Box Culvert Design And Detailing

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Executive Director
Precast Concrete Association of New York Inc.

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Learning Objectives

- Definition and Purpose
- Culvert Types
- ASTM standards related to box culverts
- Other Culvert Specifications
- Software
- Review of plans and information needed to design
- Production considerations

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Definition and Purpose

- A culvert is a transverse drain or waterway typically located below a roadway, railway, or taxiway embankment to carry water from one side of the embankment to another.



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Definition and Purpose

- Box Culvert is a type of culvert with a square or rectangular cross section

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Why Precast Box Culverts?

- Advantages or precast concrete for box culverts
  - Flexible sizes with spans up to 20’
  - Superior hydraulics
  - Accelerated construction
  - Quality of fabrication, structural integrity, and durability
  - NPCA Certified Plants

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Demand for Precast Box Culverts

- Significant increase in recent years due to:
  - Increase in design flows resulting in larger openings
  - More frequent failures involving other culvert types

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Precast Box Culvert Types

- Monolithic Single Cell

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Precast Box Culvert Types

- Monolithic Multi-Cell

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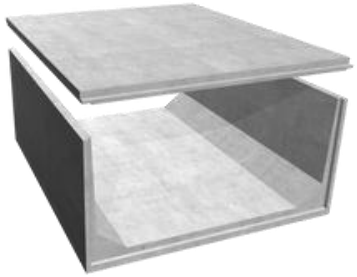
Precast Box Culvert Types

- Trench style with separate top slab



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Precast Box Culvert Types

- Mid-Seam (Clam-Shell)

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Precast Box Culvert Types

- 3-Sided frame with separate footings or separate invert slab

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ASTM Standards

- A little history:
- ASTM published the first standards for precast sections in the mid 70's under the jurisdiction of the C13 Committee on Concrete Pipe
  - ASTM C789 for culverts for earth fills equal to or greater than 2'
  - ASTM C890 for culverts with less than 2' of earth fill

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ASTM Standards

- The committee's intent was to standardize culvert sizes, slab & wall thicknesses, and reinforcing design.
- Reinforcing Tables:
  - Area-of-steel is based on welded wire reinforcing only and cannot be used for conventional rebar
  - Maximum circumferential spacing = 4"
  - Maximum longitudinal spacing = 8"
- Materials and manufacturing requirements
- Quality control and tolerances

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ASTM Standards

- Standard C789 and C850 were combined into ASTM C1433 in 1999
- ASTM C1577 was introduced in 2005 to address AASHTO LRFD design method
- ASTM C1786 was added in 2014 for Segmental Box Sections
- ASTM C1504 was originally approved in 2001 for 3-sided structures

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Other Specifications

- AASHTO Standard for Highway Bridges, 17th Edition
  - Covers H and HS truck loadings
  - Section 17.7 Reinforced Concrete Box, Precast

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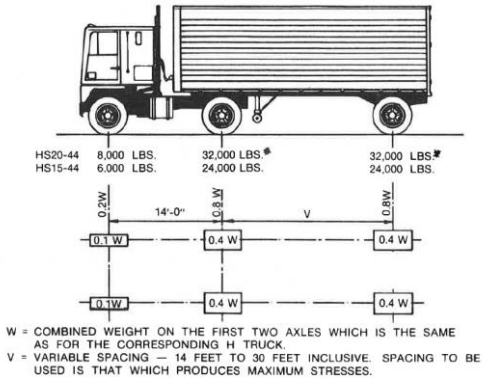
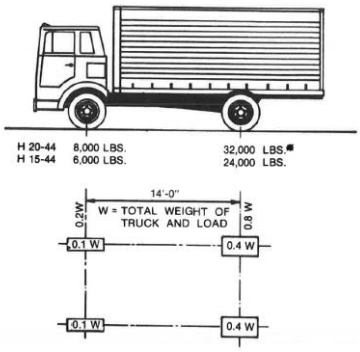
Other Specifications



