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| To: SUPERSEDED BY EB 96-019 EFFECTIVE 1/9/97 |  | New York State Department of Transportation ENGINEERING INSTRUCTION | EI 95-050 |
| Title: STRUCTURAL CRITERIA FOR TYPE IR AND TYPE IIR CORRUGATED METAL PIPE | | | |
| Distribution: <input checked="" type="checkbox"/> Main Office(30) <input checked="" type="checkbox"/> Consultants (34) <input type="checkbox"/> Local Gov.(31) <input type="checkbox"/> Contractors/AGC(39) <input checked="" type="checkbox"/> Regions(32) <input type="checkbox"/> _____ () | Approved:  P. J. Clark, Deputy Chief Engineer, Design Div. 12/15/95 _____ Date | | |

This Engineering Instruction (EI), along with EI 95-051, supersedes EI 93-011.

EFFECTIVE DATE:

The tables within this Engineering Instruction (EI) are effective with the March 21, 1996 lettings. This EI may be deleted with the issuance of the revised Highway Design Manual.

PURPOSE:

The purpose of this EI is to transmit the following structural criteria (height of fill) tables for Type IR and Type IIR corrugated metal pipe (CMP):

1. Table 1: Structural Criteria for Corrugated Steel Pipe - Type IR, U.S. Customary Units.
2. Table 2: Structural Criteria for Corrugated Steel Pipe - Type IR, Metric Units.
3. Table 3: Structural Criteria for Corrugated Aluminum Pipe - Type IR, U.S. Customary Units.
4. Table 4: Structural Criteria for Corrugated Aluminum Pipe - Type IR, Metric Units.
5. Table 5: Structural Criteria for Corrugated Steel Pipe - Type IIR, U.S. Customary Units.
6. Table 6: Structural Criteria for Corrugated Steel Pipe - Type IIR, Metric Units.
7. Table 7: Structural Criteria for Corrugated Aluminum Pipe - Type IIR, U.S. Customary Units.
8. Table 8: Structural Criteria for Corrugated Aluminum Pipe - Type IIR, Metric Units.

DESIGN CONSIDERATIONS:

Type IR (spiral rib) is a round, helically corrugated metal pipe with 19 mm (¾ inch) square rib corrugations projecting outward at 190 mm (7½ inch) spacings. Type IIR pipe is a Type IR pipe that has been formed into an arch. Both have a Mannings "n" value of 0.013. Material and construction specifications are found in a separate EI simultaneously issued with this EI.

These tables issue the structural criteria requirements for Type IR and Type IIR pipe only. All other design requirements, including durability (service life), remain unchanged at this time.

CONTACT:

Questions concerning fill height, fill requirements, and bedding should be directed to the Geotechnical Engineering Bureau at (518) 457-4791. Questions regarding metal pipe material requirements and construction should be addressed to the Field Engineering I section of the Materials Bureau at (518) 457-5956.

**Table 1: Structural Criteria for Corrugated Steel Pipe - Type IR
U. S. Customary Units**

| Area (ft ²) | Diameter (inches) | Minimum/Maximum Allowable Height of Cover (feet) | |
|----------------------------|----------------------|--|--------|
| | | Gauge | |
| | | 14 | 12 |
| 1.8 | 18 | 1/96 | - |
| 2.4 | 21 | 1/82 | 1/138 |
| 3.1 | 24 | 1/72 | 1/121 |
| 4.9 | 30 | 1/58 | 1/97 |
| 7.1 | 36 | 1/48 | 1/81 |
| 9.6 | 42 | 1/41 | 1/69 |
| 12.6 | 48 | 1/36 | 1/61 |
| 15.9 | 54 | 1.5/32 | 1.5/54 |
| 19.6 | 60 | 1.5/29 | 1.5/49 |
| 23.8 | 66 | 1.5/26 | 1.5/44 |
| 28.3 | 72 | 1.5/24 | 1.5/40 |
| 33.2 | 78 | 2/22 | 2/37 |
| 38.5 | 84 | - | 2/35 |
| 44.2 | 90 | - | 2/32 |
| 50.3 | 96 | - | 2/30 |
| 56.7 | 102 | - | 2.5/29 |

