

MDOT PIPE CULVERT MATERIAL DESIGN CRITERIA

Adopted August 24, 2000 (Latest Revision November 26, 2007)

I. CROSS-DRAINS

- A. Design Life: 50 years
- B. Alternates to be considered
 - 1. Rural Collectors and Local Roads- where Average Daily Traffic (ADT) \leq 4000 **and** Average Daily Truck (T) \leq 400 **and** pipe size \leq 48 inch (1200 mm) diameter, alternates to be considered are:
 - a. Concrete
 - b. Galvanized steel (AASHTO Designation: M 36)
 - c. Galvanized steel bituminous-coated (AASHTO Designation: M 190)
 - d. Aluminized type 2 steel (AASHTO Designation: M 36)
 - e. Polymer-coated [250 μ m (10 mils) x 250 μ m (10 mils)] (AASHTO Designation: M 245)
 - f. Aluminum alloy (AASHTO Designation: M 196, Type IA)
 - g. High Density Polyethylene (AASHTO Designation: M 294, Type S)
 - h. Poly (Vinyl Chloride) (PVC) (AASHTO Designation: M 304)Minimum cover for alternates b-h shall be 12 inch (300 mm).
Alternates b-h shall be joined with systems approved by the standard specifications for cross-drain applications.
All alternates shall have concrete end sections.
Alternates g & h shall have soil tight joints, unless otherwise specified.
 - 2. All other functional classifications or other Collectors and Local Roads, urban or rural, where ADT and/or T and/or pipe size exceeds limits shown in number 1 above: concrete only.

II. SIDE-DRAINS

- A. Design Life for all functional classifications:
Urban: 50 years Rural: 25 years
- B. Alternates to be considered are:
 - 1. Concrete
 - 2. Galvanized steel (AASHTO Designation: M 36)
 - 3. Galvanized steel bituminous-coated (AASHTO Designation: M 190)
 - 4. Aluminized type 2 steel (AASHTO Designation: M 36)
 - 5. Polymer-coated [250 μ m (10 mils) x 250 μ m (10 mils)] (AASHTO Designation: M 245)
 - 6. Aluminum alloy (AASHTO Designation: M 196, Type IA)
 - 7. High Density Polyethylene (AASHTO Designation: M 294, Type S), \leq 48 inch (1200 mm) diameter
 - 8. Poly (Vinyl Chloride) (PVC) (AASHTO Designation: M 304), \leq 48 inch (1200mm) diameterMinimum cover for alternates 2-8 shall be 12 inch (300 mm).
Alternates 2-8 shall be joined with systems approved by the standard specifications for side-drain applications.
All alternates shall have concrete end sections.
Alternates 7 & 8 shall have soil tight joints, unless otherwise specified.

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III. STORM-DRAINS

- A. Design Life: 50 years.
- B. For pipe sizes \leq 48 inch (1200 mm) diameter, in locations outside the travel and auxiliary lanes and beyond the alignment of the curb and gutter inlets, alternates to be considered are:
 - 1. Concrete
 - 2. Galvanized steel (AASHTO Designation: M 36)
 - 3. Galvanized steel bituminous-coated (AASHTO Designation: M 190)
 - 4. Aluminized type 2 steel (AASHTO Designation: M 36)
 - 5. Polymer-coated [250 μ m (10 mils) x 250 μ m (10 mils)] (AASHTO Designation: M 245)
 - 6. Aluminum alloy (AASHTO Designation: M 196, Type IA)
 - 7. High Density Polyethylene (AASHTO Designation: M 294, Type S)
 - 8. Poly (Vinyl Chloride) (PVC) (AASHTO Designation: M 304)Minimum cover for alternates 2-8 shall be 12 inch (300 mm) where storm drain crosses a side street.
Alternates 2-8 shall be joined with systems approved by the standard specifications for storm drain applications.
All alternates shall have concrete end sections.
Alternates 7 & 8 shall have soil tight joints, unless otherwise specified.
- C. For pipe sizes $>$ 48 inch (1200 mm) diameter and/or locations under the travel and auxiliary lanes and/or locations within the alignment of the curb and gutter inlets and/or for storm-drains used as under-drains, alternates to be considered: concrete only.

