

CULVERTS – BASIC STRUCTURAL CONSIDERATIONS

<https://m.youtube.com/watch?v=NTbhyHNA1Vc>

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Introduction

Currently there are approx. 8515 bridge size culverts in Alberta which accounts for ~63% of all bridge structures in the province.

Two types of culverts:

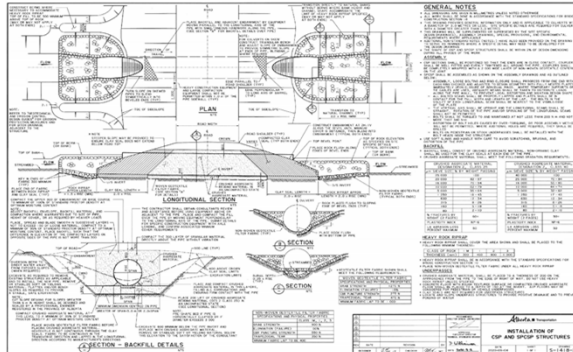
- 1) Flexible Structures (corrugated steel) (~96%)
- 2) Rigid Structures (concrete, steel or timber)

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Standard Drawings S-1418-20



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Rigid Structures

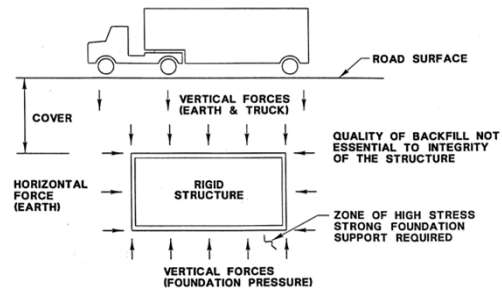
- Concrete (~4%) – either box or pipe
- Timber (0.1%) - no longer being built
- Smooth wall steel pipe liners (rigid pipe)
- No noticeable deflection under loads
- Concrete is a durable material
- Concrete is relatively expensive

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Rigid Structures



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Flexible Structures

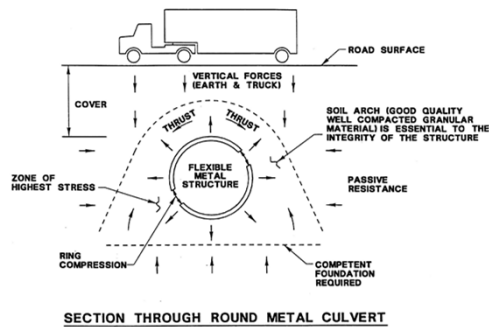
- Metal culverts comprise approximately 96% of culvert inventory
- Fabricate to almost any shape
- Relatively cheap
- Proper Backfill & Installation is **CRITICAL**
- Susceptible to structural problems
- Prone to corrosion, abrasion

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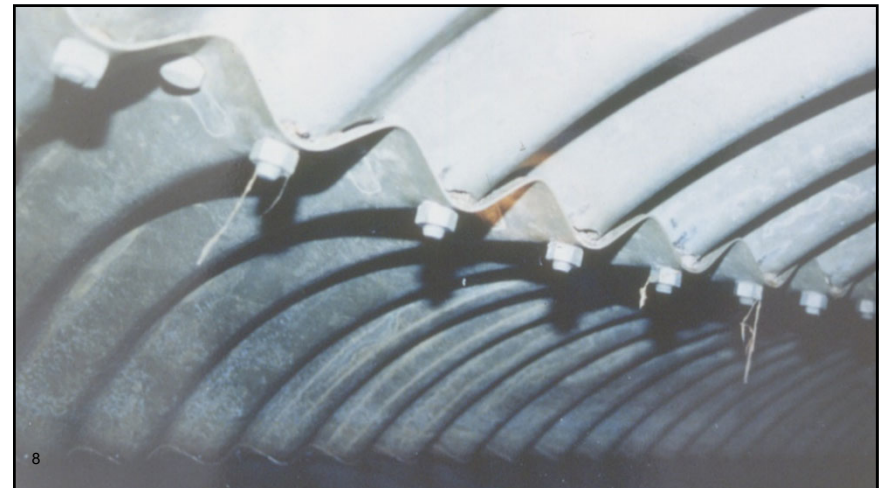
Flexible Structures



