

The excavation and backfill necessary to replace unsuitable material under the concrete leveling pad shall be paid for as Unclassified Excavation, which price and payment shall include all equipment, tools, labor, and incidentals necessary to complete the work.

Payment for each item will include all direct and indirect costs and expenses necessary to complete the work.

Payment will be made under:

Item No.	Pay Item	Pay Unit
7137175	Mechanically Stabilized Earth Retaining Wall (Segmental Block)	Square Foot

SECTION 714

PIPE CULVERTS

714.01 Description. This work shall consist of furnishing pipe of the size, shape, type, and dimensions indicated on the plans and installing them to provide drainage structures at places designated on the plans or by the Engineer in accordance with these specifications and true to the lines and grades shown on the plans or otherwise given by the Engineer. This work shall include the furnishing and installing of necessary tee, wye, elbow and bend joints, and making connections to existing and/or new structures, including drilling and chipping as may be necessary to complete the work.

MATERIALS

714.02 General. Only materials specified herein shall be used for the several items that constitute the finished pipe culvert.

714.03 Circular Reinforced Concrete Culvert Pipe. Cir-

cular RC culvert pipe shall conform to the applicable requirements of AASHTO M 170, (ASTM C 443) and the *Policy for Inspection and Acceptance of Concrete Culvert Pipe* adopted by the Department for the specified diameters, shapes, types, and strength classes, except for the modifications stated herein. When a strength class is not specified, Class III pipe shall be used. The pipe shall be furnished in manufactured lengths from 4 to 12 feet. Circular pipe sizes through 36 inches diameter shall have the standard circular reinforcement conforming to the requirements of AASHTO M 170.

Reinforcement for circular pipe sizes 42 inches in diameter or larger may contain any of the reinforcement designs conforming to the requirements of AASHTO M 170. When other than circular designs are used, the pipe joint shall have a lift hole established in the top of the shell and be marked "Top." The special design reinforcement shall be placed in position and stabilized by satisfactory means to assure that it will not shift or rotate during the manufacturing process.

For classes and sizes of circular, or elliptical pipe with reinforcement designs not shown in AASHTO M 170, or M 207, respectively, the manufacturer shall submit to the Engineer a design that will meet the strength requirements for the specified pipe.

Portland cement shall conform to the requirements of Subsection **701.02**.

Fly ash and water-granulated blast-furnace slag may be used at the option of the manufacturer in accordance with the following requirements:

1. Fly ash shall meet ASTM C 618 for Type F or C with a maximum Na_2O of 1.5%. Water-granulated blast-furnace slag shall meet the requirements of ASTM C 989, Grade 120.
2. The amount of cement to be replaced by fly ash

shall not exceed 15% and the amount to be replaced by water-granulated blast-furnace slag shall not exceed 50%. Fly ash shall replace the cement in the ratio of not less than 1.2 to 1 by weight. Water-granulated blast-furnace slag shall replace the cement in the ratio of not less than 1:1 by weight.

3. Fly ash and slag will be accepted only from approved sources. Certified mill test reports shall be furnished with each shipment to verify compliance requirements.

4. The manufacturer shall submit a mix design to the Engineer for his approval in advance of batching. The submittal shall indicate the amount of cement to be removed and the material that will replace it.

5. Storage bins, conveying devices and weighing equipment and procedures to assure accurate batching shall be provided for each material (fly ash or slag) to be used.

Aggregates shall conform to the quality requirements as specified in Section **701** for aggregates. Gradation of the aggregates shall be at the option of the manufacturer.

Steel reinforcement shall conform to the requirements of AASHTO M 31, M 32, M 55, M 221, or M 225 as applicable.

Gasket seals shall be flexible watertight gaskets conforming to AASHTO M 198, Type A, or Type B. Type B gasket seals shall be of the minimum size to produce a watertight joint in the annular space of the pipe being used. Only those gasket sources which appear on an approved list, published by the South Carolina Research and Materials Laboratory, entitled *Approved Preformed Flexible Plastic Gaskets* shall be used. Approval may be obtained by furnishing the Research and Materials Engineer a certified affidavit with test results made in a recognized laboratory confirming that the material

meets AASHTO M 198 along with complete instructions for installation of the material.

