even surface over its entire area.

8. Unsatisfactory material in the foundation shall be removed and replaced with satisfactory material designated by the Engineer. This material shall be placed in layers not exceeding six (6) inches in loose depth and compacted to ninety-five (95) percent of maximum density up to the foundation elevation.

9. Any pumping that may be permitted from the interior of any foundation enclosure shall be done in such a manner as to preclude the possibility of any portion of concrete material being carried away. Any pumping required during the placing of concrete or for a period of at least twenty-four (24) hours thereafter shall be done from a suitable sump located outside the concrete forms.

10. When conditions are encountered which render it impracticable to dewater the foundation before placing the footing the Engineer may permit the construction of a concrete foundation seal of such dimensions as he may consider necessary and of such thickness as to resist any possible uplift. Before pouring the seal the foundation shall be cleaned of all objectionable material by the use of sand pumps, spud bars, or other means which will accomplish the purpose satisfactorily. The seals shall then be constructed in accordance with the provisions in TDOT Standard Specifications Subsection 604.19 and Section 03300 - Cast-In-Place Concrete. Pumping to dewater a sealed cofferdam shall not commence until the seal has set sufficiently to withstand the hydrostatic pressure. The foundation shall then be dewatered and the seal thoroughly cleaned of all laitance and generally prepared for further construction.

11. Measurement and payment for concrete foundation seal will be as provided for under TDOT Standard Specifications Subsections 604.31 and 604.32 and Section 03300 - Cast-In-Place Concrete except as provided for in TDOT Standard Specifications Subsection 204.13 and part 5 below.

B. Pipe Culverts.

Bedding for pipe culverts shall conform to the requirements given below for Class A, B, or C bedding whichever is shown in the plans or in the special provisions. If the class of bedding is not shown Class C bedding shall be placed.

1. Class A bedding for pipe culverts shall consist of a continuous concrete cradle constructed in conformity with the details shown in the plans and the applicable requirements in TDOT Standard Specifications Section 604 and Section 03300 - Cast-In-Place Concrete.

2. Class B bedding shall be constructed by bedding the culvert pipe in a trench cut in natural ground or compacted embankment to a depth as shown in the plans. The pipe shall be bedded on a six (6) inch thickness of Class B material and sufficient additional Class B material accurately shaped by a template to fit the lower part of the pipe exterior for at least ten (10) percent of its overall height. Class B material shall then be rammed and tamped in layers not over six (6) inches in loose thickness around the pipe to a minimum depth of that shown in the plans. The remaining depth of trench shall then be backfilled and compacted as outlined in TDOT Standard

Specifications Subsection 204.11 (b) and paragraph 4.4 below. When bell and spigot pipe is to be placed recesses shall be dug in the bedding material of sufficient width and depth to accommodate the bell without its resting on the bottom of the recess. The width of the recess shall not exceed the width of the bell by more than two (2) inches.

3. Class C bedding shall be constructed by bedding the culvert pipe in a shallow trench cut in natural ground or compacted embankment to a depth of not less than ten (10) percent of the outside vertical pipe diameter and shall be shaped to fit the lower pipe exterior for the specified embedment. When bell and spigot pipe is to be placed recesses shall be dug in the earth foundation of sufficient width and depth to accommodate the bell without its resting on the bottom of the recess. The width of the recess shall not exceed the width of the bell by more than two (2) inches.

4.4 BACKFILLING

All backfill that becomes a part of the roadway prisms or their foundations shall be placed in layers and compacted to ninety-five (95) percent density in accordance with the provisions in TDOT Standard Specifications Section 205 and Section 02210 - Embankments.

A. Bridges, Box Culverts, and Other Major Structures.

1. All areas which have been excavated the volume of which is not occupied by the structure shall be refilled with acceptable earth material to the normal ground surface unless otherwise directed. This backfill shall be accomplished by building up in layers not more than six (6) inches in loose depth for mechanical tamps and ten (10) inches in loose depth for tamping rollers on both sides of the structure or around the structure unit maintaining the layers at equal elevation and thoroughly compacting each layer by tamping with suitable rapid striking power driven mechanical tampers and sheepsfoot rollers before the succeeding layer is placed.

2. Granular backfill material for structures Class A, grading D will be placed such that the compacted depth shall not exceed six (6) inches per layer and the density requirements shall be in accordance with TDOT Standard Specifications Section 303 and Section 02500 - Paving and Surfacing.

3. When any part of the structure is to function as a retainer for backfill such as abutments, retaining walls, wing walls, arches, side walls of box culverts, or minor structures the boundary slopes shall be stepped in order to prevent any wedge action.

