

SECTION 02291

RIPRAP DITCHES

02291.01 GENERAL

A. Description

Riprap ditches shall include, but not necessarily be limited to, the construction of riprap ditches to the lines and grades shown on the Plans in accordance with the Contract Documents or as directed by the County Engineer.

B. Related Work Included Elsewhere

Excavation; Sections 02210, 02220, and 02230.

C. Quality Assurance

1. The County Engineer will inspect all materials and work to ensure compliance with the Contract Documents.
2. For the purpose of visually inspecting stone for riprap, the terms "flat" and "elongated" shall be defined as follows:
 - a. A flat piece of stone is one for which the ratio of the width to thickness is greater than four to one.
 - b. An elongated piece of stone is one for which the ratio of the length to width is greater than four to one.

D. Submittals

Certificates of compliance and shop drawings shall be submitted in accordance with the "General Provisions" for all riprap material furnished. The certificate shall state that the stated materials meets the requirements specified herein and list the stone source. Shop drawing submittal shall include product information, handling, installation recommendations and a tabulation of the physical properties for the filter fabric.

02291.02 MATERIALS

A. Materials Furnished by the County

The County will not furnish any materials for riprap ditches.

B. Contractor's Options

Not Applicable

C. Detailed Material Requirements

1. General Requirements for Stone

The stone shall be hard, durable, angular in shape, resistant to weathering and to water action; free from overburden, spoil, shale, slate, organic material, and flat and elongated pieces; and shall meet the specified weight requirements.

2. Stone for riprap shall meet the following requirements as specified:

a. Grading by Class:

Class I Riprap: contain individual pieces weighing between 2 pounds and 150 pounds. The total weight of riprap shall contain not more than 10% of pieces smaller than 2 pounds.

Class II Riprap: contain individual pieces weighing between 20 pounds and 700 pounds. The total weight of riprap shall contain not more than 10% of pieces smaller than 20 pounds.

Class III Riprap: contain individual pieces weighing between 40 pounds and 2,000 pounds. The total weight of riprap shall contain not more than 10% of pieces smaller than 40 pounds.

b. Grading by d_{50} Size

Riprap shall be composed of a well graded mixture of stone size so that 50% of the pieces, by weight, shall be larger than the d_{50} size determined by using charts prepared by the US Department of Agriculture, Soil Conservation Service. A well graded mixture as used herein is defined as a mixture composed primarily of larger stone sizes but with a sufficient mixture of other sizes to fill the small voids between the stones. The diameter of the largest stone size in such a mixture shall be 1.5 times the d_{50} size.

3. Riprap shall be graded from the smallest to the largest pieces as specified above and will be controlled by visual inspection.

4. Filter Fabric

Fabric shall be furnished in accordance with Section 02295.02, Paragraph 4.

02291.03 EXECUTION**A. Excavation**

Excavation for the riprap ditches and cutoff walls shall be made to the required depth and width in reasonable close conformity to the lines, grades, and typical sections shown on the Plans. The foundation upon which the stone is to be placed shall be even and reasonably smooth.

B. Foundation

1. After the County Engineer has approved the excavation, the Contractor shall install the filter fabric over the prepared surface. Securing pins shall be used to anchor the fabric in place. Where fabric overlaps are necessary, the minimum overlap shall be two (2) feet.
2. A filter blanket between the filter fabric and the riprap will not be required; however, the Contractor shall exercise care in the placement of riprap stone to prevent puncture of the filter fabric. If the filter fabric is punctured, the riprap stone shall be fully removed for at least three feet outside the limits of the fabric puncture and a new filter fabric patch with minimum overlap, shall be securely fastened over the puncture with securing pins and the riprap stone carefully replaced. No payment will be made for work involved in the repair of Contractor damaged filter fabric.

C. Stone Placement

Stones shall be placed by mechanical or other acceptable methods with a minimum of voids. The stones shall be placed to form a neat and uniform surface area. No mortar will be required.

D. Backfill

All remaining excavated areas along the edges and ends of the placed riprap shall be backfilled with suitable material to blend in with contiguous slopes, ditch lines, or existing ground. Riprap placed within the right-of-way shall be capped with a layer of three (3) inch to five (5) inch stone.

02291.04 METHOD OF MEASUREMENT

A. Riprap Ditches

RESERVED FOR FUTURE USE

B. Foundation

RESERVED FOR FUTURE USE

C. Filter Fabric

RESERVED FOR FUTURE USE

02291.05 BASIS OF PAYMENT

A. Riprap Ditches

RESERVED FOR FUTURE USE

B. Cutoff Walls

RESERVED FOR FUTURE USE

C. Filter Fabric

RESERVED FOR FUTURE USE

SECTION 02292
CONCRETE DITCHES

02292.01 GENERAL

A. Description

Concrete ditches shall include, but not necessarily be limited to, the construction of concrete ditches to the lines and grades shown on the Plans in accordance with the Contract Documents or as directed by the County Engineer.

B. Related Work Included Elsewhere

1. Excavation; Sections 02210, 02220, and 02230.
2. Cast-in-place concrete; Section 03300.

C. Quality Assurance

The County Engineer will inspect all materials and work to ensure compliance with the Contract Documents.

D. Submittals

Shop drawings and certificates of compliance requirements shall be as specified in Sections 02240.01, 02245.01, 03300.01, and 03310.01.

02292.02 MATERIALS

A. Materials Furnished by the County

The County will not furnish any materials for concrete ditches.

B. Contractor's Options

The Contractor may use either steel or wooden forms.

C. Detailed Material Requirements

1. Borrow for backfill around the edge of concrete ditches, or replacement of unsuitable material, shall be as specified in Section 02240.02.
2. Selected backfill for replacement of unsuitable material beneath concrete ditches shall be as specified in Section 02245.02.
3. Portland cement concrete for concrete ditches shall be Mix No. 2 as specified in

Section 03310.

4. Joint filler, preformed joint filler, form release compound, and curing materials shall be as specified in Section 03300.02.

02292.03 EXECUTION**A. Excavation**

Excavation and the preparation of the subgrade shall be in accordance with Sections 02210.03 and 02610.03 respectively.

If concrete ditches are to be constructed on fill, the fill shall be compacted to 95% of the maximum density as specified in Section 02260.03, Article D.