Water shall meet the requirements of Subsection **701.12**.

714.04 Elliptical Reinforced Concrete Culvert Pipe. Elliptical RC culvert pipe shall meet the applicable requirements of Subsection **714.03**. The thickness and dimensions of the pipe shall be in accordance with the plans.

714.05 Corrugated Steel Culvert Pipe. Corrugated steel culvert pipe shall meet the requirements of AASHTO M 36. Where elliptical pipe is called for on the plans or in the special provisions, the pipe shall be distorted from a true circle to provide an increase in the vertical diameter of approximately 5%. Distortion shall be performed at the fabricating shop. The thickness of the pipe shall be in accordance with the plans.

714.06 Corrugated Steel Culvert Pipe-Arch. Corrugated steel culvert pipe-arch shall conform to the requirements of AASHTO M 36, Type II.

Dimensions shall be in accordance with Table 4 of AASHTO M 36, Type II and shall be measured from the inside crest of the corrugations. Metal thickness of the pipe arch shall be in accordance with the plans.

End sections shall be fabricated from materials conforming to the applicable requirements of AASHTO M 218. Metal thickness of the end section shall be in accordance with the plans.

714.07 Bituminous Coated Corrugated Steel Culvert Pipe and Pipe-Arch. Bituminous coated corrugated steel culvert pipe and pipe-arch shall conform to the requirements of Subsections **714.05** and **714.06** and AASHTO M 190, Type A, Type B, or Type C. The pipe or pipe-arch shall be coated with bituminous materials as hereinafter described for the particular type specified.

Type A, Fully Bituminous Coated Culvert Pipe, shall be uniformly coated with bituminous material, inside and outside, to a minimum thickness of 0.05 inch, measured on the crests of the corrugations.

Type B, Half Bituminous Coated and Paved Culvert Pipe, shall be uniformly coated for approximately one-half of the circumference of the pipe (bottom of the pipe installed), inside and outside to a minimum thickness of 0.05 inch and in addition, the bituminous material shall be applied in such a manner that one or more smooth pavements will be formed in the invert (inside bottom of the pipe when installed), filling the corrugations for at least 25% of the circumference of a pipe and 40% of the circumference of a pipe-arch. The pavement shall have a minimum thickness 1/8 inch above the crest of the corrugations, except where the upper edges intersect the corrugations.

Type C, Fully Bituminous Coated and Paved Culvert Pipe, shall be fully coated as required for Type A above and in addition, a smooth pavement shall be provided as required for Type B above.

714.08 Corrugated Aluminum Alloy Culvert Pipe and Pipe-Arch. This pipe shall conform to AASHTO M 196. The thickness of the pipe shall be in accordance with the plans.

714.09 Corrugated High Density Polyethylene Culvert Pipe (12 Inch Diameter or Greater). This pipe shall conform to the requirements of AASHTO M 294, Type C or Type S, as required.

Type C pipe shall have corrugated, high density surface both inside and outside, and shall only be used in temporary applications.

Type S pipe shall have an outer corrugated high density pipe wall and a smooth inner liner, and shall be the only type used in permanent applications

Only materials from sources appearing on the Department's approved list entitled "Corrugated High Density Polyethylene Pipe Sources" shall be used in the work. A copy of this approval list of sources may be obtained from the Department's Research and Materials Engineer. A manufacturer may request to be included on the approval list by furnishing certified test results from an independent laboratory verifying that the proposed pipe design meets or exceeds the requirements of this specification. The request must also include a certification of materials. Further, the manufacturer shall furnish complete instructions as to installation along with technical data sheets and materials safety data sheets. The approval process may require a demonstration of installation procedures and an in-plant inspection of quality control procedures.

