



LowSpan and MegaBox

***12 MILE OVER THE CHARLOTTE RIVER – CHIPPEWA COUNTY ROAD
COMMISSION***

***STEVEN A. DELAIRE
UPPER PENINSULA CONCRETE PIPE CO
ESCANABA, MI***

Who Are We?

- Innovative Concrete Pre-casting Company located in Escanaba, MI
- Do business in Michigan and Wisconsin.
- Founded in 1955 with over 150 years of pre-casting experience on staff.
- Longstanding active member in the industry.



What Do We Do?



Advantages of Buried Structures

1. Minimal rehabilitation costs versus a conventional bridge
2. Reduced bridge icing versus a conventional bridge
3. Less installation time versus a conventional bridge – FHWA's "Every Day Counts" initiative
4. Environmental benefits versus a conventional "4-sided" culvert
5. Maximum "end area"
6. Minimum rise



Purpose Of Todays Talk

The First:

- Pre-Cast Clamshell Design in Michigan
- Pre-Stressed Clamshell Design in North America (and beyond?)



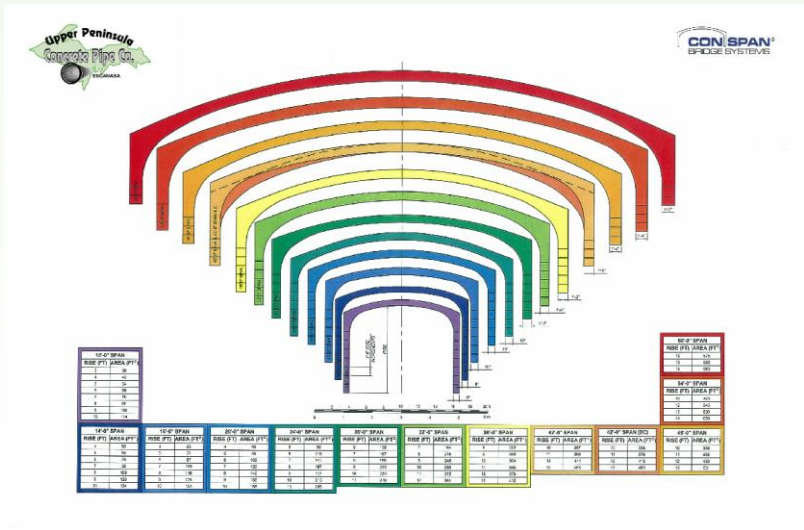
Necessary Background: LowSpan

A Three-Sided, Pre-stressed Top Slab Structure

Low-Span: A Three-Sided, Pre-Stressed Top Slab

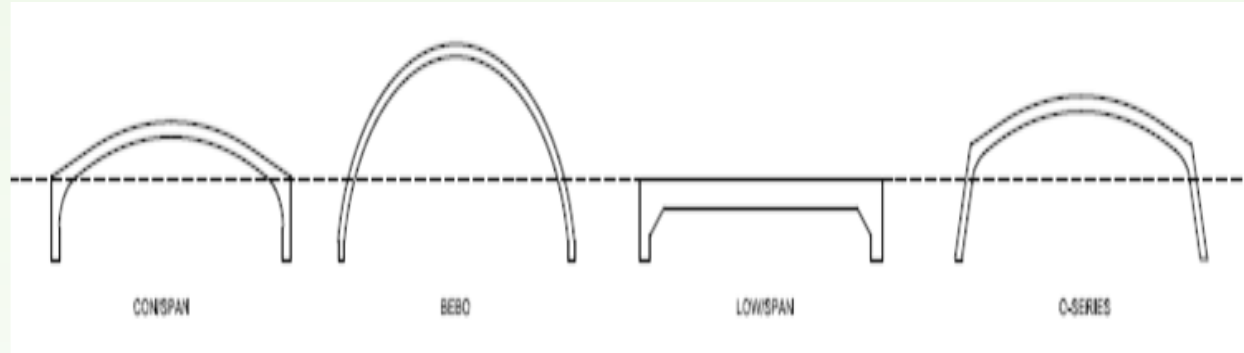


Arch: A Three-Sided, Conventional Arch



Why LowSpan?

Required Road Profile Line



Different conditions determine best product:

Road Profile, Low Bridge/High Chord, Surrounding Geography may preclude the use of a conventionally-reinforced arch.



Conventional Thinking: “Only option is a conventional bridge with decking”

New Option: “Maybe a low-rise, clear span pre-cast structure?”

Why LowSpan? – Pre-stressing for “Low and Lean” Units

LowSpan provides all the benefits of 3-sided precast design except the **pre-stressed top slab** yields:

Low profile structure of minimum 3' minimum inside rise with 10' maximum.

Lean slab thicknesses on wider spans
up to:

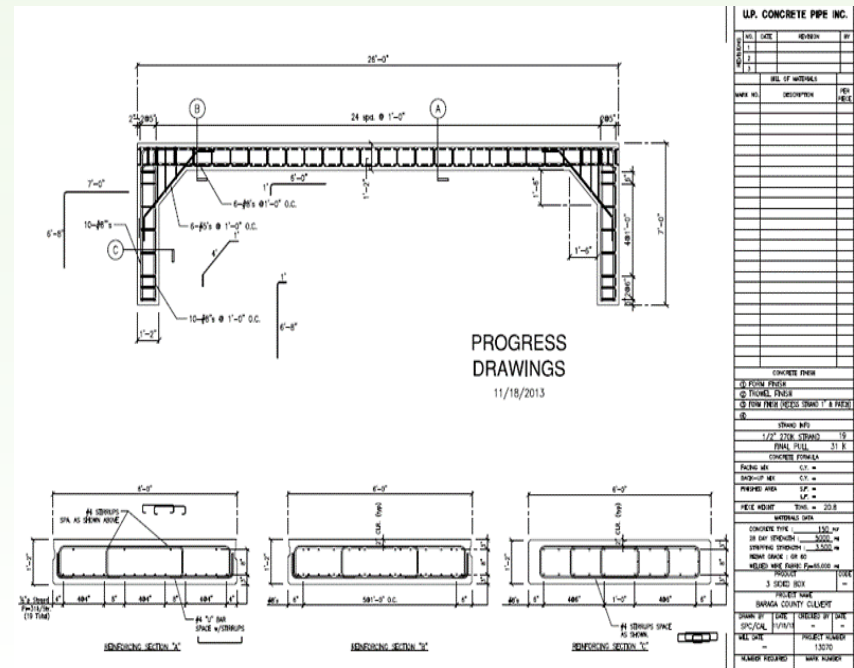
50' spans MDOT HL 93 MOD

60' spans HL 93



LowSpan – Dimensional Facts

- Minimum Rise = 3' (bottom of leg to inside of top slab)
- Top Slab = 14" or 18" thick
- Side Walls = 18" thick
- Section Lengths = 6' (or less)
- Maximum Span = 50'
MDOT HL93 MOD, 60' HL93
- Maximum Weight/pc. = 32 tons
- Skews Possible



Task at Hand

- Remove existing culvert
- Install 30 lin.ft
30'x12' Culvert
- Place 125 CY of fill material
- Place 40 CY of rip rap

NOTICE OF AUTHORIZATION

Permit Number: WRP004113
Date Issued: September 1, 2016
Expiration Date: September 1, 2021

The Michigan Department of Environmental Quality, Water Resources Division,
P.O. Box 30458, Lansing, Michigan 48909-7958, under provisions of the Natural Resources and
Environmental Protection Act, 1994 PA 451, as amended; specifically:

- ☒ Floodplain Regulatory Authority in Part 31, Water Resources Protection.
- ☒ Part 301, Inland Lakes and Streams.
- ☒ Part 303, Wetlands Protection.
- ☐ Part 315, Dam Safety.
- ☐ Part 323, Shorelands Protection and Management.
- ☐ Part 325, Great Lakes Submerged Lands.
- ☐ Part 353, Sand Dunes Protection and Management.

Authorized activity:

Remove the existing structures and install a 30 foot long by 30 foot span by 12 foot rise concrete box culvert at the 12 Mile Road crossing of the Charlotte River. Place approximately 125 cubic yards of fill to re-establish the streambed through the structure, and 40 cubic yards of rock riprap. Excavate approximately 40 cubic yards of material from the culvert inlet area.

All work shall be performed according to the attached plans and permit conditions.

To be conducted at property located in: Chippewa County, Charlotte River, Section 1/36,
Town 45/46N, Range 01W, Bruce Township.

Permittee:

Joel Wiggins
Chippewa County Road Commission
3949 S. Mackinac Trail
Sault Ste. Marie, MI 49783

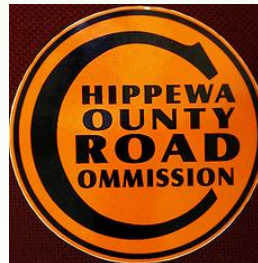

John Gustafson
Upper Peninsula District Office
Water Resources Division
906-203-9887

*This notice must be displayed at the site of work.
Laminating this notice or utilizing sheet protectors is recommended.
Please refer to the above permit number with any questions or concerns.*

MegaBox – An Application of the LowSpan System

The Team:

- UP Concrete Pipe Company
- Chippewa County Road Commission
- UPEA Engineers and Architects
- Salmons P.C.



MegaBox – An Application of the LowSpan System

The Problem:

- Existing Plate-Arch Culvert needs replacing:



MegaBox – An Application of the LowSpan System

The Other Problem:

- Owner wants to maintain buried structure as to bypass bridge icing and deck maintenance costs.
- However, soils are very poor so pilings will be very expensive.
- Silt, Clay, Organics



MegaBox – The Solution: Foundation Control

Undercut & replace with geotextile wrapped enhanced stone bedding per below.



MegaBox – The Solution: Monolithic Footprint



Lessons from Past Project:

Utilize improved bedding methods and joint ties settlement can be reduced/eliminated in notorious eastern U.P. low bearing clay.

7 yrs. Later without a dip or cracking:





Pulling Strand

0.6" strand
reinforcing
pulled to 80% of
ultimate

MegaBox - Pulling Strand

- Initial pull of 3000 pounds
- Final pull of 43,900 pounds
- Basic elongation: 5.5 inches



Mega Box –Reinforcing

- Unit legs are reinforced using conventional reinforcing
- Top and bottom slab are a combination of pre-stress and conventional reinforcing



MegaBox – Ready To Pour



Mega Box - The Pour

- 6000 PSI concrete
- 5000 PSI before cutting strand



MegaBox – QA/QC



MegaBox – The Finished Product



MegaBox – Transportation and Unloading



The Construction: Day 1 – Placement of Bottoms

- Joint Ties
- Shear key grouting
- Tuck Point all horizontal and vertical joints



The Construction: Day 2 – Placement of Tops

Grout place on leveling shims

Note Vertical and Horizontal Joint Ties along with Staggered Sections/Joints:



The Construction: Day 3 – Headwalls, Wingwalls, and Post-Tensioning

Pre-Cast Headwall and Wingwalls



Post-Tensioning all units together



The Construction: Day 3 – Installed!



Road Commission Finishes

- Armor
- Monitored Backfill
- Bridge Membrane Waterproofing
- Geotextile Blanket



Open to Traffic



1st Clamshell Box in Michigan

1st Prestressed Clamshell in North America