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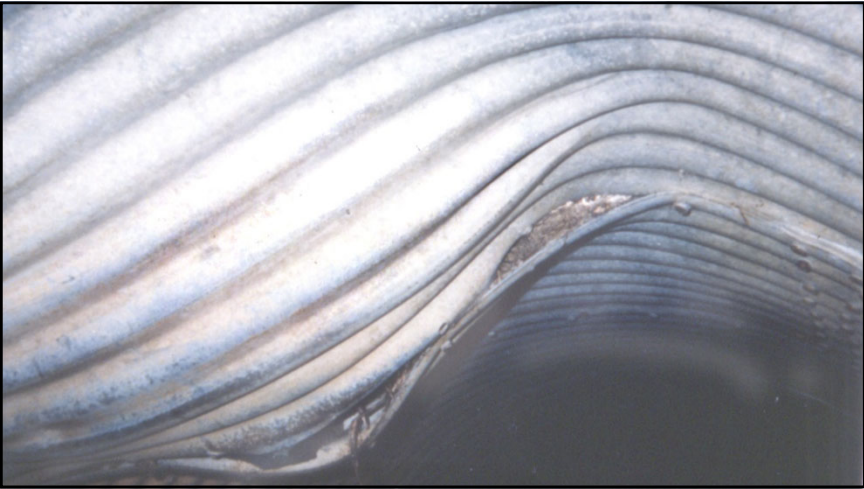


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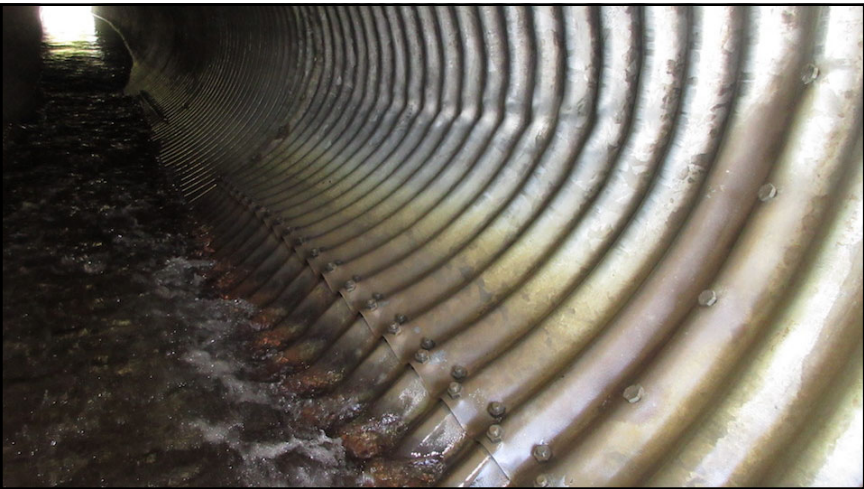
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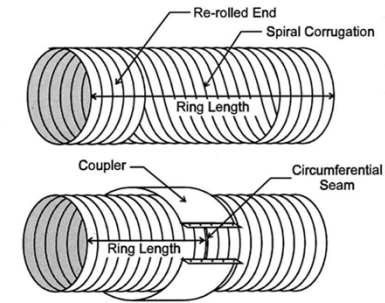


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CSP (field jointing)



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Flexible Culverts

- Two Types:
 - Corrugated Steel Pipe (CSP)
 - Structural Plate Corrugated Steel Pipe (SPCSP)

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Corrugated Steel Pipe (CSP)

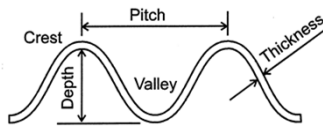
- Complete rings fabricated in plant
- Rolled helical sections, re-rolled ends
- Joined by couplers
- Bridge sizes range from 1500 to 3600
- Common sizes 1800 to 3000 (in 200mm increments)
- Segment produced in lengths to suit transport (2.5 to 15.0 m)

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CSP Properties

- Common Thickness
 - 2.8mm, 3.5mm, 4.2mm
- Common Profiles
 - 68mm (Pitch) x 13mm (depth)
 - 76mm X 25mm, and 125mm X 26mm



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Structural Plate Corrugated Steel Pipe (SPCSP)

- Flat plate is corrugated & punched
- Hot dip galvanized then curved to shape
- Five thickness – 3, 4, 5, 6, and 7mm
- Profiles - pitch x depth
 - 152 x 51 mm
 - 380 x 140 mm
 - 400 x 150 mm
- Individual plates are bolted together

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SPCSP (cont.)

