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DEPARTMENT OF PUBLIC WORKS AND HIGHWAYS
OFFICE OF THE SECRETARY
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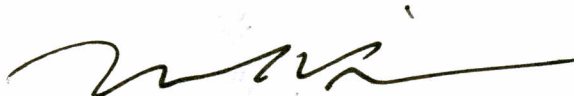
DEPARTMENT ORDER)
44)
NO. _____)
Series of 2018 03.20.18

SUBJECT: Amendment to DPWH Standard
Specification for Item 1719 –
Underdrains and Flap Gates

It has been the thrust of the Department to provide effective standard specifications in the implementation of various infrastructure projects. As such, there is a need to set an updated standard specification for the proper construction of underdrains and flap gates for flood control and drainage projects. The attached amendment for the **DPWH Standard Specification for Underdrains and Flap Gates, Item 1719** is hereby prescribed for the guidance and compliance of all concerned.

This specification shall form part of the on-going revision of the DPWH Standard Specifications for Public Work Structures – Buildings, Ports and Harbors, Flood Control and Drainage Structure and Water Supply Systems, Volume III, 1995 Edition.

This Order shall take effect immediately.


MARK A. VILLAR
Secretary

14.1.2 FET/RGT

Department of Public Works and Highways
Office of the Secretary


WIN8U01585

Amendment to DPWH Standard Specification for ITEM 1719 – UNDERDRAINS AND FLAP GATES

1719.1 Description

This Item shall consist of constructing underdrains, using pipe and granular filter materials, underdrain pipe outlets, and blind drains using granular material in accordance with this Specification and in reasonably close conformity with the lines and grades shown on the Plans or as established by the Engineer to effectively reduce excessive moisture content of existing subgrade for stable and long lasting pavement. This includes flap gates which are quality water control gates in circular, square and rectangular form, usually made of ductile, cast iron, with two (2) percent nickel or Ni-Resist.

1719.1.1 Definition

Fiber Reinforced Plastic (FRP) - a thermoset polymer matrix reinforced with a fiber or other material with a sufficient aspect ratio (length to thickness) to provide a discernable reinforcing function in one or more directions. This material is solid plastic polymer fiberglass reinforced polyester.

1719.2 Material Requirements

1719.2.1 Underdrains

Underdrain pipes shall be either 100 mm or 127 mm in diameter with smooth or corrugated tubing unless otherwise shown in the Plans. The size of the underdrain to be furnished will be based on the nominal internal diameter of a pipe. Sizes from 150 mm to 254 mm shall be considered as special provision and supported with hydrologic data.

Material for underdrains shall meet the requirements specified in Table 1719.1.

Table 1719.1 – Requirements for Underdrains

Material	Reference Standard
1. Zinc coated (galvanized) corrugated iron or steel culverts and underdrains	AASHTO M 36 - Standard Specification for Corrugated Steel Pipe, Metallic-Coated, for Sewers and Drains
2. Extra strength and standard strength clay pipe and perforated clay pipe	ASTM C700 - Standard Specification for Vitrified Clay Pipe, Extra Strength, Standard Strength, and Perforated
3. Perforated concrete pipe	AASHTO M 175 - Standard Specification for Perforated Concrete Pipe
4. Porous concrete pipe	AASHTO M 176 - Standard Specification for Porous Concrete Pipe
5. Bituminized-fiber non-pressure sewer drain and underdrainage pipe systems	ASTM C293M - Standard Test Method for Flexural Strength of Concrete (Using Simple Beam with Center-Point Loading)
6. Corrugated Polyethylene Drainage Pipe	AASHTO M 252 - Corrugated Polyethylene Drainage Pipe

Material	Reference Standard
7. Corrugated Polyethylene Pipe	AASHTO M 294 - Corrugated Polyethylene Pipe, 300-to 1500-mm Diameter
8. Poly (Vinyl Chloride) (PVC) Profile Wall Drain Pipe and Fittings	AASHTO M 304 - Poly (Vinyl Chloride) (PVC) Profile Wall Drain Pipe and Fittings Based on Controlled Inside Diameter
9. Polypropylene Pipe	AASHTO M 330 - Polypropylene Pipe, 300 to 1500 mm Diameter
10. Asbestos-cement perforated underdrain pipe	ASTM C508M - Standard Specification for Asbestos-Cement Underdrain Pipe

Pipe fittings shall match the pipe material type to be used.

Granular backfill filter material shall be permeable and shall meet the requirements of AASHTO M 6, Fine Aggregates for Hydraulic Cement Concrete, except that soundness tests shall not be required and minor variation in grading and content of deleterious substances may be approved by the Engineer.