After source approval, the manufacturer shall furnish with each shipment of materials a certification showing brand name, S.C. File Number for the project, the shipping date and to whom it is shipped, and the quantity and size of pipe represented. The certificate shall contain a statement that the material meets the South Carolina Department of Transportation specifications and is essentially the same as that approved by the Department. The shipped pipe and fittings shall be plainly marked with the manufacturer's name, trademark and type of pipe as specified in AASHTO M 294. A materials safety data sheet and installation instructions shall be furnished with each shipment.

Changes in design and/or materials after initial source approval shall be submitted to the Engineer for evaluation.

CONSTRUCTION REQUIREMENTS

714.10 Trench and Bed for Pipe. The pipe shall be laid in a trench where possible. Trenches shall be excavated to the required grade and to a width sufficient to allow for proper jointing of the pipe and for thorough compaction of the backfill material under and around the pipe. The trench bottom shall

give full support to the pipe throughout its length. The trench bottom shall be carefully shaped to fit the bottom of the pipe for a depth of at least 10% of its overall height and shall have recesses shaped to fit any projecting hubs or bells.

Where pipe culverts are to be placed in new embankments, the embankments shall first be constructed to a height of approximately 1/2 the diameter of the pipe above the top of the designated pipe or to such height as directed by the Engineer. The embankment shall be constructed for a distance of not less than 5 times the diameter of the pipe on each side of the pipe location, after which the trench shall be excavated in the embankment as described above.

When a firm foundation is not encountered at the required grade, all such unstable material under the pipe and for a width of at least one diameter on each side of the pipe, except where widths are restricted by obstructions, shall be removed and the resulting excavation backfilled with suitable material and compacted and shall be shaped as described above.

When excavating for pipe culverts, if rock, hard pan, or other unyielding foundation material is encountered, the hard unyielding material shall be excavated below the elevation of the bottom of the pipe or pipe bell to a minimum depth of 8 inches. The width of the excavation shall be 12 inches greater than the outside diameter of the pipe and shall be refilled with suitable material and compacted and shall be shaped to form a firm uniform bed.

The Contractor shall provide, as may be necessary, for temporary diversion of water or pumping in order to permit the installation of the culvert in the dry. All trenches shall be kept free from water until any joint sealant material has hardened sufficiently not to be harmed.

If desired by the Engineer, the grade of the foundation

shall be cambered by an amount sufficient to prevent the development of a sag in the flow line as the foundation soil settles under the weight of the embankment. In no case shall the camber be sufficient to produce an adverse grade after settlement has occurred.

714.11 Laying Pipe. Each section of pipe shall have a full firm bearing throughout its length, true to line and grade given. Any pipe which settles before final acceptance or which is not in alignment shall be taken up and re-laid by the Contractor without extra compensation. Pipe laying shall begin at the downstream end of the culvert with the bell or groove ends and outside laps upstream.

When concrete elliptical pipe with circular reinforcement or concrete circular pipe with elliptical or quadrant reinforcement is used, the pipe shall be installed in such a position that the manufacturer's marks designating the top or bottom of the pipe shall be not more than 5 degrees from the vertical plane through the longitudinal axis of the pipe.

Prior to being lowered into the trench, corrugated metal pipe sections shall be closely examined and so fitted that they will form a true line of pipe when in place. Sections that do not fit together properly shall not be used. Corrugated metal pipe shall be laid with the lap down stream.

Distorted circular metal pipes shall be placed with the major axis vertical. If rods, struts, or other means are used to maintain pipe distortion, they shall not be removed before the completion of the embankment unless otherwise permitted by the Engineer.

Before laying the pipe or during the pipe laying operations, adequate outfall ditches and inlets free of obstructions shall be constructed in order that proper drainage is provided.

When pipes are protected by endwalls or connect with drainage structures, the exposed ends shall be placed or cut off flush with the interior face of the structure. Where pipe

culverts are constructed in conjunction with existing structures, satisfactory connections shall be made as directed by the Engineer.