1. HS-25 loading.
2. Minimum height of cover is measured to subgrade surface.

**Table 2: Structural Criteria for Corrugated Steel Pipe - Type IR
Metric Units**

| Area (m ²) | Diameter (mm) | Minimum/Maximum Allowable Height of Cover (mm) | |
|---------------------------|------------------|--|------------|
| | | Gauge | |
| | | 14 | 12 |
| 0.16 | 450 | 300/29 000 | - |
| 0.20 | 500 | 300/25 000 | 300/42 000 |
| 0.28 | 600 | 300/22 000 | 300/37 000 |
| 0.38 | 700 | 300/19 000 | 300/32 000 |
| 0.50 | 800 | 300/17 000 | 300/28 000 |
| 0.64 | 900 | 300/15 000 | 300/24 000 |
| 0.79 | 1 000 | 300/13 000 | 300/21 000 |
| 1.13 | 1 200 | 300/11 000 | 300/18 000 |
| 1.54 | 1 400 | 450/9 000 | 450/16 000 |
| 2.01 | 1 600 | 450/8 000 | 450/14 000 |
| 2.54 | 1 800 | 450/7 000 | 450/12 000 |
| 3.14 | 2 000 | 600/7 000 | 600/11 000 |
| 3.80 | 2 200 | - | 600/10 000 |
| 4.52 | 2 400 | - | 600/9 000 |

1. MS-23 loading. (Metric equivalent of HS-25 loading.)
2. Minimum height of cover is measured to subgrade surface.

**Table 3: Structural Criteria for Corrugated Aluminum Pipe - Type IR
U. S. Customary Units**

| Area (ft ²) | Diameter (inches) | Minimum/Maximum Allowable Height of Cover (feet) | | | |
|----------------------------|----------------------|--|---------|---------|---------|
| | | Gauge | | | |
| | | 16 | 14 | 12 | 10 |
| 1.8 | 18 | 1/52 | 1/73 | - | - |
| 2.4 | 21 | 1/44 | 1/62 | 1/101 | - |
| 3.1 | 24 | 1/38 | 1/54 | 1/91 | - |
| 4.9 | 30 | 1.25/30 | 1/43 | 1/72 | - |
| 7.1 | 36 | 1.5/25 | 1.25/35 | 1/59 | 1/75 |
| 9.6 | 42 | 1.75/21 | 1.5/30 | 1.25/50 | 1/64 |
| 12.6 | 48 | - | 2/26 | 1.5/43 | 1.25/55 |
| 15.9 | 54 | - | 2/23 | 1.75/38 | 1.25/48 |
| 19.6 | 60 | - | - | 2/33 | 1.5/42 |
| 23.8 | 66 | - | - | - | 1.75/38 |
| 28.3 | 72 | - | - | - | 2/34 |

1. HS-25 loading.
2. Minimum height of cover is measured to subgrade surface.

Table 4: Structural Criteria for Corrugated Aluminum Pipe - Type IR
Metric Units

| Area (m ²) | Diameter (mm) | Minimum/Maximum Allowable Height of Cover (mm) | | | |
|---------------------------|------------------|--|------------|------------|------------|
| | | Gauge | | | |
| | | 16 | 14 | 12 | 10 |
| 0.16 | 450 | 300/16 000 | 300/22 000 | - | - |
| 0.20 | 500 | 300/14 000 | 300/20 000 | 300/32 000 | - |
| 0.28 | 600 | 300/11 000 | 300/16 000 | 300/27 000 | - |
| 0.38 | 700 | 300/10 000 | 300/14 000 | 300/24 000 | - |
| 0.50 | 800 | 450/9 000 | 450/12 000 | 300/21 000 | - |
| 0.64 | 900 | 450/8 000 | 450/10 000 | 300/18 000 | 300/23 000 |
| 0.79 | 1 000 | 600/7 000 | 600/9 000 | 450/15 000 | 300/20 000 |
| 1.13 | 1 200 | - | 600/8 000 | 450/13 000 | 450/17 000 |
| 1.54 | 1 400 | - | 600/7 000 | 600/11 000 | 450/14 000 |
| 2.01 | 1 600 | - | - | 600/9 000 | 600/12 000 |
| 2.54 | 1 800 | - | - | - | 600/10 000 |

1. MS-23 loading. (Metric equivalent of HS-25 loading.)
2. Minimum height of cover is measured to subgrade surface.

**Table 5: Structural Criteria for Corrugated Steel Pipe - Type IIR
U. S. Customary Units**

| Area (ft ²) | Span (inches) | Rise (inches) | Minimum/Maximum Allowable Height of Cover (feet) | |
|----------------------------|------------------|------------------|--|---------|
| | | | Gauge | |
| | | | 14 | 12 |
| 1.6 | 20 | 16 | 1/15 | - |
| 2.2 | 23 | 19 | 1/15 | 1/15 |
| 2.8 | 27 | 21 | 1/15 | 1/15 |
| 4.4 | 33 | 26 | 1/15 | 1/15 |
| 6.4 | 40 | 31 | 1/13 | 1/13 |
| 8.7 | 46 | 36 | - | 1/13 |
| 11.4 | 53 | 41 | - | 1/13 |
| 14.3 | 60 | 46 | - | 1/13 |
| 17.6 | 66 | 51 | - | 1.25/13 |