B. Forms

Forms may be either steel or wooden and shall extend to the full depth of the concrete. All forms shall be straight and of sufficient strength to resist pressure of the concrete without displacement. Bracing and staking of forms shall be such that the forms remain in both horizontal and vertical alignment until removal.

Before concrete is placed against the forms, they shall be cleaned and coated with a form release compound each time they are used. Forms shall not be stripped until the concrete has set for a minimum of 12 hours, and every precaution shall be taken to avoid damaging the concrete.

C. Concrete

1. When the subgrade is dry, it shall be moistened with as much water as it can absorb. The concrete shall be mixed in accordance with Section 03310.03. Volumetric batching and continuous mixing will be permitted on this work. Concrete shall be deposited on the subgrade in successive batches to the full width of the ditch. It shall be thoroughly spaded along the edges and shall be tamped to eliminate voids. It shall be struck off with an approved screed to the elevation of the top of the forms and then be floated with a wooden float.
2. The surface shall have a broomed finish. No plastering of the surface will be permitted. All outside edges and all joints shall be edged with a 1/4 inch edging tool.

D. Joints

Joints shall be constructed in sections no longer than 15 feet nor shorter than 4 feet. The joints shall be either bulkhead or weakened plane construction. Weakened plane joint shall be either tooled or sawed to a minimum depth of 3/4 inches. Expansion joints shall be spaced a maximum of 90 feet and be sealed.

E. Curing

Concrete shall be cured in accordance with Section 03300.03, and meet the requirements for cold weather construction in accordance with Section 02651.03.

F. Backfill

After the forms have been removed, the area around the edges of concrete ditches shall be backfilled and consolidated to the satisfaction of the County Engineer.

02292.04 METHOD OF MEASUREMENT

A. Concrete Ditches

RESERVED FOR FUTURE USE

B. Unsuitable Material

RESERVED FOR FUTURE USE

C. Slope Anchors and Toe Walls

RESERVED FOR FUTURE USE

02292.05 BASIS OF PAYMENT

A. General

RESERVED FOR FUTURE USE

B. Concrete Ditches

RESERVED FOR FUTURE USE

C. Unsuitable Materials

RESERVED FOR FUTURE USE

D. Slope Anchors and Toe Walls

RESERVED FOR FUTURE USE

SECTION 02293

CONCRETE SLOPE AND CHANNEL PROTECTION

02293.01 GENERAL

A. Description

Concrete slope and channel protection shall include, but not necessarily be limited to, constructing slope and channel protection of cast-in-place concrete to the lines and grades shown on the Plans in accordance with the Contract Documents or as directed by the County Engineer.

B. Related Work Included Elsewhere

1. Excavations; Section 02210, 02220, and 02230.
2. Dewatering; Section 02512.
3. Cast-in-place concrete; Section 03300.

C. Quality Assurance

The County Engineer will inspect all materials and work to ensure compliance with the Contract Documents.

D. Submittals

Shop drawings and certificates of compliance requirements shall be as specified in Sections 02240.01, 02245.01, 03200.01, 03300.01, and 03310.01.

02293.02 MATERIALS

A. Materials Furnished by the County

The County will not furnish any materials for concrete slope and channel protection.

B. Contractor's Options

Not applicable.

C. Detailed Material Requirements

1. Borrow for backfill around the edge of the concrete slope and channel protection or replacement of unsuitable material shall be as specified in Section 02240.02.
2. Selected backfill for replacement of unsuitable material shall be as in Section

02245.02.

3. Portland cement concrete for concrete slope and channel protection shall be Mix No. 2 as specified in Section 03310.
4. Welded wire fabric shall be as specified in Section 03200.02.
5. Joint filler, preformed joint filler, form release compound, curing materials, and roofing paper shall be as specified in Section 03300.02.

02293.03 EXECUTION**A. Excavation**

Excavation, including that for cutoff walls, shall be to the lines and grades shown on the Plans. The foundation upon which the slope and channel protection is to be placed shall be compacted to a firm, even surface that is acceptable to the County Engineer. All soft and unsuitable material shall be removed and replaced with suitable material.

B. Cast-in-Place Concrete

Cast-in-place concrete slope protection shall be constructed in alternate strips so that construction joints are all in one direction and that tooled joints run perpendicular to the construction joints. The result shall be a checkerboard pattern having squares not less than 3 feet or more than 5 feet. The size of squares around curved surfaces shall be as directed by the County Engineer. Square sizes for concrete channel protection shall be as indicated on the Plans or as directed by the County Engineer. Cutoff walls shall be constructed as indicated on the Plans, or as directed by the County Engineer.

C. Forms

Forms shall meet the requirements of Section 02660.02.

D. Concreting

Concrete shall be mixed in accordance with Section 03310.03. Volumetric batching and continuous mixing will be permitted on this work. Areas subject to the infiltration of water shall be dewatered in accordance with Section 02512.03 prior to placing the concrete. The concrete shall be spread, vibrated, or otherwise consolidated to secure maximum density as it is placed. It shall be struck off with an approved screed to the elevation of the top of the forms. The surface shall have a broomed finish. No plastering of the surface will be permitted. All outside edges and all joints shall be edged with a 1/4 inch edging tool.

E. CURING

Concrete shall be cured in accordance with Section 03300.03, and meet the requirements for cold weather construction in accordance with Section 02651.03.

F. Backfill

After the forms have been removed, backfills shall be made around the edges of the concrete slope and channel protection. Backfill shall be consolidated to the satisfaction of

the County Engineer.

02293.04 METHOD OF MEASUREMENT

A. Concrete Slope and Channel Protection

RESERVED FOR FUTURE USE

B. Cutoff Walls

RESERVED FOR FUTURE USE

C. Unsuitable Material

RESERVED FOR FUTURE USE

02293.05 BASIS OF PAYMENT

A. Concrete Slope and Channel Protection

RESERVED FOR FUTURE USE

B. Cutoff Walls

RESERVED FOR FUTURE USE

C. Unsuitable Material

RESERVED FOR FUTURE USE

SECTION 02294

GABION

02294.01 GENERAL

A. Description

Gabion installation shall include, but not necessarily be limited to, protecting slopes and channels with stone filled wire baskets constructed to the lines and grades shown on the Plans in accordance with the Contract Documents or as directed by the County Engineer.

B. Related Work Included Elsewhere

Excavation; Sections 02210, 02220, and 02230.

