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ENGINEERING INSTRUCTION

NEW YORK STATE DEPARTMENT OF TRANSPORTATION

SUBJECT: DESIGN CRITERIA FOR STEEL
CORRUGATED PIPE-FIG. 8A

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APPROVED:


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This instruction transmits the following materials:

- . Revised Figure 8A of the Highway Design Manual replacing the present version
- . Section 602. Polymer Coated Steel Pipes
- . Revisions to Section 707-02 Round Corrugated Steel Pipe and Pipe Arches

These materials have been prepared to:

- . Update Figure 8A with respect to Design Life for various drainage installations
- . Allow and provide specifications for Polymer Coated Pipes and Polymer Coated Invert Paved Pipes
- . Provide a policy regarding the Anticipated Service Lives for those pipes and asphalt coated and paved pipes.

A subsequent EI will distribute new insert sheets for the pay item catalog of standard pay items. In addition to these standard items, an optional specification will be distributed under separate instruction. Section 602 was opened up only because there were no more item numbers available in Section 603-Culverts and Storm Drains.

A comparison between the attached Figure 8A and that Figure as last revised in 1979 will show:

- (1) Corrugated pipe arches smaller than 60" span by 46" rise will be specified with only 2 2/3" x 1/2' corrugations. Previously 3" x 1" and 5" x 1" corrugations were also allowed in those smaller sizes but they proved too hard to fabricate.
- (2) Minimum gages for the 3" x 1" corrugation pipe arches have been raised for several of the sizes because pipes manufactured from thinner gages experienced corner buckling.

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- (3) Note A5 has been changed and now contains a special caution that Polymer coatings should not be relied on alone to increase service life in abrasive conditions.
- (4) The new 5" x 1" corrugation has been added to the column headings. These items already are coded into the computer. See EI 82-25 for details.
- (5) On the right hand side of the sheet, the Design and Service Life Criteria has been substantially changed. These changes include: (A) the 70 year design life requirement for closed drains, previously issued by memo to Regional Designers dated July 11, 1977, is now shown on the sheets. (B) 70 years is added as design life for some open systems if they are located in the midst of closed systems. (C) The map showing where Zone I and Zone II are located has been replaced by a table, but the assignment of counties to zones remains the same. This change was made only to conserve space on the sheet. (D) The table "Anticipated Service Life-Years" has been expanded to include service life information on pipes coated with polymer and polymer coated pipes with asphalt paved inverts. No fully paved polymer coated pipe is included, nor will there be any standard items for it because it is not expected to have any longer life expectancy than polymer coated invert only paved pipe. There's no hydraulic reason for the product either because its smoother hydraulic characteristics can't be counted on for the whole life of the installation. The consequence of this is that fully paved pipe would be just as large as invert paved pipe and the walls just as thick. The only differences we can see is that it will cost more because it uses more asphalt paving material and the outlet protection requirements could be more extensive.
- (6) Also, the "anticipated service life" table has been broken up into separate tables for open and closed conditions. Metal loss rates for open systems remain at 2 and 4 mils, respectively, in Zone I and Zone II. Accordingly, the anticipated life spans for plain pipe and asphalt coated invert paved pipe remain as previously reported for the open systems. For closed systems, however, that receive all their drainage from only paved surfaces, anticipated metal loss rates are now 2 mils per year, regardless of zone.
- (7) An extra five (5) years of anticipated life has been assigned to asphalt coated fully paved pipes, gage for gage, compared to invert only paved pipes in closed drainage systems. This is based on continuing pipe durability studies being conducted by the Engineering Research and Development Bureau.

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The designer should continue to make pipe selections in accordance with the criteria given in the Design Manual, that is, primarily on the basis of engineering and economic factors. In making this selection, the designer should consider Polymer Coated Pipe (Not paved) costs about 10-15% more than Asphalt Coated Paved Invert Pipe, based on bidding for these products by Erie County in 1984. Polymer Coated Paved Invert pipe may cost 1/3 more than Polymer Coated. These cost differences may be reduced in the future because additional laminated type coatings have been approved.

In the absence of firm cost data and without an engineering reason dictating the choice of one pipe material, an optional specification should be used. One is under development now and will be issued under separate instruction.

Revised Figure 8A may be used upon receipt. The new pay items for Polymer Coated and Polymer Coated Paved Invert pipe may be used effective with the letting of August 6, 1987. However, it should be noted that even though 10 gage polymer coated pipe is shown on Fig. 8A the industry has informed us that 10 gage polymer coated pipe is not commercially available at this time and therefore we have not assigned a pay item number for this pipe. We will add it as soon as it is available.

