


Basic Structural Considerations

Culverts - Basic Structural Considerations

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

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Basic Structural Considerations

Introduction

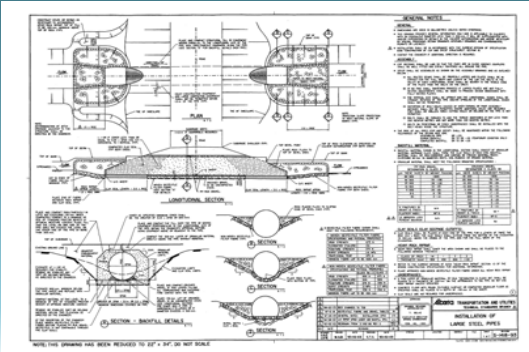
- Currently approx. 8350 bridge size culverts in Alberta
- Two types of culverts:
 - 1) Rigid Structures (concrete or timber)
 - 2) Flexible Structures (corrugated metal)

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Basic Structural Considerations

Standard Drawing S-1418-03



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Rigid Structures

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

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Rigid Structures

The diagram illustrates a rigid structure under various forces. At the top, a truck is shown on a road surface. Below the road surface, vertical forces from the earth and truck are applied. A layer of cover is shown above the structure. Horizontal forces from the earth are applied to the sides. The structure itself is labeled 'RIGID STRUCTURE'. Below it, vertical forces from the foundation pressure are shown. A 'ZONE OF HIGH STRESS' is indicated around the structure, with a note that 'STRONG FOUNDATION SUPPORT REQUIRED'. Another note states 'QUALITY OF BACKFILL NOT ESSENTIAL TO INTEGRITY OF THE STRUCTURE'.

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Flexible Structures

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

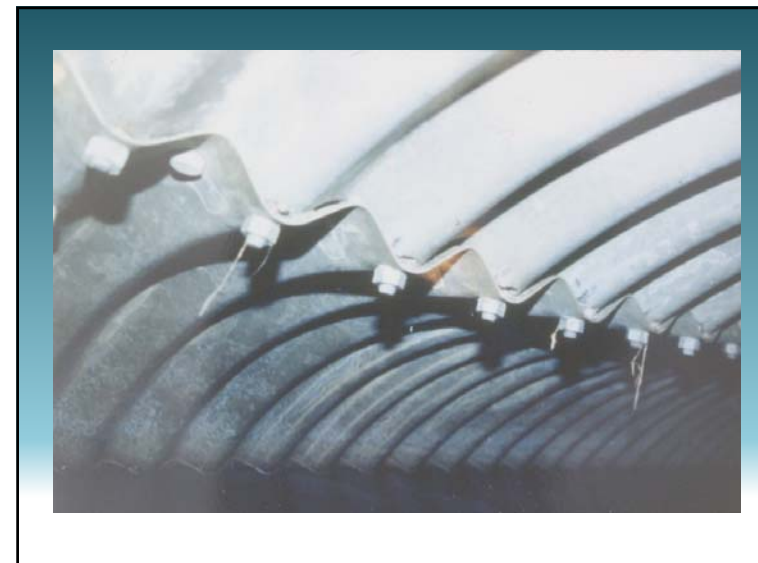
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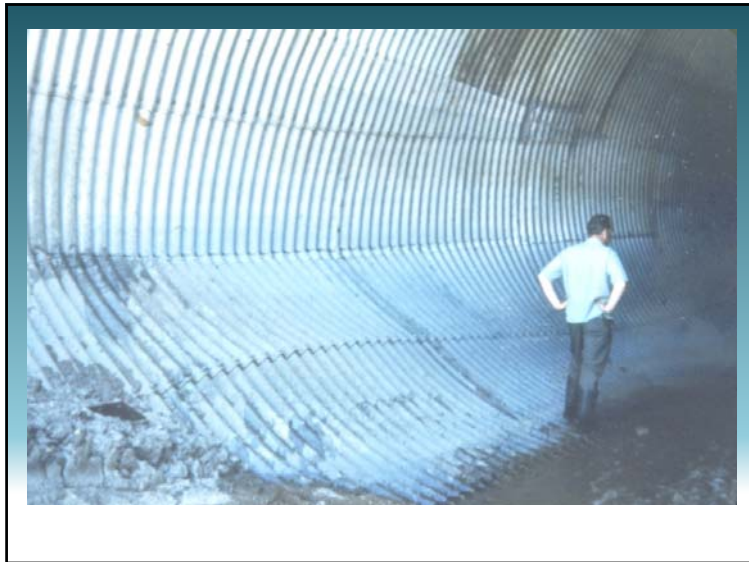
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Flexible Structures