C. Quality Assurance

1. The County Engineer will inspect all materials and work to ensure compliance with the Contract Documents.
2. Criteria for visual inspection of stone shall be as specified in Section 02291.01.

D. Submittals

1. Shop Drawings

Shop drawings shall be submitted as specified in the "General Provisions" for all wire baskets and filter fabric furnished. Shop drawings shall include general product information and assembly, handling, installation recommendations and for the filter a tabulation of its physical properties. The Contractor shall also submit the Contractor's stone sources.

2. Certificates of Compliance

Certificates of compliance shall be submitted as specified in the "General Provisions" for all wire baskets stating that the baskets meet the materials requirements specified in Section 02294.02.

02294.02 MATERIALS

A. Materials Furnished by the County

The County will not furnish any materials for gabion installation.

B. Contractor's Options

Not applicable.

C. Detailed Materials Requirements

1. Stone for Gabions

a. Stone for gabions shall be hard, durable, angular in shape, resistant to weathering and to water action; free from over burden, spoil, shale, slate, organic material, and flat and elongated pieces.

b. Size

<u>Basket Thickness (inches)</u>	<u>Size of Individual Stone Particles (inches)</u>
6	3-6
9	4-7
12	4-7
18	4-7
36	4-12

Size of particles will be determined visually.

c. Quality Requirements

<u>Test and Method</u>	<u>Specification Limits</u>
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Apparent Specific Gravity	
AASHTO T 85, min	2.50
Absorption, AASHTO T 85, % max	3.0
Sodium Sulfate Soundness	
Cycles, 2 ½ to 1 ½ inch	
Aggregate,	
AASHTO T 104, % max loss	12

2. Wire for Gabions

a. The wire for fabricating gabion baskets and tie, lacing, and connections shall be steel having a minimum tensile strength of 60,000 pounds per square inch when tested in accordance with ASTM A 370. The fabric wire shall have minimum of 10% elongation when tested in accordance with MSMT 508. Individual gabion baskets and wires for slope and channel protection shall be as shown on the Plans, or "Special Provisions." Minimum wire sizes shall be:

<u>Use</u>	<u>U.S. Steel, Wire Gauge No.</u>
Fabric Mesh	11
Edge and selvedge	9
Lacing and tie	14

b. Zinc or Galvanized Coated

Fabric, tie, lacing, and connecting wire shall be zinc or galvanized coated with not less than 0.8 ounces per square foot when tested in accordance with AASHTO T 65.

c. Polyvinyl Chloride (PVC) Coated

PVC coating for fabric, ties, lacing, and connecting wires when shown on the Plans or required by the Special Provisions shall meet the chemical and temperature resistance requirements of MSMT 508. The color shall match throughout the project and shall conform to Federal Standard 595, gray color no. 26440 or green color no. 24533. Coating thickness shall be a minimum of 0.015 inches.

4. Filter Fabric

Filter fabric shall be as specified in Section 02295.02.

5. Filter Blanket

Filter blanket shall be as specified in Section 02295.02.

02294.03 EXECUTION

A. Excavation

Excavation, including cutoff walls, shall be made in reasonably close conformity with the lines and grades shown on the Plans. The subgrade shall be smooth, firm, and free from protruding objects or voids that would affect the proper placement of the wire baskets or damage the filter cloth when one is specified.

B. Filter Fabric

When filter fabric is specified, it shall be carefully and loosely placed on the prepared subgrade and held in place by methods acceptable to the County Engineer. Adjacent strips shall be overlapped by a minimum of two (2) feet. Care shall be exercised in placing, stretching, and holding the empty basket units in good alignment in order to avoid damage to the fabric. If the filter fabric should be torn or damaged, it shall be replaced or repaired at the Contractor's expense.

C. Filter Blanket

The filter fabric shall be covered with a 6-inch deep filter blanket which shall be consolidated to the satisfaction of the County Engineer before setting the wire gabion baskets.

D. Wire Gabion Baskets

1. Fabrication

Wire baskets units shall be fabricated to the nominal dimensions shown on the

Plans in such a manner that the base, sides, top diaphragms and ends can be assembled at the work site into a fully enclosed rectangular unit. Basket units shall be subdivided into compartments not longer than 1 ½ times the basket width by equally spaced diaphragms made of the same fabric mesh as the basket.

The maximum dimensions of the mesh opening shall not exceed 4 ½ inches and the total area of the mesh opening shall not exceed 12.5 sq. inches. The fabric mesh shall be furnished so as to be nonravelling (resist pull apart of twists or connections when a single wire in the mesh is cut). The fabric shall have a minimum of 4000 pounds load bearing resistance when stretched to a minimum of 10% elongation when tested in accordance with MSMT 508.

All perimeter edges of the mesh shall be securely selvedged so that the joints formed by tying the selve are at least as strong as the body mesh.

Connecting wire shall be supplied in sufficient quantity to fasten all edges of the basket unit, its internal partitions and top and make connections to adjacent basket units.

2. Placement

The placement of the wire gabion basket units shall begin with the cutoff walls. The empty wire basket units shall be set on the prepared subgrade and the vertical ends bound together with wire ties at spacings that are adequate to permit stretching of the units to remove kinks. Stretching methods shall be optional with the Contractor. The use of stakes, pins, or other acceptable methods shall be used to insure a good alignment of the empty wire basket units.

E. Stone

The empty basket units shall be filled carefully with stone placed by hand or machine to assure good alignment with a minimum of voids between stones and to avoid bulging of mesh. The maximum height from which the stone may be dropped into the units shall be 36 inches. The stone shall be so placed as to provide a minimum of two courses. Care shall be taken in placing the top layer of stone to assure a uniform surface thus avoiding any bulging of the lid mesh. After a basket unit has been filled, its lid shall be bent over until it meets the ends of the unit. The lid shall then be secured to the sides and ends with wire ties. When a complete basket unit cannot be installed on slopes or channels because of space limitations, the basket unit shall be cut to fit in the manner approved by the County Engineer.

F. Backfill

Any excavation voids existing along the edges of the completed gabions shall be backfilled to the satisfaction of the County Engineer.

02294.04 METHOD OF MEASUREMENT

RESERVED FOR FUTURE USE

02294.05 BASIS OF PAYMENT

RESERVED FOR FUTURE USE

SECTION 02295

RIPRAP SLOPE AND CHANNEL PROTECTION

02295.01 GENERAL

A. Description

Riprap slope and channel protection shall include, but not necessarily be limited to, protecting slopes and channels with coverings of stone to the lines and grades shown on the Plans in accordance with the Contract Documents or as directed by the County Engineer.

