

**(B) Requirements for Materials Which Remain the Property of the Department**

Pile materials salvaged from the structure neatly on the right of way at locations as directed.

Do not use any materials, either temporarily or permanently, which are removed from the structure unless so permitted by the contract.

Remove structural materials carefully without damage.

Do not use explosives to remove concrete floor slabs from steel superstructures that remain the property of the Department.

**(C) Requirements for Partial Removal**

Perform partial removal true to the lines indicated in the plans. Submit, and await approval for, a plan for partial removal of bridges before beginning removal. Do not remove concrete by blasting or other method that may cause damage to the concrete or reinforcement that is used in the completed structure.

Use equipment and methods to remove portions of a concrete structure undergoing widening which are sufficient to obtain plan lines and slopes without undue spalling at edges of the concrete. Do not use an iron ball or pile hammer to remove portions of a concrete structure undergoing widening.

**402-3 MEASUREMENT AND PAYMENT**

The price and payment below will be full compensation for all items required to remove existing structures including, but not limited to, those items contained in Article 402-1.

When the contract includes the item of *Removal of Existing Structure at Station \_\_\_\_*, the work of removing the structure will be paid at the contract lump sum price for this item.

When the contract includes the item of *Removal of Existing Structures at Station \_\_\_\_*, the work of removing the structures will be paid at the contract lump sum price for this item.

Payment will be made under:

<b>Pay Item</b>	<b>Pay Unit</b>
Removal of Existing Structure at Station ____	Lump Sum
Removal of Existing Structures at Station ____	Lump Sum

**SECTION 410  
FOUNDATION EXCAVATION**

**410-1 DESCRIPTION**

Excavate any material as necessary for the construction of foundations and end bent caps for bridges, retaining walls of reinforced concrete or reinforced masonry, arch culverts and box culverts without floor slabs in accordance with the contract or as directed. Excavate, perform exploratory drilling at footings to a depth not to exceed 5 ft, blast, drain, divert water, bail and pump. Provide and remove bracing, shoring, sheeting, cribbing and cofferdams; substructure scour protection, subsurface drainage and drawings; and backfill including hauling and disposal of materials.

Do not deposit excavated materials or construct earth dikes or other temporary earth structures in rivers, streams or impoundment or so near to such waters that they are carried into any river, stream or impoundment by stream flow or surface runoff. As an exception to the above, obtain written approval for the use of confined earth materials in cofferdams for structure foundations.

## Section 410

### 1 410-2 MATERIALS

2 Refer to Division 10.

Item	Section
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Stone, No. 78M	1005
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Subdrain Fine Aggregate	1044-1
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### 3 410-3 FOUNDATION EXCAVATION

4 Notify the Engineer a sufficient time before beginning the excavation to allow measurements  
5 of the undisturbed ground.

6 Where necessary for safety, slope, shore, brace or protect by cofferdams the foundation  
7 openings in accordance with State and local safety standards. Perform foundation excavation  
8 and related work in such sequence that no portion of the structure is endangered by  
9 subsequent operations. Adequately protect completed portions of a structure during blasting  
10 operations.

11 Consider the dimensions and elevations of footings, as shown in the plans as approximate  
12 only. The Engineer may order, in writing, such changes in dimensions or elevations of  
13 footings as necessary to secure a satisfactory foundation.

14 Notify the Engineer after excavating each foundation. Do not place concrete before obtaining  
15 approval for the excavation depth, the character of the foundation and permission to proceed.  
16 Perform drilling as may be required by the Engineer to obtain information as to the depth to  
17 which the rock or other hard foundation material extends below the bottom of the footing.

18 Clean all rock or other hard foundation material of all loose material and cut to a firm surface,  
19 either level, stepped or serrated, as directed. Clean out all seams and fill with concrete,  
20 mortar or grout. Remove all loose and disintegrated rock and thin strata. Leave the rock  
21 surface in a rough condition to form an adequate key against lateral movement of the footing.

22 When the footing rests on an excavated surface other than rock, take special care not to  
23 disturb the bottom of the excavation until immediately before placing reinforcing steel and  
24 concrete. Remove foundation material softened and weakened by exposure and inundation  
25 down to sound, solid material before placing steel and concrete.

26 When using piles or drilled piers, complete the excavation of each pit before installing piles or  
27 piers.

28 When water or other unsuitable material is encountered, pile driving liquefies the soil, or the  
29 bed is otherwise unsuitable as determined by the Engineer, remove the material as required  
30 and backfill to the required elevation with an approved granular material. Such work will be  
31 paid as extra work in accordance with Article 104-7.