POLYMER COATED STEEL PIPES

Make the following changes to the Standard Specification of January 2, 1985:

Page 6-1

Change "SECTION 601 AND 602 (VACANT)" to read "SECTION 601 (VACANT)".

Add a new section as follows:

"SECTION 602 POLYMER COATED STEEL PIPES

602-1 DESCRIPTION. This work shall consist of the construction or reconstruction of culverts and storm drains with flexible pipe in accordance with these specifications, the contract plans, and the appropriate Standard Sheets.

602-2 MATERIALS. Materials shall meet the requirements specified in the following subsections:

Masonry Cement	701-02
Mortar Sand	703-03
Round Corrugated Steel Pipe and Pipe-Arches	707-02
Anchor Bolts for Corrugated Culverts	707-20
Water	712-01

602-3 CONSTRUCTION DETAILS

602-3.01 Excavation. The requirements specified in §206, Trench, Culvert and Structure Excavation, that apply to culverts and storm drains shall govern, except for modifications shown on the plans, the standard sheets or as directed by the Engineer.

602-03.02 Laying Pipe.

- A. General. All pipe shall be laid in reasonably close conformity to line and grade and shall have a full, firm and even bearing at each joint and along the entire length of pipe. Pipe laying shall begin at the downstream end and progress upstream.
- B. Handling and Assembly of Pipe. All pipe shall be handled and assembled in accordance with the plans or the Engineer's written directions.
- C. Round Corrugated Metal Pipe, Pipe-Arches and Riveted Steel Pipe. Steel pipe with longitudinal seams shall be placed with the seams at the sides. Circumferential seams with laps shall be placed with the laps in the downstream direction so flow of water is directed over instead of under each succeeding downstream section.

602-3.03 Bedding and Backfilling Pipe. The type of materials to be used in bedding and backfilling at culverts and pipes and the procedure of placement shall conform to the applicable standard sheets and provisions of §203-3.15, Fill and Backfill at Structures, Culverts, Pipes, Conduits, and Direct Burial Cables.

Special care shall be exercised in placing and compacting material immediately adjacent to pipes in order to avoid damage to the pipe and to prevent pipe misalignment.

Movement of construction equipment, vehicles and loads over and adjacent to any pipe shall be done at the Contractor's risk.

602-3.04 Damaged Pipe and Repair.

- A. General. Pipe that is damaged or disturbed through any cause occurring prior to acceptance of the contract, shall be repaired, realigned or replaced as directed by the Engineer. Pipe which is defective from any cause, including damage caused by handling and determined by the Engineer as unrepairable, shall be unacceptable for installation and shall be replaced as directed by the Engineer.
- B. Damaged Bituminous Coatings and Pavements. Damage to bituminous coating may be repaired in the field in accordance with the requirements of "Coating Repair" of subsection 707-02. Damage to bituminous paving may be repaired by an application of the hot original material for areas less than two square feet in each pipe section. Damage to paving in areas greater than two square feet in a pipe section shall be cause for rejection of that section.

602-3.05 Field Strutting of Corrugated Pipe. Field strutting of corrugated metal pipe may be done at the Contractor's option and expense to afford added protection from construction equipment and other loads during installation, backfilling, and filling above the pipe. The method and scheduling of installation and removal of strutting, shall be as approved by the Engineer.

Field strutting shall constitute installation of structurally sound timber sills, compression caps and struts.

602-3.06 Joints.

- A. Corrugated Steel Pipe. Corrugated steel pipe and pipe arch connections for making field joints shall consist of corrugated bands, so constructed as to lap on equal portions of each culvert section to be connected. All connections shall be an approved type, fabricated and installed so that a secure and firm pipe connection may be readily made in the field.

B. Dissimilar Metal Pipe Connections. When joining corrugated pipe or end sections to pipes or end section fabricated of dissimilar metals, a sleeve gasket shall be used between the pipe(s) and the coupling band or the end section. The gasket shall be wider than the coupling band, and the ends shall be kept apart to prevent electrical contact between the dissimilar metals. The gasket shall meet the requirements for gaskets in AASHTO M36."

602-3.07 Anchor Bolts. Unless instructed otherwise, anchor bolts, as specified in section 707-20 shall be used to anchor the ends of corrugated metal pipes and sectional plate arches to either reinforced or plain concrete headwalls.

602-3.08 Breaking into Existing Drainage Structures. The Contractor shall break into existing drainage structures when required to make a pipe connection. Only the minimum amount of material shall be removed from the wall of the structure. After inserting the pipe, the cavity between the pipe exterior and the wall of the drainage structure shall be filled with mortar made from mortar sand, masonry cement, and water mixed three parts sand to one part cement. Large spaces may be chinked with brick, block, or approved stones.