B. Related Work Included Elsewhere

Excavation; Sections 02210, 02220, and 02230.

C. Quality Assurance

1. The County Engineer will inspect all materials and work to ensure compliance with the Contract Documents.
2. Criteria for visual inspection of stone shall be as specified in Section 02291.01.

D. Submittals

1. Shop Drawings

Shop drawings shall be submitted as specified in the "General Provision" for all filter fabric furnished. The shop drawings shall include general product information and a tabulation of the fabrics physical properties. The Contractor shall also submit the Contractor's stone source.

2. Certificates of Compliance

Certificates of compliance shall be submitted as specified in the "General Provisions" for the filter fabric stating that the filter fabric meets the materials requirements specified in Section 02295.02.

02295.02 MATERIALS

A. Materials Furnished by the County

The County will not furnish any materials for riprap slope and channel protection.

B. Contractor's Options

When permitted by the County Engineer, suitable options may be substituted with the exception of broken concrete.

C. Detailed Materials Requirements

1. Stone for Channels and Ditches

Stone for channels and ditches shall meet the general requirements for stone and the size requirements of Class I Riprap as specified in Section 02291.02. In addition, the stone shall meet the following quality requirements:

<u>Test and Method</u>	<u>Specification Limits</u>
Apparent Specific Gravity, AASHTO T 85, min.	2.50
Absorption AASHTO T 85, % max.	3.00
Sodium Sulfate Soundness 5 cycles, 2 ½ to 1 ½ inch Aggregate, AASHTO T 104, % max. loss	20.00

2. Stone for Slopes

Stone for slopes shall meet the quality requirements specified in Paragraph 1 above and shall meet the gradation requirements of AASHTO M 43, No. 1 when determined in accordance with AASHTO T 27 omitting AASHTO T 11.

3. Filter Blanket

Filter blanket for riprap slope and channel protection shall be graded aggregate subbase meeting the gradation requirements and quality requirements for graded aggregate subbase as specified in Section 02621.02.

4. Filter Fabric

Fabric shall conform to Section 921.09 of the "MSHA Standard Specifications for Construction and Materials (1993)".

Fabric securing pins shall be 3/16-inch diameter steel, pointed at one end, and fabricated at the other end with a head to retain a steel washer having an outside diameter of not less than 1 ½ inches. Pin length shall be at least 18 inches.

02295.03 EXECUTION

A. Excavation

Excavation for riprap slope and channel protection, including cutoff walls, shall be made in reasonably close conformity with the lines and grades shown on the Plans. The foundation upon which the slope and channel protection is to be placed shall be an even surface that is acceptable to the County Engineer.

B. Foundation

1. Filter Fabric

After the County Engineer has approved the excavation, the Contractor shall install the filter fabric over the prepared surface. Securing pins shall be used to anchor the fabric in place. Where fabric overlaps are necessary, the minimum overlap shall be two (2) feet.

2. Filter Blanket

The filter fabric shall be covered with a 6-inch deep filter blanket which shall be consolidated to the satisfaction of the County Engineer.

C. Riprap Placement

The placement of the riprap shall begin with the cutoff walls. The larger stones should be placed in the cutoff walls and along the outside edges of the limits of the slope and channel protection. The riprap shall be placed with suitable equipment in such a manner as to produce a reasonably graded mass of stones. Placing the stones by methods that causes extensive segregation or damage to the underlying filter fabric will not be permitted.

D. Backfill

An excavation voids existing along the edges of the completed slope and channel protection shall be backfilled to the satisfaction of the County Engineer.

02295.04 METHOD OF MEASUREMENT

A. Riprap

RESERVED FOR FUTURE USE

B. Cutoff Walls

RESERVED FOR FUTURE USE

02295.05 BASIS OF PAYMENT

A. Riprap

RESERVED FOR FUTURE USE

B. Cutoff Walls

RESERVED FOR FUTURE USE

SECTION 02300

PILING

02300.01 GENERAL

A. Description

Piling shall include, but not necessarily be limited to, the manufacturing, furnishing, treating, painting, coating, driving, jetting, and cutting off of all types of piling that may be specified for bulkheads, buildings, jetties, fenders, dolphins, and incidental structures. Provisions are also outlined herein, and the Contractor shall always provide for all necessary test piles, testing, loading, and the tabulation of results.

The type, material, and details of the piling to be used shall be in accordance with the Contract Documents.

B. Related Work Included Elsewhere

1. Concrete reinforcement; Section 03200.
2. Portland cement concrete; Section 03310.
3. Structural steel; Section 05100.
4. Rough carpentry; Section 06100.
5. Painting; Section 09900.

C. Quality Assurance

1. Materials

The County Engineer will inspect all materials before and/or after installation to ensure compliance with the Contract Documents.

2. Field Tests

- a. Test Piling

The depth of penetration of the length of piling for a Project or a part of the Project will generally be determined by driving test piles. As a general rule, the Plans or "Special Provisions" will indicate penetrations, bearing values, and/or tip elevations desired. From this information, the Contractor shall order and drive the test piling. The actual safe bearing value of the test piling shall then be determined by methods subsequently described. Then from the test pile data and behavior, the Contractor shall order the

permanent or remainder of the piling required to complete the Contract, including the shell tip length needed for cast-in-place piles, all of which is subject to the County Engineer's approval.

The provisions for driving test piles, while applying primarily to the so-called bearing piles, also apply to piles supporting bulkheads, fenders, and jetties. Although the methods for testing piles and sheet piling for bulkheads, fenders, and jetties may differ from bearing piles, acceptable lengths must still be calculated from driving test and test sections of sheet piling piles before ordering the permanent piles, and/or sheet piling.

While the above is the usual procedure, there will be cases wherein length of piles must be determined without the benefit of test piles, load tests, borings, and other data. This usually involves piles required for emergency or temporary work, as well as piles for falsework, form supports, cofferdams, and piles which are driven by the Contractor for the Contractor's own use in building the project. For such piles, the Contractor shall submit to the County Engineer for review and approval Plans for the design of the temporary structure, which shall include all information relative to the piles to be used, i.e. size, length, penetration, bearing value, etc.