4. Backfill shall not be placed against a structure or a section or unit thereof until the Work described in TDOT Standard Specifications Subsections 604.20 and 604.22 and Section 03300 - Cast-In-Place Concrete has been performed and representative specimens of the concrete in the structure, section, or unit cured by the methods and in the manner the concrete which the test specimens represent is cured attain a compressive strength of three thousand (3000) pounds per square inch. In addition to the above requirements the concrete shall have been placed a minimum of

seven (7) days not counting the days of twenty-four (24) hours each in which the temperature falls below forty (40) degrees Fahrenheit or twenty-one (21) calendar days whichever occurs first. Backfill behind abutments held at the top by a superstructure and behind the sidewalls of culverts shall be carried up simultaneously behind abutments or sidewalls.

B. Pipe Culverts.

After the bedding has been prepared and the pipe installed the trench shall be backfilled with bedding material and/or fine compactable soil selected from excavation or borrow in accordance with the plans. Prior to backfilling concrete pipe the joints shall be cured in accordance with the provisions in TDOT Standard Specifications Subsection 607.07 and Section 02720 - Storm Sewers and Drain Systems. The material shall be placed along each side of the pipe in layers not over six (6) inches in loose depth. Each layer shall be moistened or dried if necessary to near optimum moisture content and thoroughly compacted with mechanical tampers. Special care shall be taken to compact thoroughly the material under the haunches of the pipe and to insure that the backfill material is in intimate contact with the side of the pipe. The backfill shall be brought up evenly on both sides of the pipe and for the full required length. Except as may be required where the imperfect trench method is prescribed the backfill material shall be placed for the full depth of the trench.

1. When the top of the pipe is above the top of the trench embankment material shall be placed and compacted in layers not more than six (6) inches in loose depth for a width on each side of the pipe equal to at least twice the horizontal inside diameter of the pipe or twelve (12) feet whichever is less. The embankment on each side of the pipe for a distance equal to the horizontal inside diameter of the pipe shall be of the same material and compacted in the same manner as required for backfill in the foregoing paragraph. The remainder of the fill material shall be soil which can be readily compacted and shall contain no frozen lumps, chunks or plastic clay, stones that would be retained on a three (3) inch sieve, or other objectionable material. It shall be compacted as required for backfill or by rolling in accordance with the applicable requirements in TDOT Standard Specifications Section 204 and this Section. The embankment shall be placed evenly on both sides of the pipe for the full width of the roadbed up to an elevation a minimum of one (1) foot above the top of the pipe. Above this elevation and also above the top of a backfilled trench that is one (1) foot or more above the top of the pipe embankment shall be placed in accordance with the applicable requirements in TDOT Standard Specifications Section 205 and Section 02210 - Embankments except those requirements where the imperfect trench method is prescribed.

2. When the imperfect trench method is required by the plans the pipe shall be bedded, the trench backfilled, and the embankment placed as prescribed above to a height above the top of the pipe equal to the vertical outside diameter of the pipe plus one (1) foot. A trench equal in width to the outside horizontal diameter of the pipe shall then be excavated in the newly placed backfill or embankment directly over the pipe keeping the trench walls as nearly vertical as possible and down to an elevation one (1) foot above the top of pipe. The lower one-fourth (1/4) of the trench shall be backfilled

with straw or other highly compressible material and the remainder of the trench backfilled with the excavated trench material deposited in the loosest possible manner. After the trench backfill has been completed the remainder of the embankment shall be constructed by normal methods to the finished grade line.

3. When the material specified in TDOT Standard Specifications Subsection 903.17 and Section 02720 - Storm Sewers and Drain Systems is used for Class B bedding the compaction and density requirements will be waived. The height of the lift may be increased up to a maximum of three (3) feet after the material has been thoroughly forced under the haunches of the pipe.

C. Backfill Material (flowable fill).

1. Flowable fill shall be placed at locations shown in the plans or as directed by the Engineer. The flowable fill shall be covered or otherwise protected while in the plastic state. No embankment or base shall be placed on the flowable fill prior to final set or hardening as determined by the Engineer.

2. Prior to placement of the flowable fill pipe and bedding shall be installed in accordance with the TDOT Standard Specifications and this Section and with details shown in the plans. All sections of pipe shall be securely braced or anchored both horizontally and vertically if necessary to prevent movement of the pipe during placement of the flowable fill. Pipe sections shall be joined so as to prevent the influx of flowable fill around the joints. The Contractor shall replace at his expense any pipe or sections of pipe which do not conform to the above requirements.

