

1 Remove structural materials carefully without damage.

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

4 **(C) Requirements for Partial Removal**

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

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

13 **402-3 MEASUREMENT AND PAYMENT**

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

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

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

20 Payment will be made under:

Pay Item	Pay Unit
Removal of Existing Structure at Station _____	Lump Sum
Removal of Existing Structures at Station _____	Lump Sum

21

SECTION 410

22

FOUNDATION EXCAVATION

23 **410-1 DESCRIPTION**

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

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

35 **410-2 MATERIALS**

36 Refer to Division 10.

Item	Section
Subsurface Drainage Materials	1044

37 **410-3 FOUNDATION EXCAVATION**

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

Section 410

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

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

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

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

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

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

22 When water or other unsuitable material is encountered, pile driving liquefies the soil, or the
23 bed is otherwise unsuitable as determined by the Engineer, remove the material as required and
24 backfill to the required elevation with subdrain fine or coarse aggregate. Such work will be
25 paid as extra work in accordance with Article 104-7.

26 **410-4 COFFERDAMS**

27 **(A) General**

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

35 **(B) Construction**

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

44 Construct cofferdams to protect plastic concrete against damage from a sudden rising of
45 the stream and to prevent damage to the foundation by erosion. Do not leave timber or
46 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 damage 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.

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

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

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

Do not place backfill or embankment behind abutments of rigid frame structures such as arch culverts and box culverts without floor slabs, until the top slab is placed and has developed the minimum compressive strength of the class of concrete required for the structure. Place backfill and embankment simultaneously behind opposite abutments of rigid frames.

Section 410

1 Place backfill to not cause excess lateral forces against the structure by heavy equipment or
2 from earth masses transmitting pressures caused by earth moving equipment. Place backfill
3 immediately adjacent to the structure by hand operated mechanical tampers. Do not operate
4 heavy earth moving equipment within 10 feet of the structure in backfilling operations.

5 **410-9 BLASTING ADJACENT TO HIGHWAY STRUCTURES**

6 Conduct blasting operations adjacent to highway structures in accordance with the following
7 requirements.

8 Submit a blasting plan for approval before conducting any blasting operation.

9 Do not conduct blasting operations within 60 feet of any structure until the concrete strength
10 reaches 2,400 psi. After the concrete achieves a strength of 2,400 psi, limit the maximum PPV
11 to 4 in/sec measured at the closest structure extremity.

12 For multi-column bents with column heights up to 40 feet and a combined span length for the
13 2 adjacent spans of 160 feet or less, adhere to the following criteria:

14 **(A)** Do not blast within 6 feet without obtaining prior written approval.

15 **(B)** At distance of 6 feet to 10 feet, do not use a quantity of explosives more than 0.5 lbs. per
16 delay period.

17 **(C)** From 11 feet to 60 feet, use a maximum charge weight per delay of 0.5 lb. and 0.5 lb. of
18 explosives per foot of distance over 10 feet.

19 No vibration measurements are required if the above criteria are met. If unable to meet the
20 above criteria, monitor the structure for vibrations. If the 4 in/sec limit is exceeded, the
21 Engineer will evaluate each subsequent blast, and if deemed necessary, will apply more
22 restrictive controls than those above to prevent damage.

23 **410-10 MEASUREMENT AND PAYMENT**

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

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

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

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

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

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

45 Horizontal limits for measurement are established by vertical planes located 18 inches
46 outside of the neat line dimensions of the footing as established by the plans or directed in

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

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

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

9 (a) Excavation necessary to construct end bent caps and the berm adjacent to the cap.

10 (b) Excavation necessary to construct pile encasement.

11 (c) Excavation outside of the limits described in this subarticle.

12 (d) Excavation necessary from heaving of a foundation due to the driving of piles.

13 (e) Excavation necessary from overbreaks or slides.

14 (f) Mud, muck or similar semi-solid material which can be drained away or pumped
 15 without the use of a jet or nozzle.

16 (g) Excavation made before the Engineer makes measurements of the undisturbed
 17 ground.

18 (h) Excavation necessary due to exposure or inundation allowed by the Contractor or
 19 negligence on the part of the Contractor.

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

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

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

31 (c) For excavation made below an elevation 6 feet below the original plan elevation
 32 of the bottom of the footing, payment will be made as extra work in accordance
 33 with Article 104-7.

34 (d) In areas where piles have been driven, removal of material and backfilling with
 35 subdrain fine or coarse aggregate in accordance with Article 410-3 will be paid as
 36 extra work in accordance with Article 104-7.

37 (B) Foundation Excavation on a Lump Sum Basis

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

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

42 (1) When the contract calls for payment on a lump sum basis, payment will be made at
 43 the contract lump sum price for *Foundation Excavation for Bent No. ____ at*
 44 *Station ____ or Foundation Excavation for End Bent No. ____ at Station ____* except
 45 as otherwise provided below.

Section 411

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

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

8 **(C) Furnishing and Hauling Backfill Material**

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

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

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

19 Payment will be made under:

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

20 **SECTION 411**
21 **DRILLED PIERS**

22 **411-1 DESCRIPTION**

23 Construct drilled piers consisting of CIP reinforced concrete cylindrical sections in excavated
24 holes typically stabilized with casings or slurry. Provide permanent casings, standard
25 penetration tests, integrity testing and assistance with the shaft inspection device as noted in the
26 plans. Construct drilled piers with the required resistances and dimensions in accordance with
27 the contract and accepted submittals. Use a prequalified Drilled Pier Contractor to construct
28 drilled piers.

29 Define “excavation” and “hole” as a drilled pier excavation and “pier” as a drilled pier. Define
30 “permanent casing” as a casing that remains in the excavation and acts as a form for Drilled
31 Pier concrete and “temporary casing” as any casing that is not permanent. Define “rock” as a
32 continuous intact natural material with a standard penetration resistance of 0.1 foot or less per
33 60 blows or a rock auger penetration rate of less than 2 inches per 5 minutes of drilling at full
34 crowd force or as determined by the Engineer when rock is not encountered as expected based
35 on these criteria. This definition excludes discontinuous loose natural materials such as
36 boulders and man-made materials such as concrete, steel, timber, etc. and is not for
37 measurement and payment purposes. See Article 411-7 for measurement and payment of
38 drilled piers.