When tapered shells are used for piles of footings where the footing is below the existing and proposed ground line, the diameters of the piles at cutoff elevation shall not be less the nominal butt size specified or shown on the Plans. When tapered shells are used for the piles of footings, where the footings are above the existing ground line, the diameters of the piles at the existing ground line shall not be less than the normal butt size specified or shown on the Plans. When tapered shells are used for trestles or bents, the diameters of the piles 10 feet below existing or finished ground line, the diameter of the lower, shall not be less than the nominal butt size specified or shown on the Plans, unless otherwise indicated in the "Special Provisions." The County Engineer will have the option of determining the tapered tip lengths to be used.

b. Bearing Value

The determination of the bearing value shall be primarily obtained from observation and reporting of the behavior of the test pile from the time first placed in the leads until it attains practical refusal or reaches a stratum designated by the Plans or set forth by the County Engineer. To furnish the Contractor with a guide as to the probable supporting value at each position, the County Engineer will compute the safe bearing value from the following formulas:

$$P = \frac{2WH}{S+0.1} \quad \text{for single acting power hammers}$$

$$P = \frac{2E}{S+0.1} \quad \text{double acting power hammers}$$

where P = safe bearing value in pounds

- W = weight in pounds of striking parts of hammer
H = height of fall in feet
E = approved hammer energy per blow in foot-pounds for double-acting, differential-acting, and diesel hammers
S = the average penetration in inches per blow for the last several inches of penetration

The foregoing formulas are applicable only when:

- 1) The hammer is operating properly and at the manufacturer's recommended speed in the case of a power hammer;
- 2) The head of the pile is not broomed or crushed;
- 3) The penetration is reasonably quick and uniform;
- 4) There is no discernable bounce after the blow;
- 5) A follower is not used.

If the Contract does not provide for test loading, the results of the aforesaid formula as applied to the test piles shall be used to designate the proposed penetration or lengths of piles. However, each pile shall have its driving record evaluated to assure its ability to carry the intended load.

c. Load Test

Pile load test shall conform to Section 407.03.11 of the "MSHA Standard Specifications for Construction and Materials (1993)".

D. Submittals

1. Where the length of piles must be determined without the benefit of test piles, load tests, borings, or other data, such as for emergency or temporary work, as well as piles for falsework, form supports, and other miscellaneous uses, the Contractor shall submit to the County Engineer for review and approval plans for the design of the temporary structure, which shall include all information relative to the piles to be used, i.e., size, length, penetration, bearing value, etc.
2. The Contractor shall have the hammer manufacturer's manual available for the County Engineer's use at the project site prior to the start of the pile driving operation.
3. On all special, marine, or water projects and pile bents, the Contractor shall prepare and submit to the County Engineer a plan of the Contractor's proposed driving method. This plan must be approved prior to any pile driving.
4. Shop drawings shall be submitted as specified in the "General Provisions" for pile tips and caps which shall furnish general product information and dimensions.

02300.02 MATERIALS

A. Materials Furnished by the County

The County will not furnish any materials for piling.

B. Contractor's Options

1. The Contractor may furnish timber piles of any of the species permitted under AASHTO M 168 except that all treated piles shall be Southern Yellow Pine unless otherwise noted.
2. The Contractor may treat the timber piles with any of the materials specified in Section 02300.03 unless otherwise noted.
3. The County Engineer will specify the most widely accepted material for each specific piling function. It is further the information of these Specifications to permit the use of all approved manufactured types of piling. No piles types shall be substituted or interchanged without the written permission of the County Engineer.

C. Detailed Material Requirements**1. Shells or Casings for Cast-in-Place Concrete Piles**

Steel shells or casings shall be formed from a single piece of metal having not more than one continuous welded seam. The seams shall have a minimum yield strength of 28,000 psi. Tips shall conform to ASTM A36.

2. Reinforcement for Cast-in-Place Concrete Piles

Reinforcement for cast-in-place concrete piles shall be as specified in Section 03200.02.

3. Concrete for Cast-in-Place Concrete Piles

Concrete for cast-in-place concrete piles shall be Mix No. 3 as specified in Section 03310.03.

4. Steel Bearing Piles

Steel bearing piles shall consist of structural steel meeting the requirements of ASTM A 36.

5. Steel Sheet Piles

Steel sheet piles shall meet the requirements of ASTM A 328.

6. Steel Sheet Pile Accessories

Steel for accessories to sheet piles, such as shapes for wales, caps, and miscellaneous items, shall meet the requirements of ASTM A 36. High strength bolts shall meet the requirements of Section 05100.02.

7. Timber Piling

Timber piling shall meet the requirements of AASHTO M 168.

8. Timber Preservatives

Preservatives and pressure treatment for timber shall meet the requirements of AASHTO M 133. The kind of treatment and amount of preservative shall be as specified on the Plans or in the "Special Provisions."

a. Creosote

Timber treated with creosote solutions shall retain the following minimum quantities of preservatives:

For piling	12 pounds per cubic foot
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For lumber in water and up to 5 feet above mean low water	12 pounds per cubic foot
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For lumber 5 feet or more above mean low water and at or below ground	8 pounds per cubic foot
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b. Oil-Borne Treatment

Oil-borne preservative treatment (other than creosote) shall have the following minimum dry net retention if not specified on the Plans or in the "Special Provisions:"

AWPA Standard P 8

Pentachlorophenol (Southern Pine)	0.60 pounds per cubic foot
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Pentachlorophenol (Douglas Fir, Oak, or Gum)	0.50 pounds per cubic foot
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c. Water-Borne Treatment

Water-borne preservative treatment shall have the following minimum dry net retention if not specified on the Plans or in the "Special Provisions:"

AWPA Standard P 5

Chromated Copper Arsenate, Type A, B, or C	0.40 pounds per cubic foot
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Ammoniacal Copper Arsenate	0.50 pounds per cubic foot
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9. Coal-Tar Pitch

Coal-tar pitch for waterproofing shall meet the requirements of AASHTO M 118.

10. Paint

Paint for wood shall meet the requirements of Federal Specification TT-P-102, Class B.

11. Copper

Copper for timber pile heads shall meet the weight per square foot and gage requirements of ASTM B 152.

02300.03 EXECUTION

A. General

The Contractor is responsible for ordering and delivery to the project site piles of the proper type and length.