PART 5 - MEASUREMENT AND PAYMENT

5.1 METHOD OF MEASUREMENT

A. Structure excavation will be measured by the cubic yard in its original position only.

B. Water and its removal will not be measured as it is a necessary part of the Work.

C. Excavation below foundation elevation as indicated or directed made at the direction of the Engineer will be measured and computed for payment provided the cause which made this extra excavation necessary is not attributable to the Contractor.

D. No allowance will be made for excavation necessary in connection with the construction of box bridges, box culverts, retaining walls, or minor structures including pipe culverts and sewers unless otherwise indicated in the plans except that undercutting for these structures made at the direction of the Engineer to remove unsuitable foundation material will be classified and paid under item 203-05 undercutting as provided in TDOT Standard Specifications Section 203 and Section 02200 - Earthwork.

E. When the plans provide for direct payment of excavation necessary in connection with the structures numerated in TDOT Standard Specifications Subsection 204.12 and the preceding subparagraph the excavation including any undercutting made at the direction of the Engineer to remove unsuitable foundation material will be classified and paid as item 204-01 culvert excavation (unclassified) with the following exception: excavation within the limits of box bridges and box culverts with a bottom width between the inner faces of the outside walls greater than fourteen (14) feet that is performed above the flow line of the structure and with a bottom width equal to the distance between the inner faces of the outside walls and then on a one to one (1:1) slope to the normal ground surface will be measured and paid for as item 203-08 channel excavation (unclassified).

F. Material used to replace approved undercutting for box bridges, box culverts, retaining walls, or minor structures including pipe culverts and sewers will be paid under item 204-08 foundation fill material and the measurement will be the same quantity as the approved undercutting it replaces.

G. Materials excavated prior to the necessary measurements having been obtained by the Engineer cannot be measured in their original position and therefore will not be computed for payment.

H. Slides, cave-ins, and excavation extending outside of the workable limits will not be computed for payment.

I. Material in a foundation which has bulged due to the driving of piles and which must be removed will not be measured or computed for payment.

J. No excavation above the normal ground surface will be measured for payment unless otherwise shown in the plans.

K. The normal ground surface as used in TDOT Standard Specifications Section 204 and this Section is defined as the bottom of channel excavations when channel excavation is indicated in the Contract Documents, the template section of the roadway in cuts, or the natural ground surface whichever is at the lower elevation. When it is required that the structure excavation be made in new embankment the normal ground surface shall be the planes of the new embankment at the elevation specified or directed for construction in advance of performing the required structure excavation but in no case shall the normal ground surface be above the planes of the new embankment.

L. Unless otherwise provided by the plans no separate measurements or payment will be made for the construction and removal of cofferdams, cribs, or other protective measures provided to safeguard an excavation such being considered incidental to the Work. However when items for cofferdams or cribs for individual piers or bents are provided by the plans such will be measured in individual lump sum items for the pier or bent designated.

M. When the plans indicate that direct payment will be made for excavation for box bridges, box culverts, retaining walls, or minor structures including pipe culverts and sewers the volume of culvert excavation (unclassified) will be determined by measuring the actual quantity excavated between the normal ground surface and

the foundation elevation as approved provided the limits of the excavation do not extend beyond the vertical planes located eighteen (18) inches horizontally outside the neat lines of the section of the structure at foundation elevation as indicated or directed. For box bridges and box culverts without bottom slabs the foundation elevation is considered to be the bottom of footings and the flow line elevation between footings. No allowance will be made for overlapping areas.

N. Where internal forming is required as for cut off walls, etc., the limits of excavation to be measured for payment will be twelve (12) inches horizontally outside the neat lines of the completed Work and vertically from foundation elevation to the bottom of the completed excavation.

O. No increase or decrease in payment will be allowed for changes in amount of excavation due to the shifting of locations of structures from that shown in the plans or for the additions of structures to those shown in the plans when the plans do not indicate that direct payment will be made for this excavation. Further if this area of excavation namely eighteen (18) inches horizontally outside of the neat line of the structure at foundation elevation overlaps an area in which the excavation is computed on a separate Contract Unit Bid Price the excavation in the overlapping area will not be allowed.

P. The volume of culvert excavation (unclassified) for pipe culverts when direct payment for this excavation is indicated in the plans will be determined by measuring the actual quantity excavated between the normal ground surface and the bottom of the excavation for the pipe as approved provided the limits of the excavation do not extend beyond two (2) vertical planes separated by a horizontal distance equal to the outside diameter of the pipe plus three (3) feet.

Q. Rock required to be removed and the space backfilled in order to prepare a satisfactory bed for pipe culverts will be computed only for a depth of six (6) inches below the bed of the pipe as approved. No allowance shall be made for the material used in backfilling except bedding material when specified.