1. HS-25 loading.
2. Minimum height of cover is measured to subgrade surface.

**Table 6: Structural Criteria for Corrugated Steel Pipe - Type IIR
Metric Units**

| Area (m ²) | Span (mm) | Rise (mm) | Minimum/Maximum Allowable Height of Cover (mm) | |
|---------------------------|--------------|--------------|--|-----------|
| | | | Gauge | |
| | | | 14 | 12 |
| 0.15 | 500 | 400 | 300/5 000 | - |
| 0.18 | 550 | 450 | 300/5 000 | 300/5 000 |
| 0.26 | 680 | 530 | 300/5 000 | 300/5 000 |
| 0.35 | 770 | 630 | 300/5 000 | 300/5 000 |
| 0.46 | 880 | 690 | 300/4 000 | 300/4 000 |
| 0.59 | 1 000 | 770 | 300/4 000 | 300/4 000 |
| 0.72 | 1 100 | 850 | - | 300/4 000 |
| 1.0 | 1 330 | 1 030 | - | 300/4 000 |
| 1.4 | 1 550 | 1 200 | - | 300/4 000 |
| 1.8 | 1 780 | 1 360 | - | 450/4 000 |

1. MS-23 loading. (Metric equivalent of HS-25 loading.)
2. Minimum height of cover is measured to subgrade surface.

**Table 7: Structural Criteria for Corrugated Aluminum Pipe - Type IIR
U. S. Customary Units**

| Area (ft ²) | Span (inches) | Rise (inches) | Minimum/Maximum Allowable Height of Cover (feet) | | | |
|----------------------------|------------------|------------------|--|---------|---------|---------|
| | | | Gauge | | | |
| | | | 16 | 14 | 12 | 10 |
| 1.6 | 20 | 16 | 1/15 | 1/15 | - | - |
| 2.2 | 23 | 19 | 1/15 | 1/15 | 1/15 | - |
| 2.8 | 27 | 21 | 1.25/15 | 1/15 | 1/15 | - |
| 4.4 | 33 | 26 | 1.5/15 | 1.25/15 | 1/15 | - |
| 6.4 | 40 | 31 | 1.75/13 | 1.5/13 | 1.25/13 | 1/13 |
| 8.7 | 46 | 36 | - | - | 1.5/13 | 1.25/13 |
| 11.4 | 53 | 41 | - | - | 1.75/13 | 1.25/13 |
| 14.3 | 60 | 46 | - | - | 2/13 | 1.5/13 |
| 17.6 | 66 | 51 | - | - | 2/13 | 1.75/13 |

1. HS-25 loading.
2. Minimum height of cover is measured to subgrade surface.

**Table 8: Structural Criteria for Corrugated Aluminum Pipe - Type IIR
Metric Units**

| Area (m ²) | Span (mm) | Rise (mm) | Minimum/Maximum Allowable Height of Cover (mm) | | | |
|---------------------------|--------------|--------------|--|-----------|-----------|-----------|
| | | | Gauge | | | |
| | | | 16 | 14 | 12 | 10 |
| 0.15 | 500 | 400 | 300/5 000 | 300/5 000 | - | - |
| 0.18 | 550 | 450 | 300/5 000 | 300/5 000 | 300/5 000 | - |
| 0.26 | 680 | 530 | 450/5 000 | 300/5 000 | 300/5 000 | - |
| 0.35 | 770 | 630 | 450/5 000 | 450/5 000 | 300/5 000 | - |
| 0.46 | 880 | 690 | 450/4 000 | 450/4 000 | 450/4 000 | - |
| 0.59 | 1 000 | 770 | 600/4 000 | 450/4 000 | 450/4 000 | 300/4 000 |
| 0.72 | 1 100 | 850 | - | - | 450/4 000 | 450/4 000 |
| 1.0 | 1 330 | 1 030 | - | - | 600/4 000 | 450/4 000 |
| 1.4 | 1 550 | 1 200 | - | - | 600/4 000 | 450/4 000 |
| 1.8 | 1 780 | 1 360 | - | - | 600/4 000 | 600/4 000 |

1. MS-23 loading. (Metric equivalent of HS-25 loading.)
2. Minimum height of cover is measured to subgrade surface.