- Plate lengths
 - 3,050mm (10 ft)
 - 3,670mm (12 ft)
- Plate width 5N, 6N, and 9N

N is the circumferential bolt spacing
 $N = 3\pi$ (244 mm or 9.6")
 Ex: Number of bolts in a 3.048m or 10' diameter ring
 $= \pi \times 3048 \text{ mm} / 244 \text{ mm} = 39.2 = 39 \text{ spaces or } 40 \text{ bolts per ring}$

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SPCSP - some recent products

- Atlantic Industry's 'Bolt-a-Plate'
 - width 1067, length 3N to 16N
- Twister Pipe's 'MP 200'
 - pitch 200, depth 55mm
- SuperCor, and Bridge Plate
 - (pitch 380, depth 140)
- New coating systems



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SPCSP - some recent products

- New coating systems

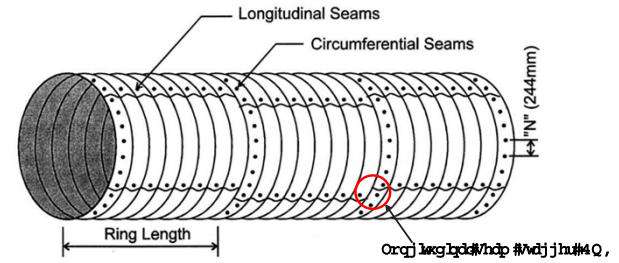


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SPCSP (field bolting)



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SPCSP Barrel

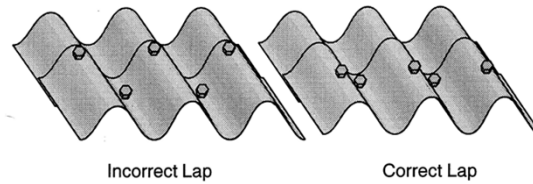


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SPCSP (longitudinal lapping)



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Properly Lapped Seam
Bolt in valley is nearest visible edge



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Improperly Lapped Seam
Bolt in valley is farthest from visible edge

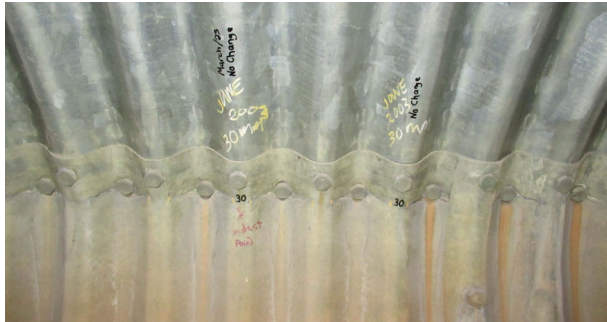


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Improperly Lapped Seam
Bolt in valley is farthest from visible edge

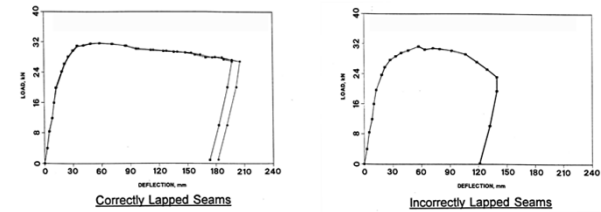


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SPCSP (seam strength tests)



- Both types of laps can carry about the same load
- Correctly lapped seams are more ductile – do not typically develop cracks

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Bridge Construction Inspection Manual

<https://open.alberta.ca/publications/bridge-construction-inspection-manual-edition-3>

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Questions?



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