B. Storage and Handling

In storage and handling of shells or casings for cast-in-place concrete piles, the methods must be such as to avoid deforming the member by denting. Where the Plans call for painting or coating the shells before driving, additional methods of storing and handling are required so that the paint or coat may dry and the dry film is not scratched, discolored, or otherwise damaged.

Steel H piles and sheet piling are least likely to require special storage and handling methods, except where same are required to be painted or coated. Steel H piles and sheet piling must, however, be protected against any abuse which would permanently deform the member or bend its flanges.

C. Preparation for Driving

Piling shall not be driven until after excavation is completed. Furthermore, where piling is to be driven through a compacted embankment, no piles, including test piling, shall be driven until the embankment has been completed to planned preliminary dimensions.

The Contractor shall construct an adequate template. This template shall be properly aligned and positioned to assure that piling is driven plumb.

1. Pile Cap

The heads of all piling shall be equipped with a cap or cushion so that the energy imparted by the hammer can be transmitted to the pile without injury to the top or butt. Where the top or butt of a pile is greater than the moving or striking face of the hammer, the driving head or cap shall be designed to cover the entire surface of the top of the pile and distribute the blow of the hammer evenly to top of the pile. For steel shells or casings, the driving cap shall be such that the blow of the hammer is distributed evenly to the entire periphery of the shell. For steel H piles, the driving head must distribute the energy of the hammer's blow evenly to flanges and web. Generally, the driving head or cap for timber piling shall have a suitable protective device to prevent damage to the pile top. For timber piles, the use of a cap or driving head may be omitted where the Contractor is willing to take the responsibility. For manufactured piles, driving heads, mandrels, or other devices recommended by the manufacturers shall in all cases be obtained and used by the

Contractor. No interchanging or substitution of recommended devices will be accepted unless the Contractor and/or manufacturer is willing to accept all responsibility for damage or delay caused thereby.

Driving heads and cushions for temporary sheet piling shall be at the option of the Contractor. Driving heads and cushions used on permanent sheet piling shall be of proper configuration and construction to prevent damage to the piling.

Prior to any capping or placing of a driving head, the top of the pile, shall be sawed, cut, or shaped, so that it is normal to the axis of the moving parts of the hammer.

2. Pile Tips

Timber piles shall be pointed where driving conditions require. The point must be symmetrical. In no case, however, shall the tip or point be less than 4-inch diameter. Furthermore, timber piles may have the tips or bottoms shod with a metal shoe or point when shown on the Plans, described in the "Special Provisions," or directed by the County Engineer to facilitate perforation of hard strata. Any tip or point, irrespective of whether forged or pressed, shall be subject to the approval of the County Engineer before use. The tip shall be electrically welded and guaranteed for permanent fixity.

Shells or casings for cast-in-place concrete piles shall be shod with conical shaped tips or points of cast or pressed steel as recommended by the manufacturer except that flat steel plates for tips or points are excluded.

Steel H piles shall be driven without any special treatment to the bottom unless indicated otherwise on the Plans or in the "Special Provisions."

C. Splicing

Splicing of timber piles will not be permitted. In the event of an isolated timber pile penetrating below planned top, it shall be replaced or supplemented by an additional pile, unless the structure above can be changed without detriment.

If splicing of steel H piles and shells for cast-in-place concrete piles is necessary, they shall be spliced as indicated on the Plans by electric arc welding in accordance with latest AWS Structural Welding Code for the full periphery. The number of splices permitted must be compatible with driving conditions at the site and the standard lengths of piling produced by manufacturers.

Where a manufactured pile type is designed to be spliced by screwing two pieces together or by the use of couplings or collars, and the details for the splice are not shown on the Plans, the device must be submitted to the County Engineer and approved before use.

The provisions outlined above shall apply to sheet piling.

D. Pile Driving

1. Piles shall be driven with approved hammers. An approved hammer is one which has been accepted and rated by the County Engineer prior to use. Any hammer which does not perform satisfactorily on piles being driven, notwithstanding previous

approval of the hammer or type of hammer, shall be replaced by a hammer acceptable to the County Engineer.

2. The hammer to be used for driving permanent piles shall be the same hammer that was used to drive the test piles. If the Contractor changes hammers, the Contractor must drive additional test pile(s) at the Contractor's expense before driving the permanent piles even if the energy ratings of the hammers are identical.
3. Power hammers are defined for the purpose of these Specifications to mean a hammer which has a driving ram actuated by steam, air, or diesel power.
4. Power hammers shall be operated at speeds recommended by the manufacturer for the bearing value stipulated.
5. Hammer energy is defined for the purpose of these Specifications as the approved rate energy per blow of the power hammer.
6. The manufacturer's energy rating may or may not be accepted. Tests may be designated and required by the County Engineer to determine the acceptability and energy rating of power hammers. The County will not pay costs or expenses of test for approval and energy rating of any hammer.

The minimum rated striking energy of the hammer to be used in driving piles is as follows:

- a. untreated and treated timber piles - 6000 per blow;
- b. steel bearing piles weighing 57 foot-pounds or less and cast-in-place concrete piles shells 14 inches in diameter or less - 1300 foot per pounds per blow;
- c. steel H piles weighing more than 57 pounds per foot and cast-in-place concrete pile shells greater than 14 inches in diameter, precast and prestressed concrete piles will be specified in the "Special Provisions."

When considering the hammer for approval, the ratio of the weight of the pile to the weight of the striking unit shall be evaluated to determine the adequacy of the hammer.

7. All pile driving, plumb and/or batter, shall be done using leads or spuds held rigidly in position to maintain the axial alignment of the hammer, pile, and leads during driving. Leads or spuds shall be constructed in such a manner to afford freedom of movement of the hammer during the driving phases. Fixed leads are defined as leads attached to the crane boom at the top, and rigidly held in position at the bottom, to prevent movement of the leads. If necessary, intermediate supports of leads may be required to provide rigidity and axial alignment of hammer, pile, and leads.

Regardless of the type of leads used, the Contractor shall be responsible for driving the piles within the tolerance as specified without injury to the piles. Any leads that do not produce satisfactory end results in the driving of piling shall be ordered removed from the work.

No driving shall be done with the hammer out of the leads.