Table 1719.2 – Fine Drain Fill (AASHTO M 6, Fine Aggregate)

Filter Aggregate Size	Percent Passing by Weight
9.5 mm	100
4.75 mm	95 to 100
2.36 mm	80 to 100
1.18 mm	50 to 85
600 µm	25 to 60
300 µm	10 to 30
150 µm	2 to 10

The plants shall be inspected periodically as required by the Engineer in compliance with the specified manufacturing methods. Material sample shall be obtained for laboratory testing for compliance with material quality requirements. This shall be the basis for acceptance of manufacturing lots as to quality.

Filter cloth for underdrain trenches shall conform to the applicable requirements of Item 1404, Filter Fabric and Aggregates or as indicated in the Plans.

All material shall be subjected to inspection for acceptance as to condition at the latest practicable time.

1719.2.2 Fiber Reinforced Plastic Mortar (FRPM) Pipe Culverts

The pipes shall be free from injurious flaws and the inner surfaces thereof shall be smooth. Fiber reinforced plastic mortar pipe culverts shall be either ordinary or perforated.

Unless otherwise shown on the drawings, the FRPM pipe dimensions shall be as shown in Table 1719.3.

Table 1719.3 – Dimensions of FRPM Pipes

Property	Drainage Pipes		Ventilation Pipe
	Ordinary	Perforated	Perforated
Nominal diameter (mm)	300	300	200
Minimum wall thickness (mm)	8.0	8.0	7.0
Diameter of perforations (mm)	none	20.0	20.0
No. of holes around circumference	none	5	3
Longitudinal distance between holes	none	190	190

For FRPM pipe with specified nominal diameter ranging from 200 mm – 500 mm, the dimensional tolerances shall be within the following range for each property:

Table 1719.4 – Dimensional Tolerances for FRPM Pipes

Property	Tolerance (mm)
Pipe thickness	+3.0
Inner diameter of straight pipe part	+ 1.50
Outer diameter of straight pipe part	+ 1.50
Length of socket	+ 1.50
Effective length of the pipe	+30.0 - 10.0

The external pressure strengths of FRPM pipes shall be tested in accordance with ASTM D2924, Standard Test Method for External Pressure Resistance of "Fiberglass" (Glass-Fiber-Reinforced Thermosetting-Resin) Pipe.

1719.2.3 Flap Gate

The flap gate shall be obtained from an approved manufacturer and the Contractor shall submit full drawings and details of the proposed flap gate to the Engineer for approval at least 28 days before commencing installation of any flap gate.

The flap gates and frames shall have the following features:

1. Dual hinge arms, each with dual pivot points.
2. Stops to prevent the flap from overturning.
3. Distance between hinge arms approximately equal to clear opening width.
4. Fifty to seventy Chloroprene seals of durometer hardness.
5. Stainless steel hinge pins in double shear.
6. Frame and cover, either an ultraviolet stabilized Fiber Reinforced Plastic (FRP) or Aluminum Alloy 5083, as appropriate to the flap gate body material.

The flap gate shall be in accordance with the details shown in Table 1719.5 except otherwise indicated in the Plans or as directed by the Engineer.

Table 1719.5 – Flap Gate Dimensions and Sizes

Location	Material	Shape	Size
Drainage Outlets	FRP	Circular	300 mm dia.
	FRP	Circular	750 mm dia.
	FRP	Circular	900 mm dia.
Sluice Structure	Aluminum	Rectangular	2000 mm x 2000 mm
	Aluminum	Rectangular	1700 mm x 1700 mm

Flap gates shall have one (1) standard material combination as listed in Table 1719.6:

Table 1719.6 – Material Standard Combination for Flap Gates

Description	Standard Material	Reference Standard
Seat and Cover	Cast iron, Class B	ASTM A126 - Standard Specification for Gray Iron Castings for Valves, Flanges, and Pipe Fittings
Seating Faces	Silicon Bronze, Alloy 651	ASTM B98 - Standard Specification for Copper-Silicon Alloy Rod, Bar and Shapes
Pivot Lugs	Ductile Iron, Grade 80-55-06	ASTM A536 - Standard Specification for Ductile Iron Castings
Links		
Bushings	Bronze, Alloy 932	ASTM B584 - Standard Specification for Copper Alloy Sand Castings for General Applications
Fasteners	Stainless Steel, Alloy Group 2, type 316	ASTM F593 - Standard Specification for Stainless Steel Bolts, Hex Cap Screws, and Studs

1719.2.3.1 Fiber Reinforced Plastic (FRP)

FRP shall conform to the requirements of the following ASTM standards in Table 1719.7:

Table 1719. 7 – ASTM Standards for FRPM

Designation	Description
ASTM D638	Standard Test Method for Tensile Properties of Plastics
ASTM D3039M	Standard Test Method for Tensile Properties of Polymer Matrix Composite Materials
ASTM D790	Standard Test Methods for Flexural Properties of Unreinforced and Reinforced Plastics and Electrical Insulating Materials
ASTM D695	Standard Test Method for Compressive Properties of Rigid Plastics
ASTM D570	Standard Test Method for Water Absorption of Plastics
ASTM D1435	Standard Practice for Outdoor Weathering of Plastics

1719.2.3.2 Aluminum Alloy 5083

Aluminum Alloy 5083 used in flap gates shall conform to ASTM B209M, Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate.