IV. UNDER-DRAINS

- A. Design Life: 50 years.
- B. For pipe sizes \leq 6 inch (150 mm) diameter:
 - 1. Concrete
 - 2. Galvanized steel (AASHTO Designation: M 36, Type III)
 - 3. Galvanized steel bituminous-coated (AASHTO Designation: M 190, Type A)
 - 4. Aluminized type 2 steel (AASHTO Designation: M 36, Type III)
 - 5. Polymer-coated [250 μ m (10 mils) x 250 μ m (10 mils)](AASHTO Designation: M 245, Type III)
 - 6. Aluminum alloy (AASHTO Designation: M 196, Type III)
 - 7. Type PSM Poly (Vinyl Chloride) (PVC) Sewer Pipe (ASTM Designation: D 3034, for the pipe SDR number specified)
 - 8. Acrylonitrile-Butadiene-Styrene (ABS) Sewer Pipe (ASTM Designation: D 2751, for the pipe SDR number specified)
 - 9. Poly (Vinyl Chloride) (PVC) Class PS46 (AASHTO Designation: M 278)
 - 10. Corrugated Polyethylene (AASHTO Designation: M 252, Type S and/or Type SP)Alternates 2-10 shall be joined with systems approved by the standard specifications for under-drain applications.
For alternates 2-6, manufacturer must repair coating damage resulting from perforating pipe.
Non perforated PVC pipe shall either be manufactured with an ultra-violet light inhibitor or be fully coated with an ultra-violet light inhibitor.

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IV. UNDER-DRAINS (continued)

- C. For pipe sizes > 6 inch (150 mm) and ≤ 48 inch (1200 mm) diameter **and** in locations outside the travel and auxiliary lanes, alternates to be considered are:
1. Concrete
 2. Galvanized steel (AASHTO Designation: M 36, Type III)
 3. Galvanized steel bituminous-coated (AASHTO Designation: M 190, Type A)
 4. Aluminized type 2 steel (AASHTO Designation: M 36, Type III)
 5. Polymer-coated [250 μm (10 mils) x 250 μm (10 mils)] (AASHTO Designation: M 245, Type III)
 6. Aluminum alloy (AASHTO Designation: M 196, Type III)
 7. High Density Polyethylene (for pipe sizes ≥ 12 inch (300 mm), AASHTO Designation: M 294, Type S and Type SP ; for pipe sizes < 12 inch (300 mm), AASHTO Designation: M 252 Type S and/or Type SP)
 8. Poly (Vinyl Chloride) (PVC) (AASHTO Designation: M 304)
- Minimum cover for alternates 2-8 shall be 12 inch (300 mm).
Alternates 2-8 shall be joined with systems approved by the standard specifications for under-drain applications.
For alternates 2-6, manufacturer must repair coating damage resulting from perforating pipe.
All alternates shall have concrete end sections.
Non perforated PVC pipe shall either be manufactured with an ultra-violet light inhibitor or be fully coated with an ultra-violet light inhibitor.

V. "ADD-ON" LIFE

The following "ADD-ON" life for protective or barrier coating will be:

<u>TYPE</u>	<u>YEARS</u>
A. Bituminous coated	3
B. Aluminized Type 2	10
C. Polymer Coated (0.25 μm [10 mils] each side)	20

VI. ADDITIONAL REQUIREMENTS FOR METAL PIPE

- A. The California Department of Transportation (CALTRANS) method is to be used to determine the life of steel culverts. The pipe life is time to first perforation.
- B. Aluminum Alloy Pipe is restricted to soil and water pH ranges between 5 and 9. The estimated life is as follows:
- | | |
|---|--------------|
| 1. Resistivity above 10,000 ohm centimeters | 50 year life |
| 2. Resistivity between 1,500 to 10,000 | 25 year life |
- C. Do not use steel pipe in marshy areas or other areas where standing water will be a common occurrence.
- D. Do not use steel pipe as cross-drains in locations where the pH is less than 4 and/or the resistivity is less than 10,000 ohm centimeters.
- E. Do not use Aluminum Alloy or Aluminized Type 2 Steel Pipe as cross-drains in locations where the pH is less than 5 or greater than 9 and/or the resistivity is less than 10,000 ohm centimeters.
- F. If the pH is less than 4 and/or the resistivity is less than 1000 ohm centimeters, steel pipe will not be considered for side-drains.
- G. If the slope of side-drains is greater than 4 percent and the velocity of flow through cross-drains is computed to be greater than 8 ft/sec (2.4 meters per second), specify paved inverts.

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VII. BEDDING AND BACKFILL REQUIREMENTS FOR NON-RIGID PIPE IN CROSS-DRAIN AND STORM-DRAIN APPLICATIONS

- A. Bedding shall be Class B in accordance with Subsection 603.03.2 of the *Mississippi Standard Specifications for Road and Bridge Construction, 2004 Edition*.
- B. Backfill material shall be one of the following:
 - 1. Flowable Fill in accordance with Section 631 of the *Mississippi Standard Specifications for Road and Bridge Construction, 2004 Edition*.
 - 2. Crushed Stone Aggregate Backfill in accordance with Subsection 703.04.03 of the *Mississippi Standard Specifications for Road and Bridge Construction, 2004 Edition*.

