Upcoming Ballot Items Related to Concrete Pipe and Box Culverts

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Incorporating the Correct Reference for Wire Reinforcement

12.4.2.7 – Steel Reinforcement
Reinforcement shall comply with the requirements of Article 5.4.3, and shall conform to one of the following: AASHTO M 31M/M 31 (ASTM A615/A615M), M 32M/M 32 (ASTM A82/A82M), M 55M/M 55 (ASTM A185/A185M), M221 M/M 221 (ASTM A497), or M 225M/M 225 (ASTM A496/A496M), or ASTM A1064/A1064 M.
Old Wire Reinforcement Standards are Superseded

ASTM A82-02

Historical Standard: ASTM A82-02 Standard Specification for Steel Wire, Plain, for Concrete Reinforcement

SUPERSEDED
Latest ASTM Wire Reinforcement Standard

ASTM A1064/A1064M-14 Standard Specification for Carbon-Steel Wire and Welded Wire Reinforcement, Plain and Deformed, for Concrete

Active Standard (Latest Version)

Abstract

Scope

1.1 This specification covers carbon-steel wire and welded wire reinforcement produced from hot-rolled rod to be used for the reinforcement of concrete. The steel wire is cold-worked, drawn or rolled, plain (non-deformed, as-drawn or galvanized), or deformed. Welded wire reinforcement is made from plain or deformed wire, or a combination of plain and deformed wire. Common wire sizes and dimensions are given in Table 1, Table 2, Table 3, and Table 4. Actual wire sizes are not restricted to those shown in the tables.
Incorporate the Use of Higher Reinforcing Strengths

12.4.2.7 - Steel Reinforcement
For smooth wire and smooth welded wire fabric the yield strength may be taken as 65.0 ksi. For deformed welded wire fabric, the yield strength may be taken as 70 ksi. The nominal yield strength shall be the minimum as specified for the grade of steel selected, except that yield strengths in excess of 75 ksi, but less than or equal to 100 ksi shall be used only when allowed by specific articles. The yield strength or grade of the bars or wires shall be shown in the contract documents.
Incorporate the Use of Higher Reinforcing Strengths

• **5.4.3.1 - General**

• “The nominal yield strength shall be the minimum as specified for the grade of steel selected, except that yield strengths in excess of 75.0 ksi shall not be used for design unless specified minimum yield strengths up to 100 ksi are permitted by Article 5.4.3.3. **The yield strength or grade of the bars or wires shall be shown in the contract documents.**”
Incorporate the Use of Higher Reinforcing Strengths

- **5.4.3.3 – Special Applications**
- “Where permitted by specific articles, reinforcing steel with specified minimum yield strengths of less than or equal to 100 ksi may be used for all elements and connections in Seismic Zone 1.”
12.10.4.2.4a – Circumferential Reinforcement

$f_y = \text{specified yield strength of reinforcing (ksi) } \leq 100 \text{ ksi}$
Minimum Reinforcement

12.10.4.2.4b – Minimum Reinforcement

\( f_y = \) specified yield strength of reinforcing (ksi). \( < 75 \text{ ksi} \)
Radial Tension Reinforcement

12.10.4.2.4c Maximum Flexural Reinforcement without Stirrups –

\( f_y = \) specified yield strength of reinforcing (ksi).  \(< 100 \text{ ksi}\)
Maximum Flexural Reinforcement

12.10.4.2.4c Maximum Flexural Reinforcement without Stirrups –

\( f_y = \) specified yield strength of reinforcing (ksi).  < 100 ksi
Live Load Distribution (Shallow)

3.6.1.2.6 – Distribution of Wheel Load through Earth Fills

Live load shall be distributed to the top slabs of flat top, three-sided, or long-span concrete arch culverts, or concrete pipe with less than 2.0 ft of fill as specified in Article 4.6.2.10 in accordance with Equation 4.6.2.10.2-1, regardless of the direction of travel. Round concrete culverts with 1.0 ft or more but less than 2.0 feet of cover shall be designed for a depth of 1.0 ft. Round culverts with less than 1.0 ft of fill shall be analyzed with more comprehensive methods.
Live Load Distribution (Shallow)