R. No allowance will be made for shaping necessary to accommodate the bells of the pipe.

S. The volume of dry excavation (bridges), wet excavation (bridges), rock excavation (bridges), and bridge excavation (unclassified) will be determined by measuring the actual quantity excavated between the normal ground surface and the bottom of the excavation as approved provided the limits of the excavation do not extend beyond vertical planes located eighteen (18) inches horizontally outside of the neat lines of the section of the structure at foundation elevation or where a concrete seal is used do not extend beyond the neat lines of the concrete seal as specified or directed.

T. The volume of excavation necessary to form struts, diaphragms, beams, etc., will be determined by measuring the actual volume excavated between the normal ground surface and a plane located twelve (12) inches below the members provided the limits of the excavation do not extend beyond vertical planes located eighteen (18) inches horizontally beyond the limits of the members.

U. In computing extra depth excavation the working limits established herein

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will be adhered to.

- V. Rock drilling performed in accordance with TDOT Standard Specifications Subsection 204.10 (a) and this Section will be measured by the linear foot.
- W. The volume of Class A bedding shall be based on the theoretical quantity in cubic yards per foot of pipe as shown on the standard drawings.
- X. The volume of Class B bedding shall be based on the theoretical quantity in cubic yards per foot of pipe as shown on the standard drawings.
- Y. Backfill material (flowable fill) shall be measured by the cubic yard complete in place. Measurement shall be made along the centerline of the pipe for the width of trench shown in the plans. Depth for payment shall be based on field measurements of the actual trench depth prior to placement. The volume of any portion of the pipe enclosed by the flowable fill shall be deducted.

5.2 BASIS OF PAYMENT

- A. Structure excavation and foundation preparation of the various classes will be paid for only on the volume computed as set out in TDOT Standard Specifications Subsection 204.12 and paragraph 5.1 above except that foundation fill material will be paid for by the cubic yard as measured in the hauling vehicles.
- B. Embankment construction, sloping, shaping, dressing, disposal of excess or unsuitable material, final cleanup, etc., will not be paid for directly but the cost of performing the requirements therewith shall be absorbed in the pay items hereinafter provided.
- C. Unless otherwise indicated in the plans no direct payment will be made for foundation preparation and backfill and the costs involved shall be included in the Contract Unit Bid Price for other items of construction.
- D. Material moved prior to securing the necessary measurement; material specified to be moved under TDOT Standard Specifications Section 203 and Section 02200 - Earthwork; slides or cave-ins occurring outside of the working limits stipulated TDOT Standard Specifications Subsections 204.08 and 204.10 and paragraphs 4.1 and 4.3 above; material excavated outside of said working limits; material excavated even though within the said working limits below foundation elevation as indicated or directed and made necessary on account of the construction methods of the Contractor or failure on his part to provide sufficient or proper protection; presplitting of rock; material excavated below foundation when shooting; bulged material caused by driving piles in a foundation; water and its removal; and in general material moved which it would have been unnecessary to move in order to complete the structure in accordance with the plans, TDOT Standard Specifications and this Section, or the directions of the Engineer will not be paid for.
- E. Culvert Excavation (unclassified).

When direct payment is provided by the plans this item will be paid for at the Contract Unit Bid Price per cubic yard for culvert excavation (unclassified) which price shall be full compensation for all structure excavation and foundation preparation classified as culvert excavation (unclassified) performed within the limits

stipulated in TDOT Standard Specifications Subsections 204.08 and 204.10 and paragraphs 4.1 and 4.3 above and which has been performed in accordance with the conditions, stipulations, provisions, and requirements contained therein.

F. Dry Excavation (bridges).

This item will be paid for at the Contract Unit Bid Price per cubic yard for dry excavation (bridges) which price shall be full compensation for all structure excavation and foundation preparation classified as dry excavation (bridges) which has been performed in accordance with the conditions, stipulations, provisions, and requirements contained herein.

G. Wet Excavation (bridges).

This item will be paid for at the Contract Unit Bid Price per cubic yard for wet excavation (bridges) which price shall be full compensation for all structure excavation and foundation preparation classified as wet excavation (bridges) which has been performed in accordance with the conditions, stipulations, provisions, and requirements contained herein.

H. Rock Excavation (bridges).

This item will be paid for at the Contract Unit Bid Price per cubic yard for rock excavation (bridges) which price shall be full compensation for all structure excavation and foundation preparation classified as rock excavation (bridges) and which has been performed in accordance with the conditions, stipulations, provisions, and requirements contained herein.