1719.2.3.3 Submittals

The flap gate manufacturer shall submit three (3) copies of their most recent product brochure for the FRP flap gate product covered by this Specification.

The submitted flap gate shall be manufactured in accordance with the requirements of this Specification and shall be a standard commercial product. Additional or better features which are not specifically prohibited by this Specification, but which are a part of manufacturer's standard commercial product, shall be included in the flap gate being furnished. A standard commercial product is one that has been sold or is currently offered for sale on the commercial market through advertisements or manufacturer's catalogs or brochures.

The manufacturer shall also have in place a Quality Assurance Program that will ensure the FRP flap gate is in conformance with the intent of this Specification. Each delivered FRP flap gate shall be examined by the Engineer for compliance with the appropriate requirements of this specification. This inspection shall encompass all visual examinations including minor cracks, dents or chipped-offs and dimensional measurements. Noncompliance with any specified requirements or presence of one or more major defects preventing or lessening maximum efficiency shall constitute cause for rejection.

1719.2.3.4 Manufacturer's Certificate

The Contractor shall submit the manufacturer's Material Safety Data Sheet (MSDS) or the manufacturer's certificate of the FRP flap gate and pipe culverts to confirm the physical and chemical characteristics of the material, including but not limited to material information about hazardous ingredients, if any, and other pertinent information so as to fully describe the said FRP flap gates and aluminium component, as well. The manufacturer shall include in the said certificate guarantee/warranty stating the FRP material that is furnished meets the requirement of the Specification. The certificate shall be attested to by a person having legal authority to bind the company. Either mismarking or misinterpretation by the manufacturer shall be reason to discontinue acceptance under these specifications. Notice sent to the manufacturer by the purchaser regarding the discontinuance of acceptance shall be considered to be a notice to all wholesalers, jobbers, distributors, agents and other intermediaries handling the manufacturer's product.

1719.3 Construction Requirements

1719.3.1 Pipe Installation

Trenches shall be excavated to the dimensions and grades required by the Plans or as directed by the Engineer. The excavation shall begin at the outfall and proceed toward the upper end. A minimum of 50 mm bedding layer of granular backfill material shall be placed and compacted at the bottom of the trench and a width equal to the outer diameter of underdrain pipe plus 300 mm and length.

Filter cloth, if called for on the Plans, shall be placed as shown on the Plans and Standard Details and shall conform to the applicable requirements of Item 1404, Filter Fabric and Aggregates.

Subdrainage pipe of the type and size specified shall be embedded firmly in the bedding material.

Perforated pipe shall normally be placed with the perforations down and the pipe sections shall be joined securely with the appropriate coupling fittings or bands.

Non-perforated pipe shall be laid with the bell end up grade and with open joints wrapped with suitable material to permit entry of water, or unwrapped as may be specified. Upgrade end sections of all sub-drainage pipe installations shall be closed with suitable plugs to prevent entry of soil materials.

After the pipe installation has been inspected and approved, granular backfill material shall be placed to a height of 300 mm above the top of pipe. Care shall be taken not to displace the pipe or the covering at open joints. The remainder of the granular backfill material shall then be placed and compacted in 150 mm maximum layers to the required height. Any remaining portion of trench above the granular backfill shall be filled with either granular or impervious material, as may be specified, and thoroughly compacted.

1719.3.2 Underdrain Outlets

Trenches for underdrain outlets shall be excavated to the width and depth shown on the Plans or as otherwise directed. Pipes shall be laid in the trench with all ends firmly joined by the applicable methods and means. Pipe screens shall be placed in the end of the outlet pipe. Underdrain outlet protectors shall be constructed as indicated on the Plans. After inspection and approval of the pipe installation, the trench shall be backfilled in accordance with Item 803, Structure Excavation.

1719.3.3 Blind Drain

Trenches for blind drains shall be excavated to the width and depth shown on the Plans and shall be filled with granular backfill material to the depth required by the Plans. Any remaining upper portion of trench shall be filled with either granular or impervious material in accordance with Item 803, Structure Excavation.