If Backfill material 1 is utilized, care shall be taken to prevent "floating" of pipe.

The cost of furnishing and placing the required bedding and backfill material indicated in A & B shall be included in the unit cost of the non-rigid pipe alternate, i.e., there will be no separate pay item for non-rigid pipe bedding and backfill material.

VIII. BEDDING AND BACKFILL REQUIREMENTS FOR NON-RIGID PIPE IN SIDE-DRAIN APPLICATIONS

- A. Bedding shall be Class C in accordance with Subsection 603.03.2 of the *Mississippi Standard Specifications for Road and Bridge Construction, 2004 Edition*.
- B. Backfill material shall be in accordance with Subsection 203.03.8.6 of the *Mississippi Standard Specifications for Road and Bridge Construction, 2004 Edition*.

Pipes that serve as a side-drain on Departmental ROW, but travel under a county or local road shall adhere to the bedding and backfill requirements for a cross-drain contained in Section VII of this criteria.

The cost of furnishing and placing the required bedding and backfill material indicated in A & B shall be included in the unit cost of the non-rigid pipe alternate, i.e., there will be no separate pay item for non-rigid pipe bedding and backfill material.

IX. CRITERIA FOR PRECAST INLETS

Precast units may be used in lieu of the cast-in-place inlets and junction boxes that are shown in Department plans and Standard Drawings. The Project Engineer shall decide whether or not precast units will be allowed on a particular project. The Project Engineer may decide to allow precast units for all inlets and junction boxes on a particular project or to require cast-in-place units at specific locations.

The Project Engineer may also allow precast units to be used that require certain segments of the precast units to be cast-in-place (i.e. tops). This condition may occur whenever the plans require the SS-2 curb inlet, for example. The precast units for SS-2 inlets usually come in more than a single segment. The bottom section, riser sections, extensions, wings and top are separate units. The tops, wings and extensions of the SS-2 inlet shall be poured in place unless otherwise specified. All of the pipe/precast inlet connections shall require a poured in place pipe collar.

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IX. CRITERIA FOR PRECAST INLETS (Cont.)

Manufacturer's precast units must have prior approval from the Roadway Design Division of MDOT before their units may be used on a MDOT project. Other manufacturers of precast units may submit their drawings to the Roadway Design Division for review. Approved shop drawings will be maintained on file in the Roadway Design Division and the Materials Division.

If the units are from a supplier that does not have prior approval from Roadway Design, the Project Engineer shall forward the appropriate shop drawings and letter to the Roadway Design Division for approval. Once Roadway Design has approved the shop drawings and notified the Materials Division, then the Materials Division will proceed with setting up inspection of the units.

Precast units will also require inspection by the Materials Division. This inspection will follow the procedures in place for inspecting concrete pipe. When precast units are allowed on a project, the Project Engineer shall forward a letter of request for inspection to the Materials Division.

X. ACCEPTANCE CRITERIA

- A. Rigid Pipe and Plastic Pipe shall meet all applicable requirements contained within Section 708 of the Mississippi Standard Specifications for Road and Bridge Construction, 2004 Edition.
- B. Metal Pipe shall meet the requirements of Section 709 of the Mississippi Standard Specifications for Road and Bridge Construction, 2004 Edition.

XI. TRIAL INSTALLATIONS & EVALUATION

At any time, Manufacturers may request in writing to have materials not approved herein evaluated for a specific application. Requests for trial installations shall be submitted to the following:

Mississippi Department of Transportation
Research Division (86-01)
P.O. Box 1850
Jackson, MS 39215-1850

Manufacturers will be responsible for providing the pipe culvert materials to be evaluated at no cost to the MDOT.

Manufacturers will be responsible for any additional cost incurred by the construction contractor as a result of the trial installation.

MDOT will concur with the identification of a suitable location for the trial installation.

During installation, the Manufacturer shall have a representative at the installation site.

The Manufacturer shall notify MDOT's State Research Engineer at least 3 working days prior to the installation.

For cross drain applications, trial installations shall have a concrete pipe culvert installed in a separate construction trench to service the same drainage area.

Trial installations shall perform satisfactorily under design traffic loading for no less than one year before conclusions regarding product performance are made.

During the one year evaluation period, at a time chosen by the MDOT, Manufacturers will be responsible for providing laser video inspection services on the trial installation utilizing an inspection contractor selected by the MDOT.

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XI. TRIAL INSTALLATIONS & EVALUATION (Cont.)

Based on the results of the laser video inspection, trial installations shall meet Department standards for deflection, joint separation, buckling, tearing, sagging and cracking. Upon successful completion of the one year monitoring period, MDOT's Pipe Culvert Subcommittee shall review the performance and determine the acceptability of the material for future inclusion into the *MDOT Pipe Culvert Material Design Criteria*.