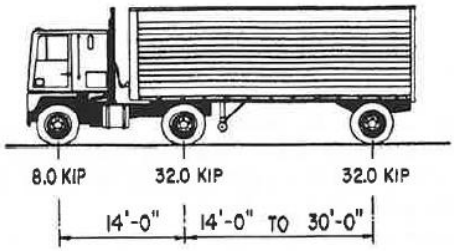
AAHSTO HS Truck



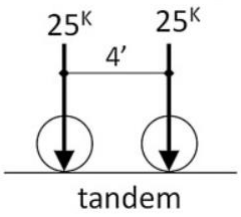
AAHSTO H Truck

Other Specifications

- AASHTO LRFD Design Specification, 9th Ed. most current
  - HL93 loadings - Standard truck, tandem axle and lane load
  - Buried structures are covered in Chapter 12



AAHSTO HL93 Truck



Other Specifications

- American Railway Engineering Manual, AREMA
  - Cooper Railroad Loading (E80)

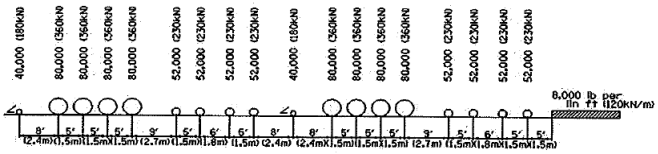


Figure 8-2-1. Cooper E 80 (EM 360) Axle Load Diagram

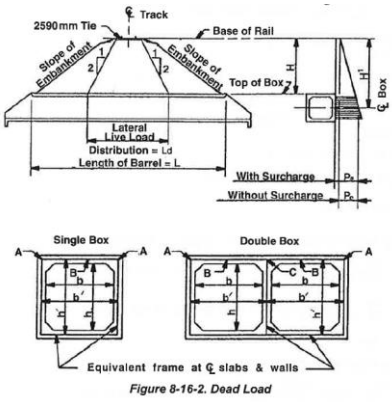


Figure 8-16-2. Dead Load

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Other Specifications

- AASHTO Material Specifications
  - M259 (Same as ASTM C789)
  - M273 (Same as ASTM C850)

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Other Specifications

- State Specifications
  - Many state DOTs have their specifications that may differ from ASTM
    - Load rating vehicles (several states)
    - Maine adds 25% to HL93 standard truck load
    - PennDOT – PHL93 and special LR vehicles. All culverts are post-tensioned
    - NYSDOT – Load ratings for all culvert $\geq$ 5' span, Min 1.2 Inventory rating
    - Some states have requirements for:
      - Minimum slab & wall thickness
      - Bar cover
      - Epoxy bar requirements

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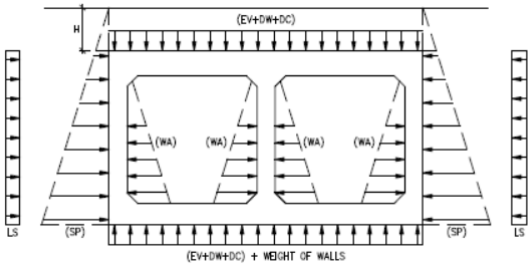
Design Software

- The structural analysis of a rigid frame is somewhat complicated and does not lend itself to hand calculations



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Design Software

- BOXCAR –First released in 1982 under sponsorship of ACPA
  - Latest Version 3.1 uses AASHTO Standard or LRFD
  - Program no longer supported by ACPA
  - Coes not comply with latest LRFD specifications
  - Single cell monolithic box only

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Design Software

- BRASS Culvert – Wyoming DOT
  - AASHTO Standard or LRFD 9th Edition
  - User defined truck loadings for design and load ratings
  - Multi-cell culverts

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Design Software

- CANDE – Culvert Design and Analysis
  - Developed in 1976 under sponsorship of FHWA
  - Primarily used for soil-structure interaction- Arches
  - Not user friendly

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Design Software

- Eriksson Culvert – Previously ETCulvert
  - Developed by Eriksson Software
  - Single and multi-cell culverts
  - 3-Sided Frames
  - Segmental Boxes
  - Wingwalls
  - AASHTO Standard and LRFD 9th Edition
  - AREMA and CSA
  - Several state DOT agency recommended settings
  - Design, analysis, and load ratings

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Information Needed to Design

- Controlling Specification
- Clear span and clear rise
- Min & Max earth fill over top of culvert
  - Measure earth fill within the roadway limit
- Design loads (Vehicles)
- Direction of traffic (skew)
  - Parallel to main reinforcing
  - Perpendicular to main reinforcing