602-4 Method of Measurement.

602-4.01 Polymer Coated Steel Pipe. Polymer Coated Steel Pipe shall be measured as the number of linear feet along the bottom centerline as designated on the plans and specifications or as directed by the Engineer in writing.

602-5 Basis of Payment.

602-5.01 General. The unit price bid shall include the cost of furnishing all labor, materials, and equipment necessary to perform the work including the cost of breaking into existing drainage structures. All excavation and backfill necessary will be paid for separately under the appropriate items of \$203 and \$206, as applicable.

Payment will be made under:

<u>Item No.</u>	<u>Item</u>	<u>Pay Unit</u>
602.05xx	Corrugated Steel Pipe-Polymer Coated (2 2/3 x 1/2)	Linear Foot
602.06xx	Corrugated Steel Pipe-Polymer Coated Paved Invert (2 2/3 x 1/2)	Linear Foot
602.08xx	Corrugated Steel Pipe-Arch, Polymer Coated (2 2/3 x 1/2)	Linear Foot
602.09xx	Corrugated Steel Pipe-Arch, Polymer Coated Paved Invert (2 2/3 x 1/2)	Linear foot
602.11xx	Corrugated Steel Pipe-Polymer Coated (3 x 1) or (5 x 1)	Linear Foot
602.12xx	Corrugated Steel Pipe-Polymer Coated Paved Invert (3 x 1) or (5 x 1)	Linear Foot
602.14xx	Corrugated Steel Pipe-Arch, Polymer Coated (3 x 1) or (5 x 1)	Linear Foot
602.15xx	Corrugated Steel Pipe-Arch, Polymer Coated, Paved Invert (3 x 1) or (5 x 1)	Linear Foot

Note: See EI 87-8 for pay items for individual sizes and gages.

Under §707-02-Round Corrugated Steel Pipe and Pipe Arches, delete all the material except Table 707-1 and replace with the following:

SCOPE. This specification covers corrugated steel pipe and pipe arches intended for use in the construction of metal culverts.

MATERIAL REQUIREMENTS. Corrugated steel pipe and pipe arches shall conform to the requirements specified for Types I and II Pipe in AASHTO M36, M190, and M245 except as modified herein. The ends of round and elliptical corrugated pipe with diameters 12 inches or greater shall be rerolled to form a minimum of two annular corrugations of no less than 2-2/3 inch pitch by a 1/2 inch depth.

Coupling Bands. Annular (circumferentially) or helically corrugated round steel pipe shall be field joined with corrugated bands. Annular or helically corrugated elliptical steel pipe and pipe arches shall be field joined with either corrugated or special projection type bands.

Annular corrugated bands shall be used to join the round pipe sections with rerolled ends. The band shall mesh with at least one full corrugation and shall lap equally, on each pipe end. The band width shall be a minimum of 7 inches for pipe diameters up to and including 30 inches. The band width shall be a minimum of 10-1/2 inches for pipe diameters greater than 30 inches. The band shall not be more than 2 nominal sheet thicknesses thinner than the pipe thickness and in no case thinner than 0.052 inches.

Annular corrugated bands detailed above or special projection bands shall be used to join elliptical pipe (pipe arches) with rerolled ends. The special projection band shall consist of two rows of projections at 3 inches center to center that will mesh with at least one full corrugation and shall lap equally, on each pipe end. The band width shall be a minimum of 10-1/2 inches. The special projection type band shall not be more than 2 nominal sheet thicknesses thinner than the pipe thickness with a minimum of 0.064 inches.

Projection type coupling bands (dimpled bands) will not be acceptable for pipe 12-inches in diameter and larger. Projection type bands may be used on pipe smaller than 12 inches in diameter.

Projection type bands may be used on all sizes of perforated underdrain pipe and for connecting pipe extensions to existing helically corrugated metal pipe without rerolled ends, unless otherwise shown on the plans.

Coupling bands shall be one piece or two piece. Two piece coupling bands shall be used for 48 inch or greater diameter pipes.

Coupling band connectors shall be one of the following types:
2" X 2" X 3/16" galvanized steel angles, lug connectors or bar and strap connectors. These connectors shall be riveted, bolted or welded to the coupling bands. Any evidence of loose bolts or rivets, bearing failure, weld or band tearing shall be cause for rejection and replacement of that coupling band. As an alternate to the coupling band connectors stated above a corrugated angle which conforms to an approved Materials Detail may be used for 30 inch and less diameter.