### 32 410-4 COFFERDAMS

#### 33 (A) General

34 The term cofferdam designates any temporary or removable structure constructed to hold  
35 the surrounding earth, water or both, out of the excavation. It includes timber cribs, any  
36 type of sheet piling, removable steel shells or similar structures, all necessary bracing and  
37 the use of pumping wells or well points for the same purpose. Ensure cofferdams located  
38 in bodies of water are designed, detailed and sealed by an engineer licensed by the State  
39 of North Carolina when the distance from the water surface to the bottom of the  
40 excavation is 5 ft or greater.

**(B) Construction**

Design and construct cofferdams to adequate depths and heights, safely and as watertight as is necessary for the proper performance of the work. Provide interior dimensions of cofferdams as to give sufficient clearance for the construction and inspection of forms and to permit pumping outside the forms. Provide at least 5 ft of clearance between the proposed edge of footing and inside face of cofferdam when a keyed footing is required and at least 3 ft when a keyed footing is not required. Right, rest or enlarge cofferdams that are tilted or moved laterally during the process of sinking to provide the necessary clearance.

Construct cofferdams to protect plastic concrete against damage from a sudden rising of the stream and to prevent damage to the foundation by erosion. Do not leave timber or bracing in cofferdams that could extend into the substructure concrete without permission.

**(C) Removal**

After the completion of the substructure, unless otherwise provided in the contract, remove cofferdams with all sheeting and bracing to the stream bed or one foot below existing ground. Take care not to disturb or injure the finished concrete.

**410-5 PUMPING**

Perform pumping operations in accordance with Article 414-5.

**410-6 PRESERVATION OF CHANNEL**

Unless otherwise required by the contract or permitted by the Engineer, do not excavate in stream channels outside of cofferdams. Do not disturb the natural stream bed adjacent to the structure without permission. Backfill any excavation or dredging made at the site of the structure outside of the cofferdam limits to the original ground surface or river bed with approved material.

Remove materials placed within the stream area and leave the stream in its original condition, unless otherwise permitted.

**410-7 UTILIZATION OF EXCAVATED MATERIAL**

Use suitable excavated material as backfill. Use suitable material that is not required for backfill to form embankments, subgrades or shoulders. Furnish disposal areas for excavated unsuitable materials and suitable materials not required in connection with other work included in the contract. Do not place excavated material in a stream or other body of water or wetland.

Do not deposit excavated material at any time so as to endanger the partly finished structure, either by direct pressure, indirectly by overloading banks adjacent to the operations or in any other manner.

**410-8 BACKFILLING AND FILLING**

Use approved material for backfill that is free from large or frozen lumps, wood or other undesirable material. Where there is not an adequate quantity of suitable backfill material available from the excavation, provide suitable backfill material compensated in accordance with Article 410-10.

Refill all excavated spaces, not filled with permanent work, with earth up to the ground surface existing before the excavation. Place backfill to provide adequate drainage as soon as concrete surfaces are finished in accordance with Subarticle 420-17(B) and the concrete has been inspected and approved. The Engineer has the authority to suspend all operations until such backfilling is acceptably completed.

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1 Eliminate any slope adjacent to the excavation for abutments, wingwalls and retaining walls  
2 by stepping or serrating to prevent wedge action.

3 Place and compact all portions of the backfill that become a part of roadway typical sections  
4 or their foundations in accordance with Subarticles 235-3(B) and 235-3(C). Place all other  
5 portions of the backfill in layers not more than 10" in depth of loose measure and compact to  
6 a density comparable to the adjacent undisturbed material.

7 Place backfill or embankment material simultaneously to approximately the same elevation on  
8 both sides of an abutment, pier or wall. If conditions require placing backfill or embankment  
9 higher on one side, do not place the additional material on the higher side until the concrete  
10 develops the minimum specified strength for the class of concrete required for the structure as  
11 specified in Table 1000-1.

12 Do not place backfill or embankment behind the walls of concrete culverts, abutments of  
13 bridges other than rigid frames or abutments of rigid frame structures until the top slab is  
14 placed and has developed the minimum compressive strength required by Article 420-20.  
15 Place backfill and embankment simultaneously behind opposite abutments of rigid frames or  
16 sidewalls of culverts.

17 Place backfill to not cause excess lateral forces against the structure by heavy equipment or  
18 from earth masses transmitting pressures caused by earth moving equipment. Place backfill  
19 immediately adjacent to the structure by hand operated mechanical tampers. Do not operate  
20 heavy earth moving equipment within 10 ft of the structure in backfilling operations.