The diagram shows a section through a round metal culvert. A truck is on the road surface above. Vertical forces from the earth and truck are applied. A layer of cover is shown. Horizontal forces from the earth are applied to the sides, creating a soil arch. The structure is labeled 'FLEXIBLE METAL STRUCTURE'. Below it, vertical forces from the foundation are shown, with a note that 'COMPETENT FOUNDATION REQUIRED'. A 'ZONE OF HIGHEST STRESS' is indicated at the top of the structure. Other labels include 'THRUST', 'PASSIVE RESISTANCE', and 'RING COMPRESSION'. A note states 'SOIL ARCH (GOOD QUALITY WELL COMPACTED GRANULAR MATERIAL) IS ESSENTIAL TO THE INTEGRITY OF THE STRUCTURE'.

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Basic Structural Considerations

CSP (field jointing)

The diagram illustrates two views of a Corrugated Spiral Pipe (CSP) field joint. The top view shows a single ring with labels for 'Re-rolled End', 'Spiral Corrugation', and 'Ring Length'. The bottom view shows two rings joined together, with labels for 'Coupler', 'Ring Length', and 'Circumferential Seam'.

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BIM
Bridge Inspection and Maintenance

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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)
- Length to suit transportation (2.5 to 15.0m)



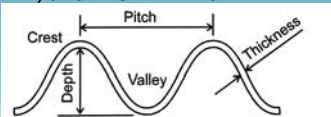
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CSP Properties

- 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
- HD galv. then curved to shape
- Five thickness – 3, 4, 5, 6, and 7mm
- Profiles - pitch x depth
 - 152 x 51
 - 380 x 140
 - 400 x 150
- Plates bolted together



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SPCSP (cont.)

- Plate lengths
 - 3050mm (10 ft)
 - 3670mm (12 ft)
- Plate width 5N, 6N, and 9N

N is the circumferential bolt spacing
 $N = 3\pi$ (244mm or 9.6")
 $N/\text{ring} = 4(\text{dia. in feet})$
 (i.e. 10ft dia = 40N)




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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

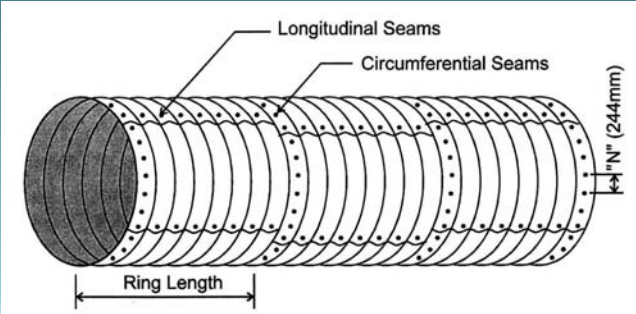



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SPCSP (field bolting)



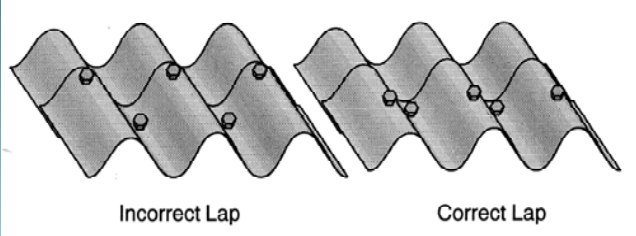



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SPCSP (longitudinal lapping)






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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



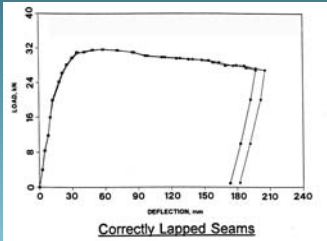


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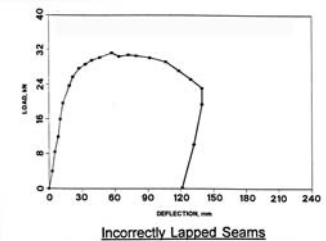


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SPCSP (seam strength tests)




Correctly Lapped Seams




Incorrectly Lapped Seams

Both types of laps can carry about the same load
Correctly lapped seams are more ductile - don't normally develop cracks




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Bridge Construction Inspection Manual

<http://www.transportation.alberta.ca/Content/docType30/Production/BridgeConstructionManualDec2015.pdf>



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Questions??



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