On all special, marine, or water projects and pile bents, the leads shall be of sufficient length so that the use of a follower will not be necessary. Long piles and batter piles may require guides at intervals and additional support to prevent excessive bending and buckling under the hammer blow. Piles may be held in place and alignment by templates or checkerboards consisting of heavy timbers or structural steel shapes. If the template or checkerboard is of sufficient height to maintain multiple point fixity along the length of the piles and the bottom of driving leads or spuds fixed to the template or checkerboard, then the top of the leads or spuds may swing by a crane in pendulum fashion, provided that the hammer, pile, and leads are maintained in identical axial alignment during the entire driving.

Special permission may be granted by the County Engineer to use swinging leads or spud in isolated circumstances such as proximity to power lines or traffic.

The driving of piling with followers shall be avoided if practicable and shall be done only with prior written permission of the County Engineer. When followers are used, one pile from each group of ten shall be a long pile driven without a follower or one from each support, whichever gives the most piles as long piles, and shall be used as a test pile to determine the average bearing power of the group or support.

8. The use of water jets will only be permitted with the written authorization of the County Engineer.
9. Where piling must perforate strata which resists driving, the Contractor is directed and shall be prepared to auger or drill holes through same. The size of the auger or drill to be used shall not be larger than the nominal diameter of round pile or the minimum diameter of a circle in which an H pile will fit and shall meet with the approval of the County Engineer before use, with the County Engineer as the sole judge as to the size of auger. After the hole is completed, the pile shall be inserted; and if there is a space between the outside of the pile and the wall of the augured hole, dry sand shall be used to completely fill the voids between the pile and the walls of the hole. Driving shall then be completed after which any remaining voids are to be completely filled with dry sand.
10. Piles shall be driven with a variation of not more than 1/4 inch per foot from the vertical or from the batter shown on the Plans. If the pile can be moved into place by use of a manual "come along," then no further review is necessary. Rotation of the "H" pile in excess of 25 degrees from the as planned axis will not be permitted.

E. Defective Piles

1. The pile shall be withdrawn and replaced by a new and, if necessary, longer pile.
2. A second pile shall be driven adjacent to the defective or low pile.
3. A sufficient portion of the footing extended to properly embed the pile.
4. Timber piles shall not be spliced without specific permission of the County Engineer.
5. Any pile pushed up by the driving of adjacent piles shall be redriven to the required

bearing value.

F. Timber Pile Cutoff

1. The tops of all piles, except timber piles which support timber caps, shall be cut off at the elevations indicated on the Plans and on a true plane perpendicular to the axis of the pile unless otherwise specified.
2. Timber piles which support timber caps shall be cut off in such a manner to insure that the plane of the bottom of the cap will bear fully on the pile head. (Chain saws shall not be utilized for this purpose, and guides must be employed for whatever other tools are used.) No shimming between the timber cap and pile head will be allowed.

G. Treatment for Timber Pile Heads

Treatment of timber pile heads shall conform to Section 407.03.11 of the "MSHA Standard Specifications for Construction and Materials (1993)".

H. Concreting Cast-In-Place Piles

1. Reinforcement shall be formed into a unit, the bars being securely fastened together to form a cage which shall be positioned and held at the given uniform distance from the shell.
2. Tie bars and bands for reinforcing cages of foundation (footing) piles may be tack welded provided a certified welder is used.
3. Tie bars, bands, and spacer lugs for bents or column piles shall not be tack welded to any of the main reinforcing bars with the following exception. If the Contractor desires, the Contractor may place a band at the top and bottom of the pile cage and weld all main bars thereto. However, the remainder of the intersections of ties and main bars shall be fastened by tie wiring.
4. After the pile shells have been accepted and the reinforcing unit is ready, the shells shall be filled with concrete. No concrete shall be placed in any casing or shell until all driving within a radius of 15 feet has been completed, nor until all the shells for any unit of the structure (pier, bent, abutment, etc.) have been driven to their final penetration and accepted by the County Engineer. In the event that this procedure cannot be followed, all driving within the above limits shall be discontinued until the concrete in the last pile poured has set at least three days.
5. Immediately prior to concreting, water or other foreign substances found in a shell shall be removed. The concrete shall be deposited in one continuous operation. The restriction for dropping concrete more than 5 feet will not apply. Mixing and placing of concrete shall be in accordance with the provisions of Sections 03300.03 and 03310.03. Reinforcing steel cages shall be set and fastened in proper position in the pile before any concrete filling is placed, except that when the reinforcing steel cage extends 6 feet or less below the top of the pile, the concrete filling may be placed to the bottom of these bars before they are set and fastened in proper position in the pile; and then the concrete filling shall be continued to completion, all in a continuous operation. Concrete deposited in piles shall be thoroughly

compacted with mechanical vibrators from the bottom of reinforcing steel cages to the tops of piles during and immediately after placing concrete. Care shall be exercised to obtain workable concrete of uniform consistency in order to prevent water gain, the formation of stone pockets, honeycomb, or other defects.

6. Freshly concreted piles shall not be disturbed in any way nor shall any loads be allowed upon any of them until all concrete has been in place at least 72 hours. The exposed surface of cast-in-place concrete piles shall be cured with two layers of burlap which shall be kept continuously wet for a period of seven days.

I. Cold Weather Protection

Provisions for protecting cast-in-place concrete in piles during cold weather shall be as follows: for heads of cast-in-place concrete piles projecting above the ground and where water is not normally present, protection of concrete from cold weather shall be done by enclosing the heads of the piles and heating the atmosphere therein as prescribed in Section 03300.03. Where the piles are in an excavated trench, the heads may be inundated with water to a minimum depth of 1 foot over the pile heads, if the temperature of the water is maintained at 40°F or warmer. For trestle or bent piles, however, projecting above water and/or ground, concrete placed in cold weather must be protected in the same manner as prescribed for a concrete structure.

02300.04 METHOD OF MEASUREMENT

A. Piling

RESERVED FOR FUTURE USE

B. Timber Sheet Piling

RESERVED FOR FUTURE USE

C. Steel Sheet Piling

RESERVED FOR FUTURE USE

D. Pile Points

RESERVED FOR FUTURE USE

E. Load Tests

RESERVED FOR FUTURE USE

F. Non Measured Items

RESERVED FOR FUTURE USE

02300.05 BASIS OF PAYMENT

RESERVED FOR FUTURE USE

PILING

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A. Piling

RESERVED FOR FUTURE USE

B. Timber Sheet Piling

RESERVED FOR FUTURE USE

C. Steel Sheet Piling

RESERVED FOR FUTURE USE

D. Pile Points

RESERVED FOR FUTURE USE

E. Load Tests

RESERVED FOR FUTURE USE

SECTION 02400

EXCAVATION SUPPORT

024001.01 GENERAL

A. Description

1. Excavation support shall include, but not necessarily be limited to, the designing, furnishing, and placing of timber or steel sheeting or other systems for excavation support in accordance with the Contract Documents.
2. All work shall comply with Title 29, Code of Federal Regulations, Part 26, Subpart P (and other applicable sections) of Occupational Safety and Health Regulations for Construction and the requirement of MOSHA, Maryland Occupational Safety and Health Regulations for Construction.