### 21 **410-9 BLASTING ADJACENT TO HIGHWAY STRUCTURES**

22 Conduct blasting operations adjacent to highway structures in accordance with the following  
23 requirements.

24 Submit and await approval of a blasting plan before conducting any blasting operation.

25 Do not conduct blasting operations within 60 ft of any structure until the concrete strength  
26 reaches 2,400 psi. After the concrete achieves a strength of 2,400 psi, limit the maximum  
27 peak particle velocity to 4 in/sec measured at the closest structure extremity.

28 For multi-column bents with column heights up to 40 ft and a combined span length for the  
29 2 adjacent spans of 160 ft or less, adhere to the following criteria:

30 (A) Do not blast within 6 ft without obtaining prior written approval.

31 (B) At distance of 6 ft to 10 ft, do not use a quantity of explosives more than 0.5 lb per delay  
32 period.

33 (C) From 11 ft to 60 ft, use a maximum charge weight per delay of 0.5 lb and 0.5 lb of  
34 explosives per foot of distance over 10 ft.

35 No vibration measurements are required if the above criteria are met. If unable to meet the  
36 above criteria, monitor the structure with an engineering seismograph to determine whether  
37 the 4 in/sec limit is exceeded. If the 4 in/sec limit is exceeded, the Engineer will evaluate  
38 each subsequent blast, and if deemed necessary, will apply more restrictive controls than  
39 those above to prevent damage.

### 40 **410-10 MEASUREMENT AND PAYMENT**

41 Payment of blasting operations is included in the bid price for *Foundation Excavation* at the  
42 affected substructure unit.

**(A) Foundation Excavation on a Cubic Yard Basis**

When the contract calls for payment of *Foundation Excavation* on a cubic yard basis, it will be measured and paid as the actual number of cubic yards of materials, measured in their original position within the limits described below and computed by the average end area method, that are acceptably excavated.

The upper limits for measurement are the actual ground surface at the time of starting work, except where the excavation is performed in cut areas excavated under Section 225, the upper limits are the roadway plan typical section. For keyed footings the upper limits of the keyed section are as shown in the plans. Define a “keyed footing” as a footing placed without forms for the keyed depth in an excavation whose sides, as near as practical, are located at the neat line dimensions of the footing and are vertical.

When the foundation material is other than rock, the lower limits for measurement are the elevation of the bottom of footing as established by the plans or as directed. When the foundation material is rock, the lower limits for measurement are the actual rock elevations after the foundation is approved.

As an exception to the lower limits established above, when in the opinion of the Engineer excess excavation is performed due to carelessness or negligence on the part of the Contractor, the Engineer notifies the Contractor of that portion of the excavation which is not measured for payment.

Horizontal limits for measurement are established by vertical planes located 18" outside of the neat line dimensions of the footing as established by the plans or directed in writing by the Engineer. For keyed footings the horizontal limits for measurement of the keyed section are established by vertical planes located at the neat line dimensions of the footing as established by the plans or directed in writing.

Measurement includes mud, muck or similar semi-solid material within the limits described above provided such material is present at the time excavation begins and cannot be drained away or pumped without the use of a jet or nozzle.

(1) No measurement is made of the following excavation, as such excavation is incidental to the work being performed:

- (a) Excavation necessary to construct end bent caps and the berm adjacent to the cap.
- (b) Excavation necessary to construct pile encasement.
- (c) Excavation outside of the limits described in this subarticle.
- (d) Excavation necessary from heaving of a foundation due to the driving of piles.
- (e) Excavation necessary from overbreaks or slides.
- (f) Mud, muck or similar semi-solid material which can be drained away or pumped without the use of a jet or nozzle.
- (g) Excavation made before the Engineer makes measurements of the undisturbed ground.
- (h) Excavation necessary due to exposure or inundation allowed by the Contractor or negligence on the part of the Contractor.

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1 (2) *Foundation Excavation* will be paid at the contract unit price per cubic yard for  
2 *Foundation Excavation* except where the Engineer directs the Contractor in writing  
3 to excavate below the original plan elevation of the bottom of the footing. Payment  
4 for such excavation will be made as follows:

5 (a) For excavation made below the original plan elevation of the bottom of the  
6 footing to an elevation 3 ft below such plan elevation, payment will be made at  
7 the contract unit price per cubic yard for *Foundation Excavation*.

8 (b) For excavation made below an elevation 3 ft below the original plan elevation of  
9 the bottom of the footing but not more than 6 ft below such plan elevation,  
10 payment will be made at 150% of the contract unit price per cubic yard for  
11 *Foundation Excavation*.

12 (c) For excavation made below an elevation 6 ft below the original plan elevation of  
13 the bottom of the footing, payment will be made as extra work in accordance  
14 with Article 104-7.