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Analysis vs Design

- Design Mode
  - Enter span, rise, fill depth, bar cover, design spec, and loading
  - Program performs iterations to determine slab/wall thickness and reinforcing
- Analysis Mode
  - Enter all above information plus member thickness and reinforcing
  - Program checks for strength and serviceability against specification requirements

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Culvert Layout

- Determine individual section lay length
  - Considerations:
    - Form limits – typically 8’
    - Max weight – may be determined by contractor
    - Hook height within the plant
    - Shipping

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Culvert Layout

- Determine individual section lay length
  - Uniform section length = overall length/# sections
    - Example L = 42’ ÷ 6 Sections = 7’/section
  - Adjust section length for joint gap
    - Joint gap = ½”
    - L = 42’ x 12” – ½” x 5 joints ÷ 6 Sections = 83.5833” ~ 6’-11 9/16”
  - Do all 6 sections need to be equal length?

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Culvert Layout

- Let's make the outlet end a little shorter
  - Inlet end and standard section L = 83 ¾" (6'-11 ¾")
    - Length with joints = 5 x 83.75" x 5 joints x ½" = 421.25" = 35'-1¼"
  - Outlet end
    - L = 42' x 12 – 421.25 = 82.75" = 6'-11 ¼"
  - Make up the ½" difference with a plate over the pallet

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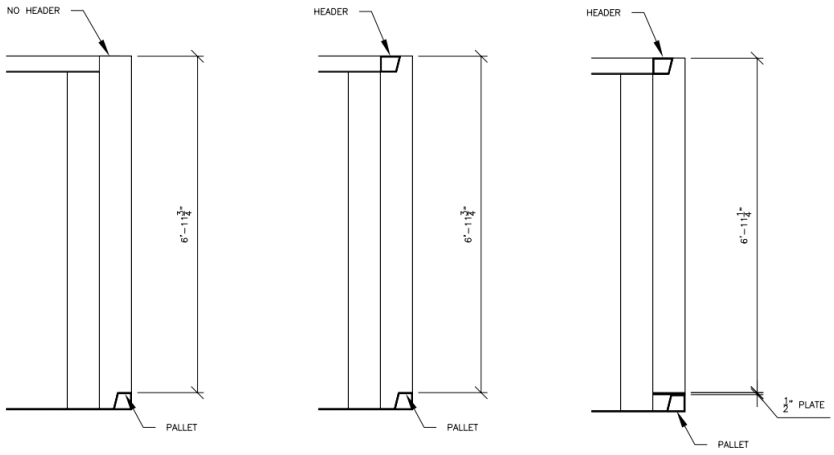
Culvert Layout



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Joint Design

- ASTM C1433 Section 9.1
  - “The precast reinforced concrete box sections shall be produced with tongue and groove ends. The ends shall be of such design and the ends of the box sections so formed that the sections can be laid together to make a continuous line of box sections..”
    - Primarily for proper alignment
    - NOT for load transfer across t he joint
    - Annular space is needed for installation and to prevent load transfer

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Joint Design

- ASTM C1433 Section 9.2
  - “Joints may conform to the requirements of Specification C990, Specification C1677, or other established joint type as approved by the owner including, but not limited to, mortar, sealant, or fabric-wrapped joints...”
    - C990 – Preformed Flexible Joint Sealants (Butyl)
    - C1677 – Rubber Gaskets
  - Unless the joint is required to be watertight (silt-tight is typically acceptable), recommend closed cell neoprene gasket conforming to ASTM D1056, Grade #2A1 or #2A2

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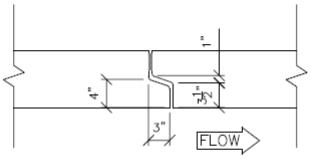
Joint Design

- Male end of joint should point downstream



SHIP–LAP JOINT
DIMENSIONS

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Lifting and Handling

- Lifter type and placement considerations
  - Position and orientation of culvert sections for casting, yard storage, shipping, and installation
  - Weight of section being lifted
  - Center-of-gravity
  - Rigging and overturning
    - Lifter orientation will switch from shear to tension
  - Handling Stress
    - Local stress – lifter breakout
    - Global stress – Cracking moment