I. Bridge Excavation (unclassified).

This item will be paid for at the Contract Unit Bid Price per cubic yard for bridge excavation (unclassified) which price shall be full compensation for all structure excavation and foundation preparation which has been performed in accordance with the conditions, stipulations, provisions, and requirements contained herein.

J. Extra Depth Structure Excavation and Foundation Preparation.

Extra depth structure excavation and foundation preparation classified as culvert excavation (unclassified) made necessary by the Engineer establishing the foundation below the elevation indicated in the plans will be paid for at the Contract Unit Bid Price per cubic yard for culvert excavation (unclassified) and this price shall be accepted by the Contractor as full compensation for performing this extra depth structure excavation and foundation preparation in accordance with the conditions, stipulations, provisions, and requirements set out in TDOT Standard Specifications and this Section for structure excavation and foundation preparation of this class.

1. Extra depth structure excavation and foundation preparation for bridges made necessary by the Engineer requiring excavation below the foundation elevation indicated in the plans will be paid for on a basis of the Contract Unit Bid Price per cubic yard for dry excavation (bridges), wet excavation (bridges), or rock excavation (bridges) as classified for the actual

quantity in cubic yards excavated from the designated zone this zone being between the elevation shown in the plans and the final approved elevation as directed by the Engineer plus the additional percentages for each zone corresponding to the depths lowered below plan elevation as set out in the following schedule:

Depth Lowered Below Plan Elevation					
Additional Percent	Sub-Item	Zone	More	Not	
	<u>Designation</u>	<u>No.</u>	<u>Than</u>	<u>Over</u>	
	None	0	0 feet	4 feet	0.0
	a	1	4 feet	8 feet	50.0
	b	2	8 feet		80.0

2. In the above table the depths to be used for computing the volumes of material for payment under any sub-item will be the depths applicable to each zone between the foundation elevation as indicated in the plans and the final foundation elevation as approved by the Engineer for example: if the foundation has been lowered seven and one-half (7 1/2) feet below the foundation elevation as indicated in the plans the volume for the sub-item shall be computed for a depth of three and one-half (3 1/2) feet and multiplied by the Contract Unit Bid Price for the class of material excavated plus fifty (50) percent. The volume of material down to a level four (4) feet below the foundation elevation as indicated in the plans shall be paid for at the Contract Unit Bid Price for the class of material excavated.

3. The Contract Unit Bid Price for the class of material excavated plus the additional percentage shown in TDOT Standard Specifications Subsection 204.13 and above provided shall be accepted by the Contractor as full compensation for performing extra depth structure excavation and foundation preparation classified as dry excavation (bridges), wet excavation (bridges), or rock excavation (bridges) in accordance with the conditions, stipulations, provisions, and requirements set out in TDOT Standard Specifications and this Section for structure excavation and foundation preparation of the respective classes.

K. Rock Drilling (bridges).

This item will be paid for at the Contract Unit Bid Price per linear foot for rock drilling (bridges).

L. Concrete for Class A Bedding.

Concrete for Class A bedding will be paid for at the Contract Unit Bid Price per cubic yard for bedding material (pipe) Class A complete in place.

M. Material for Class B Bedding.

Material for Class B bedding will be paid for at the Contract Unit Bid Price

per cubic yard for bedding material (pipe) Class B complete in place.

N. Cofferdams or Cribbs.

When items for cofferdams or cribs have been provided for and installed for a designated pier or bent the lump sum item shall be full compensation for the furnishing and installation of all material, maintenance, removal, satisfactory clean up of the area, and for all tools, equipment, labor, and incidentals necessary to complete the Work. Concrete seals shall also be included except when otherwise noted in the plans.

O. Foundation Preparation.

When the plans indicate that direct payment will be made for foundation preparation the lump sum item shall be full compensation for the preparation of foundations for all substructures. The cost of cofferdams, shoring, pumping, or seal concrete unless otherwise noted shall be incidental to the lump sum bid for foundation preparation. Excavation required for the foundation preparation shall be paid as defined by TDOT Standard Specifications and this Section except that no percent increase will be allowed for extra depth excavation.

P. Backfill Material (flowable fill).

Accepted quantities of backfill material (flowable fill) shall be paid for at the Contract Unit Bid Price per cubic yard which shall be full compensation for all materials, mixing, transporting, placing, and finishing of the flowable fill as well as all labor, tools, equipment, and other incidentals necessary for the satisfactory completion of the Work. No measurement and payment will be made for material placed outside the neat line limits or outside the adjusted limits or for unused or wasted material.

END OF SECTION - 02225