1719.3.4 Flap Gates

1719.3.4.1 Installation of Flap Gates

The gate shall be anchored to the drainage structure end wall or to the sluice structure wall with stainless steel anchor bolts.

The Contractor shall ensure that the anchor holes are accurately located and shall check the hole spacing by "dry fitting" the gate frame before attempting to mount the gate body on the wall.

Where a flap gate is to be installed for a circular culvert pipe, the gate shall be sized to allow attachment of the gate frame to the culvert end wall without the anchoring bolts damaging the pipe culvert wall.

1719.3.4.2 Tests after Installation of Flap Gates

After installation, the Contractor shall carry out the following tests/inspections on all flap gates:

1. Inspection by feeler gauge measurement of all sealing faces.
2. Inspection of satisfactory installation of all clamping elements.
3. Measurement of the clamping torque.
4. Checking of satisfactory operation under dry condition.
5. Checking of satisfactory release of water under the attainable landside and river water level.
6. Checking of water leakage from the closed valve under an acceptable river water level.

Following rectification of any defects or following identification of improper operation, the complete set of tests/inspections shall be repeated to the satisfaction of the Engineer.

1719.4 Method of Measurement

Underdrains and outlets shall be measured by linear meter of pipe per type and size specified. Blind drains shall be measured by linear meter including all excavation and backfill materials required.

Granular backfill filter material, when specified in the Contract as a Pay Item shall be measured in place by the cubic meter, completed and accepted. Cross-sectional measurements will not exceed the net dimensions shown on the Plans or as directed by the Engineer. Filter cloth shall be considered as a subsidiary Item under Item 1719, Underdrains and Flap Gates, thus it shall not be measured separately.

Excavation for underdrain pipe will be measured and paid for as provided in Item 803, Structure Excavation.

The quantities to be paid for FRPM pipes shall be measured in meters of installed FRPM pipes.

The quantities to be paid for flap gates shall be the number of each size of the gates completed and accepted by the Engineer.

1719.5 Basis of Payment

The accepted quantities determined as provided in Section 1719.4, Method of Measurement, shall be paid for at the Contract unit prices for underdrains and flap gates which price and payment shall be full compensation for furnishing and installing all materials, labor, equipment, tools and incidentals necessary to complete this Item. Ancillary items for installation of flap gate shall not be separately measured for payment and the cost of these items shall be considered to have been included for flap gate.

Payment shall be made under:

Pay Item Number	Description	Unit of Measurement
1719 (1)	Underdrain	Linear Meter
1719 (2)	Blind drain	Linear Meter
1719 (3)	Granular Backfill Filter Material For Underdrains	Cubic Meter
1719 (4) a1	Fiber Reinforced Plastic Mortar (FRPM) Pipe, 300 mm dia.	Meter
1719 (4) a2	Fiber Reinforced Plastic Mortar (FRPM) Pipe, 200 mm dia.	Meter
1719 (4) b1	Fiber Reinforced Plastic Mortar (FRPM) Perforated Pipe, 300 mm dia.	Meter
1719 (4) b2	Fiber Reinforced Plastic Mortar (FRPM) Perforated Pipe, 200 mm dia.	Meter
1719 (5) a1	Fiber Reinforced Plastic (FRP) Flap Gate, 300 mm dia.	Each
1719 (5) a2	Fiber Reinforced Plastic (FRP) Flap Gate, 750 mm dia.	Each
1719 (5) a3	Fiber Reinforced Plastic (FRP) Flap Gate, 900 mm dia.	Each
1719 (6) a1	Rectangular Aluminum Flap Gate, 2000 x 2000 mm	Each
1719 (6) a2	Rectangular Aluminum Flap Gate, 1700 x 1700 mm	Each

References:

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2. <http://www.in.gov/indot/files/proced2chapter10.pdf> - 10 Underdrains
3. <https://www.udot.utah.gov/main/uconowner.gf?n=21939100246622725> - Supplemental Specification 2012 Standard Specification Book SECTION 02622 UNDERDRAIN
4. <http://ftp.dot.state.tx.us/pub/txdot-info/cmd/cserve/specs/1995/standard/m556.pdf> - ITEM 556 PIPE UNDERDRAINS
5. <http://www.fdot.gov/roadway/DS/13/IDx/00286.pdf> - underdrain 2013
6. http://www.caltrain.com/assets/_engineering/engineering-standards-2/Specs/Div2/02620.pdf - Caltrain Standard Specifications 02620 -1 September 30, 2011 SUBDRAINAGE SYSTEMS SECTION 02620 SUBDRAINAGE SYSTEMS
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8. ASTM Standards
9. Introduction to Aluminum Alloys and Tempers J. Gilbert Kaufman, p39-76 DOI:10.1361
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