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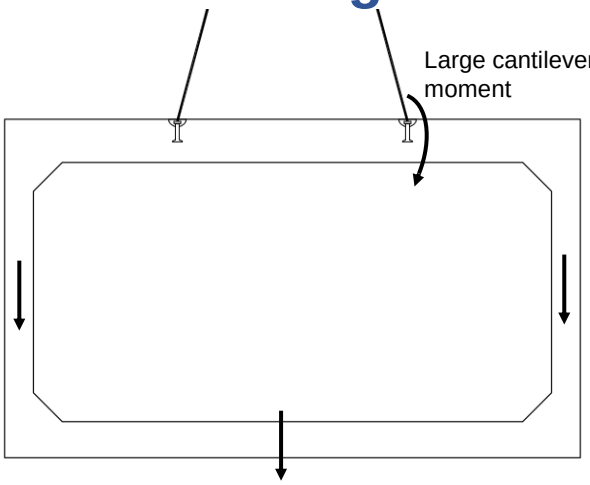
Lifting and Handling



Cracking moment
Mcr = fr x S

Fr = Modulus of rupture
= 5√f'c
S = Section Modulus
= b x h^2/6

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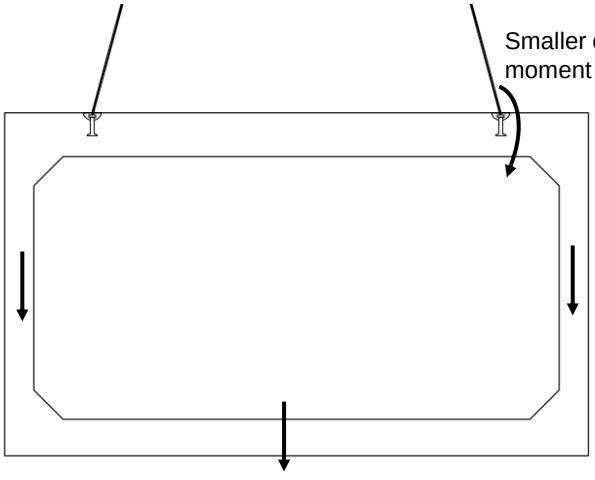
Lifting and Handling



Cracking moment
Mcr = fr x S

Fr = Modulus of rupture
= 5√f'c
S = Section Modulus
= b x h^2/6

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Reinforcing

- Rebar – ASTM A615
- Weldable Bar – ASTM A706
- Welded Wire Reinforcing – A1064
  - Smooth or deformed
- Fibers – Synthetic and non-synthetic may only be used as a nonstructural material, i.e. crack control
- Bar cover – Unless otherwise specified, 1” all locations and 2” in top of top slab if earth fill < 2’

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Reinforcing Cover

- Rebar – ASTM A615
- Weldable Bar – ASTM A706
- Welded Wire Reinforcing – A1064
  - Smooth or deformed

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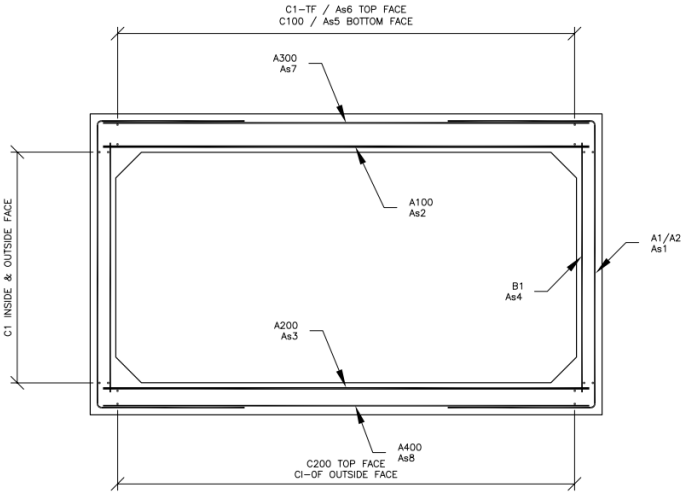
Reinforcing Designations



MK#	ASTM	Location
A100	As2	Top slab inside
A200	As3	Bottom slab inside
A300	As7	Top slab outside
A400	As8	Bottom slab outside
A1	As1	Wall outside
B1	As4	Wal inside
C100	As5	Top slab longit. Inside
C200		Bottom slab longit inside
C1-TF	As6	Top slab longit. outside
C1		Wall longitudinal