714.12 Joints. All concrete pipe shall be laid with cement mortar joints or approved preformed flexible watertight gaskets. The mortar mixture shall be one part portland cement and two parts approved clean sand by volume. The quantity of water in the mixture shall be sufficient only to produce a stiff, workable mortar and shall not exceed $\frac{1}{2}$ gallons of water per bag of cement. The pipe ends shall be thoroughly cleaned and wetted with water before the joint is made. Stiff mortar shall then be placed in the lower half of the bell or groove of the pipe section already laid.

Next, mortar shall be applied to the upper half of the spigot or tongue of the pipe section being laid. Then the spigot end of the pipe section shall be inserted in the groove end of the pipe section already laid, the joint pulled up tight so that the joint shall be pressed full. Care shall be taken to see that the inner surfaces of the abutting pipe sections are flush and even. After the section is laid, the inner circumference of the joints shall be sealed and packed with mortar and finished smooth and flush with the adjacent section of pipe. Additional mortar shall be applied from the outside and forced into the unfilled portion of the bell or groove to fill completely the annular space around the spigot or tongue. Mortar joints shall be made with an excess of mortar to form a bead around the outside of the conduit. Pipes more than 36 inches in diameter shall have beads of not less than 4 inches wide nor less than 2 inches thick. The completed joints shall be protected against rapid drying by suitable covering material. The back-filling operation shall be performed in such manner as not to disturb the mortared joints. After placement of the earth fill, any joints found not filled with mortar due to settlement, or other reasons shall be finished smooth and even with the inside surface of the pipe.

Instead of the mortar mix type joints, the Contractor, at his option, may seal the culvert joints using flexible soil-tight gas-

kets conforming to the requirements of AASHTO M 198. The gaskets shall be continuous in the joint and shall be of the minimum size to produce a soil-tight joint in the annular space of the culvert. The gasket diameter may be varied by the Engineer to require enough seal or to prevent waste of the gasket material. When the culvert is in place, the gasket seal should be visible on the inside or the outside (not necessarily both) depending on where it was placed before the culvert joints were jointed. When seal is observed to be squeezing out of the inside or outside of the culvert joints in excess, special attention shall be given to the placing of the gasket on the section tongue to prevent this. In the event the seal is observed squeezing out on the inside and outside in excess, the gasket diameter may be reduced to prevent waste of seal material.

All culvert joints shall be forcefully pressed together to form a durable soil-tight joint. In all cases, the culvert joints shall be dry from all forms of moisture and free from dust and contaminants before the gasket is placed on the section tongue. The culvert trench shall be free from standing water and mud when section is being placed. Type A gaskets shall not be stretched more than 20% of the original circumference when seated on the spigot or tongue of the section. Type B gaskets may consist of one or more pieces and shall be used without stretching.

Corrugated high density polyethylene pipe joints may be the bell and spigot type that ensures a soil-tight joint. A bell may be manufactured either as part of the pipe on one end or separately from the pipe with materials as specified in AASHTO M 294. The bell, if manufactured separately from the pipe, shall be attached to the pipe when shipped. All joints shall be provided with gaskets. Gaskets shall be pre-installed on the spigot end of the pipe or inside of the bell and covered with a removable wrap. Gaskets shall be manufactured in accordance with the requirements of ASTM F 477 and shall not have any visible cracking when tested according to ASTM D 1149. Split couplers are not approved for use.

At the Contractor's option, corrugated high density polyethylene pipe joints may be installed with reinforced mastic couplers that assure a soil-tight joint. The coupler shall consist of a band of cross laminated polyethylene with the underside coated with a rubberized mastic reinforced with a heavy woven polypropylene fabric. There shall be a peelable protective film against the exposed mastic that shall be removed when the coupler band is applied to the pipe joint. Three nylon straps, 1/2 inch wide and a minimum strength of 600 pounds each, shall be located within the mastic between the outer polyethylene layer and the reinforcing polypropylene layer. The straps shall be sheathed in tubes that isolate them from the mastic, thus allowing them to slip freely when tightened around the pipe joint. The width of the coupler band shall be determined by the pipe diameter and the spacing of the corrugations. The straps shall be spaced within the coupler to correspond to the spacing of the corrugations on the pipe. The length of the coupler band shall be the length of the outside circumference of the pipe joint plus a minimum 8 inch overlap.