15 (d) In areas where piles have been driven, removal of material and backfilling with  
16 approved granular material in accordance with Article 410-3 will be paid as  
17 extra work in accordance with Article 104-7.

### 18 (B) Foundation Excavation on a Lump Sum Basis

19 When the contract calls for payment of *Foundation Excavation* on a lump sum basis, no  
20 measurement will be made of any foundation excavation made at such locations.

21 The prices and payments below will be full compensation for all items required to  
22 complete foundation excavation.

23 (1) When the contract calls for payment on a lump sum basis, payment will be made at  
24 the contract lump sum price for *Foundation Excavation for Bent No. \_\_\_\_ at*  
25 *Station \_\_\_\_ or Foundation Excavation for End Bent No. \_\_\_\_ at Station \_\_\_\_*  
26 except as otherwise provided below.

27 (2) Where the Engineer directs the Contractor to excavate below the original plan  
28 elevation of the bottom of the footing by a distance which is less than 3 ft the  
29 character of the work will not be considered to be materially changed and no  
30 additional compensation will be allowed for the foundation excavation at such  
31 location.

32 (3) Where the Engineer directs the Contractor in writing to excavate more than 3 ft  
33 below the original plan elevation of the bottom of the footing, payment for such  
34 excavation will be made as extra work in accordance with Article 104-7.

### 35 (C) Furnishing and Hauling Backfill Material

36 Where it is necessary to provide backfill material from sources other than excavated areas  
37 or borrow sources used in connection with other work in the contract, payment for  
38 furnishing and hauling such backfill material will be paid as extra work in accordance  
39 with Article 104-7. Placing and compacting such backfill material is not extra work but  
40 is incidental to the work being performed.

41 When the Contractor has been directed by the Engineer to drill in the vicinity of a footing  
42 to obtain subsurface information, such drilling in excess of a 5 ft depth will be paid as  
43 extra work in accordance with Article 104-7.

44 When so used, no additional payment will be made for use of the material under other  
45 pay items or for stockpiling the material for use under other pay items.

1 Payment will be made under:

<b>Pay Item</b>	<b>Pay Unit</b>
Foundation Excavation	Cubic Yard
Foundation Excavation for Bent No. ____ at Station ____	Lump Sum
Foundation Excavation for End Bent No. ____ at Station ____	Lump Sum

2

## SECTION 411 DRILLED PIERS

3

### 4 411-1 DESCRIPTION

5 Construct drilled piers consisting of cast-in-place reinforced concrete cylindrical sections in  
6 excavated holes typically stabilized with casings or slurry. Provide permanent casings,  
7 standard penetration tests, integrity testing and assistance with the shaft inspection device as  
8 noted in the plans. Construct drilled piers with the required resistances and dimensions in  
9 accordance with the contract and accepted submittals. Use a prequalified Drilled Pier  
10 Contractor to construct drilled piers.

11 Define "excavation" and "hole" as a drilled pier excavation and "pier" as a drilled pier.  
12 Define "rock" as a continuous intact natural material in which the penetration rate with a rock  
13 auger is less than 2" per 5 minutes of drilling at full crowd force. This definition excludes  
14 discontinuous loose natural materials such as boulders and man-made materials such as  
15 concrete, steel, timber, etc. and is not for measurement and payment purposes. See  
16 Article 411-7 for measurement and payment of drilled piers.

### 17 411-2 MATERIALS

18 Refer to Division 10.

<b>Item</b>	<b>Section</b>
Grout, Nonshrink	1003
Portland Cement Concrete, Class Drilled Pier	1000
Reinforcing Steel	1070

19 Provide Type 3 material certifications in accordance with Article 106-3 for permanent casings  
20 and roller, chair, steel pipe and cap materials. Store steel materials on blocking at least 12"  
21 above the ground and protect it at all times from damage; and when placing in the work make  
22 sure it is free from dirt, dust, loose mill scale, loose rust, paint, oil or other foreign materials.  
23 Load, transport, unload and store drilled pier materials so materials are kept clean and free of  
24 damage.

#### 25 (A) Steel Casing

26 Define "casing" as a temporary or permanent casing. Use smooth non-corrugated clean  
27 watertight steel casings of ample strength to withstand handling and installation stresses  
28 and pressures imposed by concrete, earth, backfill and fluids.

#### 29 (1) Temporary Casings

30 Provide temporary casings with nominal wall thicknesses of at least 0.375" and  
31 outside diameters equal to or larger than the design pier diameters for which casings  
32 are used.

#### 33 (2) Permanent Casings

34 Use permanent casings with yield strengths of at least 36 ksi and nominal wall  
35 thicknesses that meet Table 411-1.