4.6.2.10 Equivalent Strip Widths for Box Culverts

Case 1 – Traffic Travels Parallel to Span

\[ E = 96 + 1.44 \, S \]

Case 2 – Traffic Travels Perpendicular to Span

“…live load shall be distributed to the top slab using the equations specified in Article 4.6.2.1…”
Live Load Spread for Less Than 2 feet of Cover (single axle) (Parallel)
## Live Load Distribution (Shallow)

### Table 4.6.2.1.3-1—Equivalent Strips

<table>
<thead>
<tr>
<th>Type of Deck</th>
<th>Direction of Primary Strip Relative to Traffic</th>
<th>Width of Primary Strip (in.)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Concrete:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>• Cast-in-place</td>
<td>Overhang</td>
<td>45.0 + 10.0X</td>
</tr>
<tr>
<td></td>
<td>Either Parallel or Perpendicular</td>
<td>+M: 26.0 + 6.6S</td>
</tr>
<tr>
<td></td>
<td></td>
<td>−M: 48.0 + 3.0S</td>
</tr>
<tr>
<td>• Cast-in-place with stay-in-place concrete formwork</td>
<td>Either Parallel or Perpendicular</td>
<td>+M: 26.0 + 6.6S</td>
</tr>
<tr>
<td></td>
<td></td>
<td>−M: 48.0 + 3.0S</td>
</tr>
<tr>
<td>• Precast, post-tensioned</td>
<td>Either Parallel or Perpendicular</td>
<td>+M: 26.0 + 6.6S</td>
</tr>
<tr>
<td></td>
<td></td>
<td>−M: 48.0 + 3.0S</td>
</tr>
</tbody>
</table>
Live Load Distribution (Shallow)
For traffic parallel to the span, culverts shall be analyzed for a single loaded lane with the single lane multiple presence factor. For traffic perpendicular to the culvert span, analysis shall include consideration of multiple lane loadings with appropriate multiple presence factors. Only the axle loads of the design truck or design tandem of Articles 3.6.1.2.2 and 3.6.1.2.3, respectively shall be applied as live load on culverts, regardless of traffic orientation.
Interaction Depth for Wheels (Parallel)

W_{ws} for a single wheel

S_w

W_{ws} for two wheels

W_{ws} if H < H_{intw}

W_{ws} if H > H_{intw}

H_{intw}
Previously (Multiple Lanes)

<table>
<thead>
<tr>
<th>Lanes</th>
<th>MPF</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>1.2</td>
</tr>
<tr>
<td>2</td>
<td>1.0</td>
</tr>
<tr>
<td>3</td>
<td>0.85</td>
</tr>
<tr>
<td>4</td>
<td>0.65</td>
</tr>
</tbody>
</table>
Applied Live loads

• 3.6.1.3.3 Design Loads for Decks, Deck Systems, and the Top Slabs of Box Culverts

  ▪ Where the slab spans primarily in the transverse direction, only the axles of the design truck of Article 3.6.1.2.2 or design tandem of Article 3.6.1.2.3 shall be applied to the deck slab of the top of box culverts.
Applied Live loads

• 3.6.1.3.3 Design Loads for Decks, Deck Systems, and the Top Slabs of Box Culverts

  ▪ Where the slab spans primarily in the longitudinal direction:

  ▪ For top slabs of box culverts of all spans and for all other cases, including slab-type bridges where the span does not exceed 15.0 ft, only the axle loads of the design truck or design tandem of Articles 3.6.1.2.2 and 3.6.1.2.3, respectively, shall be applied.
Incorporate the Use of Higher Reinforcing Strengths

• 5.4.3.3 – Special Applications
• “Reinforcement to be welded shall be indicated in the contract documents, and the welding procedure to be used shall be specified.”
NCHRP Report 679, “Design of Concrete Structures Using High-Strength Steel Reinforcement”

• “As reported in Appendix A, A1035 bars and A496 and A82 wire exhibit no discernable yield plateau.”
C4.6.2.1.3

• “Values provided for equivalent strip widths and strength requirements in the secondary direction are based on past experience. Practical experience and future research work may lead to refinement.

• To get the load per unit width of the equivalent strip, divide the total load on one design traffic lane by the calculated strip width.”
Live Load Spread for Less Than 2 feet of Cover (Parallel)
The End