When the pipe sections to be joined are butted end to end, the reinforced mastic coupler, with the protective film removed, shall be placed around the pipe, spanning the joint with the exposed mastic against the pipe. The center strap within the coupler and shall be aligned over the butted pipe ends while the two outside straps shall be aligned with the first corrugation groove on each side. The ends of the band shall be overlapped at the top of the pipe. The two outside straps shall be secured tightly around the joint with a proper tensioning tool and buckles. Only after the two outside straps

are secure, the center strap shall be tightened and secured. The remaining flap, with the protective film removed, shall cover the exposed strap and working area.

In addition to be used as an alternative to bell and spigot joints, reinforced mastic couplers may be used to join corrugated pipe with dissimilar corrugation configurations, or to join

pipe of dissimilar materials.

Corrugated steel and aluminum pipe and ribbed aluminum pipe may be joined with coupling bands. The coupling band shall be fully corrugated of like material to match the same type of corrugation as the pipe that the band will join together. Pipe ends will not be re-rolled to form annular corrugations on helical pipe. Coupling bands shall conform to the requirements of AASHTO M 196 excepted for the following: Coupling bands with projections (i.e. dimples) will not be permitted. Coupling bands shall have closed cell expanded rubber gaskets to insure a soil tight joint. The gaskets shall be 12 inches wide and approximately 3/8 inch thick. Rubber O-ring gaskets will not be allowed. Bolts for all size bands shall be 0.5 inch in diameter with nuts, and shall conform to the requirements of ASTM A 307.

The jointing of sections of other types of pipe shall be done in a workmanlike manner in accordance with the standard practice recommended by the pipe manufacturer.

714.13 Backfilling. The Contractor shall advise the Engineer of the time backfilling operations are expected to begin. If he is not properly advised, the Engineer may require the excavation and re-compaction of the backfill material.

The material for backfilling shall be soil that can be readily compacted. It shall not contain large stones, frozen lumps, chunks of highly plastic clay or any other material that is deemed unsuitable by the Engineer.

The backfill material shall be thoroughly compacted at the proper moisture content, in layers not exceeding 6 inches of compacted material. Compaction shall be performed by the use of mechanical tampers with the assistance of hand tamps when necessary. Care shall be exercised to thoroughly compact the backfill under the haunches of the pipe and to insure that the backfill soil is in intimate contact with the side of the pipe. The backfill shall be brought up evenly on both sides of the pipe for its full length.

Backfill compaction may be supplemented by rolling or operating heavy equipment longitudinally parallel with the culvert, provided care is taken to avoid displacement or damage of the pipe.

In addition, compaction of backfill for the corrugated high density polyethylene pipe shall be a minimum of 95% of the AASHTO T 99 maximum dry density. Care shall be given not to damage or misalign the pipe during the backfill operation.

714.14 Installing Pipe Culvert Under Existing Pavement.

On projects where the original approach pavement structure is being retained, the pipe culvert shall be laid as herein specified. The portion of the pavement structure removed due to the excavation of the trench shall be repaired using the same type of materials used in the original construction. The Engineer may accept the use of other materials as he deems appropriate. The work shall be performed as directed by the Engineer. The cost of the materials and the labor involved shall be included in the unit bid price for the culvert pipe.

714.15 Removing Existing Pipe. Existing pipe shall be removed in accordance with the provisions of Subsection **202.04**.

714.16 Cleaning Out Pipe. The entire length of new and re-laid pipe culverts shall be thoroughly cleaned out. Retained pipe culverts shall be maintained in the same condition as existed before beginning work.

714.17 Placing Pipe Under Railroads and Other Transportation Facilities.

When the plans include the installation of pipe under railroads or other transportation facilities not under the jurisdiction of the Department, the Contractor shall, unless otherwise provided, install the pipe using such methods and procedures required by the owner. There will be no extra payment for this change in methods and procedures.

This requirement will not apply to the installation under roadways.