Bituminous Material. The bituminous material for coating and/or paving shall be homogenous and have the following properties in addition to those specified by AASHTO M190:

Pen. at 77°F 100g. 5 sec.	25-50
Pen. Ratio (39.2°F/77°F x 100)	80-90
Soft Point. °F (B&R)	190-230

Polymer Material. The polymer coating material shall conform to AASHTO M-246 be of a brand which appears on the Department's Approved List.

Gauge. The nominal metal thickness corresponding to any gauge number shall be as shown in Table 707-1.

Coatings. The pipe coatings shall consist of six types designated as:

Plain. The steel sheet shall have a protective coating of zinc (galvanizing), aluminum or aluminum-zinc alloy. The type of metallic coating furnished is at the option of the contractor. The same type of metallic coating shall be used for each culvert on a project.

Fully Bituminous Coated and Paved Invert. In addition to one of the metallic coatings listed under Plain, the pipe shall be fully bituminous coated and have a bituminous paved invert.

Fully Bituminous Coated and 100 Percent Paved. In addition to one of the metallic coatings listed under Plain, the pipe shall be fully bituminous coated and have a fully paved smooth bituminous interior.

Polymer Coated. The steel sheet shall have a protective coating of zinc (galvanizing), aluminum or aluminum-zinc alloy. In addition, the steel sheet when formed into pipe shall have an interior polymer coating thickness of 0.010 inches and either an exterior polymer coating thickness of 0.003 inches minimum or the metallic coating. The type of metallic coating and exterior coating furnished is at the option of the contractor.

Polymer Coated, with a Bituminous Paved Invert. In addition to one of the metallic coatings and the polymer coating listed under Polymer Coated, the pipe shall have a bituminous paved invert.

Polymer Coated, 100 Percent Bituminous Paved. In addition to one of the metallic coatings and the polymer coating listed under Polymer Coated, the pipe shall have a fully paved smooth bituminous interior.

Coupling Band Coating. The steel sheet used for coupling bands shall be coated with one of the metallic coatings. When plain pipe is joined, coupling bands shall have the same metallic coating as the pipe.

Marking. Each length of coated pipe shall be marked over the coatings or tagged as approved by the Department to show metal thickness.

Coating Repair. Damaged metallic, bituminous, and/or polymer coating shall be repaired when directed by the Engineer at no cost to the state.

Field repair will be allowed only when the total damaged area on each piece is less than 2 square feet of coated surface. Exterior damage to bituminous or polymer coated pipe shall require repair to the metallic coating only. Any piece which has a damaged area greater than the amount specified above will be rejected and the Contractor shall replace it at no cost to the State.

Metallic coatings shall be repaired in accordance with AASHTO M36 except that the coating paint shall be of a brand which appears on the Department's Approved List.

Bituminous coatings may be repaired by using the original material or a cold asphalt repair material which appears on the Department's Approved List. Polymer coating shall be repaired by using the material appearing on the Approved List.

Additional Defects. In addition to coating damage, the following defects other than those listed in AASHTO, will be cause for rejecting the pipe when inspected at the project:

Variation from a straight centerline shall be no more than 3/4 inch in 20 feet.

Any dents greater than 3 inches in diameter or any punctures.

Loosely formed or cracked lock seams.

All types of pipe ends, whether rerolled or not, shall be matched in a joint such that the maximum difference in the diameter of abutting pipe ends is 1/2 inch.

Sharp bends in pipe arch that are less than the specified minimum corner radius for that size.

BASIS OF ACCEPTANCE. This corrugated steel pipe will be accepted on the basis of certified documentation issued by a supplier appearing on the Department's Approved List. Corrugated connecting angles will be accepted provided they are an approved Materials Detail on the Department's Approved List. Certification format and fabrication shop approval shall be in accordance with procedural directives issued by the Materials Bureau. At the option of the Department, this material may be subjected to shop inspection.

Application for polymer coating approval shall be submitted to the Materials Bureau. Samples are required for laboratory and field testing. Field testing will be a minimum of two years duration. The facilities of the coating applicator and method of application shall be subject to the approval of the Director, Materials Bureau. Upon approval, the brand of polymer coating and applicator will be placed on the Department's Approved List.

Polymer coated corrugated steel pipe delivered to the project will be accepted at the work site on the basis of certified documentation by the supplier that appears on the Department's Approved List. This documentation shall identify the brand and applicator of the polymer coating, which must be one that appears on the Approved List.

Addendum 1

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Under Page 7-58 delete all the material.