B. Related Work Included Elsewhere

1. Excavation; Section 02220 and 02250.
2. Dewatering; Section 02512.

C. Quality Assurance

1. It shall be the Contractor's responsibility to select materials, methods, and equipment, and design an excavation support system which will:
 - a. Support earth pressures, utility loads, equipment, applicable traffic and construction loads, and other surcharge loads in such a manner as will allow the safe and expeditious construction of the permanent facilities without movement or settlement of the ground and will prevent damage to or movement of adjacent buildings, structures, and utilities.
 - b. Support the maximum loads that can occur during construction. For the purpose of this section, the design load means the maximum load the support member will have to carry in actual practice, and the proof load means a specified test load greater than the design load.
 - c. Carry bottom of support system to a depth below the main excavation adequate to prevent lateral and vertical movement. Where additional excavation is carried below the main excavation, provide means to prevent movement of the main excavation supports.
 - d. Allow the required open excavated space.
 - e. Allow for staged removal to conform to construction and backfill sequence,

EXCAVATION SUPPORT

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or as shown on the Plans.

- f. Provide diagonal bracing where needed for stability of the system. Arrange wales, struts, posts, and braces in such a manner as will minimize interference with compaction of the backfill.

D. Submittals

When specified in the "Special Provisions," the Contractor shall, prior to the installation of the excavation support system, submit to the County Engineer working drawings and design data showing any or all of the following:

1. Submit working drawings showing proposed excavation support system including details, arrangement, and methods of construction for the proposed system and details illustrating the method for preloading the bracing. Show level of streets, struts, and shores, as applicable, and permissible depth to which excavation may be carried before such supports are installed and preloaded. Show full excavation depth load to be carried by various members of the support system; and, if required, the preloads. Submit appropriate design calculation including maximum theoretical deflections of support members.
2. Revised working drawing as required to show the actual locations of existing utilities in relation to the excavation support system. Show design and methods to overcome interference with such existing utilities and the excavation support system.
3. Proposed sequence of strut and shore removal as applicable and as related to concrete placement and backfilling operations.
4. Proposed method of installing sheet piling, including the sequence of driving, template, and driving equipment description.

02400.02 MATERIALS

A. Materials Furnished by the County

The County will not furnish any materials for excavation support.

B. Contractor's Options

The Contractor may utilize the excavation support system of the Contractor's choosing unless otherwise noted.

C. Detailed Material Requirements

1. Steel Sheet Piling

Continuous interlocking type, ASTM A 328, provided with at least one 2-1/2 inch diameter handling hole on the centerline of the web located at least 6 inches from each end of the sheet pile.

2. Timber

Structural grade with a minimum working stress of 1100 pounds per square inch. Timber to be left in place; creosote or creosote-coal tar solution treated in accordance with AASHTO M 133.

02400.03 EXECUTION**A. General**

1. It shall be the Contractor's responsibility to support the sides and ends of excavations. All excavation support systems shall be designed and arranged so that it may be withdrawn as backfilling proceeds, without injury to the facility built under the Contract or to any adjacent facility.
2. All excavation support systems, unless otherwise noted, shall be withdrawn as the backfilling of the excavation proceeds.
3. Sheeting or other materials left in place shall be cut off by the Contractor at least 12 inches below finished grade.
4. When the depth of the excavation requires 2 lengths of sheeting, one above the other, the lower length shall be set inside the box stringers or wales of the upper length and driven down and braced as the excavation continues.
5. Driving heads and cushions for temporary sheet piling shall be used at the option of the Contractor. Driving heads and cushions used on permanent sheet piling shall be of proper configuration and construction to prevent damage to the piling.

B. Timber Sheeting

Timber sheeting shall be drift sharpened or leveled at the bottom so as to wedge adjacent boards in tight contact to prevent the loss of material from behind the sheeting.

C. Steel Sheet Piling

Steel sheet piling shall be driven in plumb position with each pile interlocked with adjoining piles for its entire length so as to form a continuous diaphragm throughout the length of each run of wall, bearing tightly against original ground. Drive to depth indicated on the Plans or to a firm seat against or into bedrock. Exercise care in driving so that interlocking members can be extracted, if required, without injury to adjacent fills. Do not drive piles within 100 feet of concrete less than seven days old. The methods of driving, cutting, and splicing shall conform to the approved working drawings.

D. Internal Bracing Support System

1. The internal bracing support system includes wales, struts, and shores.

EXCAVATION SUPPORT

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2. Install and maintain all bracing support members in tight contact with each other and with the surface being supported.
3. When required, preload bracing members by jacking struts and shores at 50% of the allowable design load. Preload bracing members in accordance with methods, procedures, and sequence as described on the approved working drawings. Coordinate excavation work with installation of bracing and preloading. Use steel shims and steel wedges welded or bolted in place to maintain the preloading force in the bracing after release of the jacking equipment pressure.
4. Excavate to a depth no more than 2 feet below the point of support about be to placed. Install the support and preload immediately after installation and prior to continuing excavation.

E. Removal

1. Unless otherwise noted or directed by the County Engineer, the Contractor shall remove the excavation support system once it has served its purpose.
2. The excavation support system shall be removed in such a manner that will not disturb or damage the installed facility or any adjacent land, facility, or improvement. Supports shall not be removed until the backfill within has been compacted to the required density.
3. The Contractor shall be solely responsible for the removal of the excavation support system and shall repair all damage resulting from the support system's removal at no additional cost to the County.
4. The Contractor may, with the approval of the County Engineer, leave the excavation support system in place provided that no portion of the system extends above 12 inches below finished grade.

02400.04 METHOD OF MEASUREMENT

RESERVED FOR FUTURE USE

02400.05 BASIS OF PAYMENT

RESERVED FOR FUTURE USE