714.18 Method of Measurement. For concrete culvert pipe, the linear feet of pipe to be measured for payment shall be the net length of each size and class or thickness of culvert pipe complete in place and accepted. The net length shall be obtained by multiplying the nominal length of the pipe sections by the number of sections used. The maximum length of pipe approved for payment shall not exceed the length required if only 4 foot sections of pipe were used.

For all culvert pipe, except concrete, the quantity of pipe to be measured for payment shall be the actual number of linear feet of each size, class, thickness, or type of culvert pipe, complete in place and accepted.

Tees, wyes, elbows, bends, reducers, and increasers shall be measured by the unit for each size, kind, and class, thickness, or type of unit, complete in place and accepted. The length of each unit will not be included in the linear feet of culvert pipe when measured as provided herein.

The excavation of unyielding, unstable, or otherwise unsuitable material necessary to obtain a satisfactory foundation for pipe culverts as outlined in Subsection **714.10**, shall be measured as provided in Subsection **203.13**. The unstable material shall be disposed of in the manner as outlined in Subsection **203.06**.

The excavation necessary for the removal of existing pipe culverts that are not to be replaced by new culverts will be measured in cubic yards as set forth in Subsection **202.06C**.

714.19 Basis of Payment. Culvert pipe, tees, wyes, bends, reducers, and increaser, measured as provided in Subsection **714.18**, will be paid for at the contract unit price for the respective items, which price and payment shall be full compensation for furnishing, hauling and placing all pipe sections and materials, excavation and backfilling new or existing

trench, removal of existing pipe to be replaced, constructing pipe joints, removal of old endwalls, cleaning out pipe, disposal of surplus materials and for all labor, equipment , tools and incidentals necessary to complete the work.

The excavation of unyielding or unstable material, measured as provided in Subsection **714.18**, will be paid for at the contract unit price for Unclassified Excavation in accordance with Subsection **203.15**.

The excavation, measured in accordance with Subsection **714.18**, will be paid for at the contract unit price for Unclassified Excavation, which price and payment shall be full compensation for all work and costs of removal, transporting, and storing or disposing of existing pipe that is not to be replaced by a new structure.

Payment for each item will include all direct and indirect costs and expenses necessary to complete the work.

Payment will be made under:

Item No.	Pay Item	Pay Unit
714XXXX	<i>(size) (kind) Culvert Pipe (class or thickness or type)</i>	Linear Foot
714XXXX	<i>(size) (kind) Pipe Culvert Beveled End Section (class or thickness)</i>	Each
714XXXX	<i>(size) (kind) Pipe Culvert Flared End Section (class or thickness)</i>	Each

Pay Items (Continued)

Item No.	Pay Item	Pay Unit
714XXXX	<i>(size) (kind) Pipe Culvert Tee (class or thickness or type)</i>	Each

714XXXX	<i>(size) (kind) Pipe Culvert Wye (class or thickness or type)</i>	Each
714XXXX	<i>(size) (kind) Pipe Culvert (degree) Bend (class or thickness)</i>	Each
714XXXX	<i>(size) (kind) Reducer (size) to (size) Diameter (class or thickness)</i>	Each
714XXXX	<i>(size) (kind) Increaser (size) to (size) Diameter (class or thickness)</i>	Each

SECTION 715

STRUCTURAL PLATE PIPE STRUCTURAL PLATE PIPE-ARCH AND STRUCTURAL PLATE ARCH CULVERTS

715.01 Description. This work shall consist of furnishing galvanized corrugated steel structural plates or corrugated aluminum alloy structural plates, of the required shape, size and thickness; assembling such plates to form a pipe culvert, pipe-arch culvert or an arch culvert of the length, size and design indicated on the plans or specified; and installing these culverts to provide drainage structures at places designated on the plans or by the Engineer, in accordance with these specifications and to the lines and grades given.

MATERIALS

715.02 Plates, Nuts, and Bolts. Plates, nuts, and bolts shall conform to the requirements of AASHTO M 167 or AASHTO M 219.

When so specified on the plans, structural plate pipe shall be vertically elongated in advance of placing backfill material.