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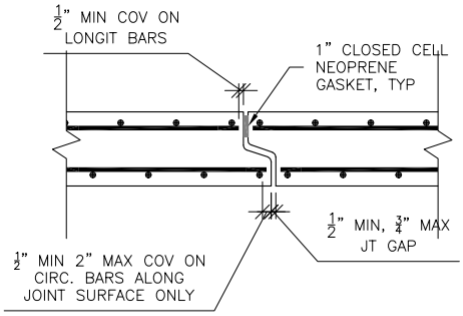
Joint Reinforcing



JOINT REINFORCING

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Case Study

New York State Department of Transportation
Contract #D264902
Culvert Replacement on NY Route 2 and Moses Road
Town of Petersburgh, NY

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NYSDOT Culvert C140138

- Design Parameters
  - Clear Span = 8’-0”
  - Frame Rise = 8’-4”
  - Length = 57’-0”
  - Minimum Fill Depth = 3’
  - Maximum Fill Depth = 5’
  - Skew Angle = 26.60°
  - Design Load = AASHTO HL93
  - Culvert Type – 3-Sided Frame w/Invert Slab

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Section Length and Skewed End Dimensions

Span	8	ft	Top Slab	10.00	in	Wash	1.00	in	
Frame Rise	8.33	ft	Bottom Slab	0.00	in				
Length	57	ft	Walls	8.00	in				
Keyway	4	in	Haunch	10.00	in				
Clear Rise	8.00	ft							
Length along centerline				57	ft	Standard Section Length		6.667 ft	80 in
				684	in	Array Spacing (Length + Jt)			80.5 in
End Sect Skew Angle				26.60	deg	No of Std Sections		7	
Outside culvert width				9.333	ft	Length with joints		46.92 ft	563
Number of Sections				9		Number of Skewed Ends		2	1 jt
Number of Joints				8		CL Dim of Skewed Ends		5 ft	60 in
Joint Spacing				0.5	in	Add to outlet	0 in	5 ft	60 in
						Max length		7.337 ft	88.04 in
						Min Length		2.663 ft	31.96 in
						Subtract for Inlet	0 in	5 ft	60 in
						Max length		7.337 ft	88.04 in
						Min Length		2.663	31.96 in

	Inlet			Outlet		Slope
Top-of-Footing Elev	799.180			794.530		8.16%
Top-of-Concrete Elev	808.095			803.445		
Upstream -	WW-2	WW-1	Downstream -	WW-3	WW-4	
Headwall Elevations	811.000	811.700		806.800	807.400	
Headwall Height (ft)	2.91 ft	3.61 ft		3.36 ft	3.96 ft	

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Invert Slab Length and Cut-off Wall Depth

Span	8.947	ft	Top Slab	0.00	in				
Frame Rise	0.00	ft	Invert Slab	12.00	in				
Length	57	ft	Walls	8.95	in				
Keyway	3	in	Haunch	0.00	in				
Slab Width	11.93	ft							
Length along centerline				57	ft	Standard Section Length		9.5 ft	114 in
				684	in	Array Spacing (Length + Jt)			114 in
End Sect Skew Angle				0	deg	No of Std Sections		6	
Outside culvert width				10.44	ft	Length with joints		57 ft	684
Number of Sections				6		Add 1 for outlet end		0	0 jt
Number of Joints				5		Outlet End Length		0 ft	0 in
Joint Spacing				0	in				

	Inlet	Outlet
Invert Elevation	799.180	794.530
Cut-Off Wall Elevations	794.800	790.300
Cut-Off Wall Depth	3.38 ft	3.23 ft

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3-Sided Frame Design

REFERENCES:

1 AASHTO LRFD Specification for Highway Bridges, 9th Edition
2 NYSDOT Specification 562
3 Design using Eriksson Culvert V6.0.4

DESIGN CRITERIA

1	Live Load	HL93				
2	Design Span	8.00 FT	OD =	9.333 ft		
3	Design Rise	8.33 FT	OD =	9.166 ft		
4	Min Earth Fill	3.17 FT				
5	Max Earth Fill	5.17 FT				
6	Overall Length	57.0 FT				
7	Section Length	6.67 FT				
8	Concrete Strength	6500 PSI				
9	Design Skew	0 Degrees				

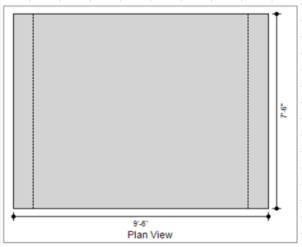
Member Thickness

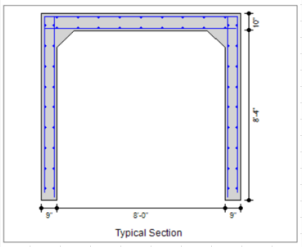
Roof	10	in
Wall	8	in On Skew
Base	0	in
Haunch	10	in

Concrete Vol		**Weight**	
0.74	cy/ft	1.50	Ton/ft
4.93	cy/sect	9.99	Ton/Sect

Location	Type	Cover	Bar Size		Spacing		As Prov	Length	Horiz (ft)	Vert (ft)	Qty	Wgt (lbs)
A100	Str	1.50in	#5	@	6.00	in	0.62 in sq	8.67 ft			14	127
A300	Str	2.00in	#4	@	12.00	in	0.20 in sq	8.67 ft			7	41
A1	"L"	1.50in	#5	@	8.00	in	0.47 in sq	11.08 ft	2.25	8.83	22	254
B1	Str	2.00in	#5	@	12.00	in	0.31 in sq	8.83 ft			14	129
C100	Str		#4	@	12.00	in	0.20 in sq	6.50 ft			9	39
C1-TF	Str		#4	@	12.00	in	0.20 in sq	6.50 ft			10	43
C1-IF	Str		#4	@	12.00	in	0.20 in sq	6.50 ft			16	69
C1-OF	Str		#4	@	12.00	in	0.20 in sq	6.50 ft			18	78
											Total	780

ETC MK#	ASTM MK#	Bar Locations
A100	As2	Top Slab Inside
A300	As3	Top Slab Outside
A1	As1	Wall Outside
B1	As4	Wall Inside
C100	As5	Top Slab Longit Ins.
C1-TF	As6	Top Slab Longit Out.
C1-IF	As5	Wall Inside Longit
C1-OF	As6	Wall Outside Longit





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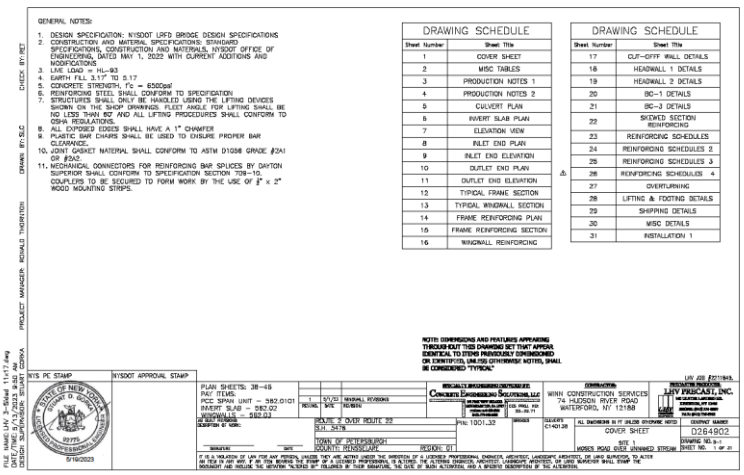
Shop Drawings



GENERAL NOTES:

1. DESIGN SPECIFICATION: NYSDOT LRFD BRIDGE DESIGN SPECIFICATIONS
2. CONSTRUCTION AND MATERIAL SPECIFICATIONS: STANDARD SPECIFICATIONS, CONSTRUCTION AND MATERIALS, NYSDOT OFFICE OF ENGINEERING, DATED MAY 1, 2023 WITH CURRENT ADDITIONS AND MODIFICATIONS
3. LIVE LOAD = HL-93
4. EARTH FILL 3.17' TO 5.17'
5. CONCRETE STRENGTH, f'c = 6500psi
6. REINFORCING STEEL SHALL CONFORM TO SPECIFICATION
7. STRUCTURES SHALL ONLY BE HANDLED USING THE LIFTING DEVICES SHOWN ON THE SHOP DRAWINGS. FLEET ANGLE FOR LIFTING SHALL BE NO LESS THAN 60° AND ALL LIFTING PROCEDURES SHALL CONFORM TO OSHA REGULATIONS.
8. ALL EXPOSED EDGES SHALL HAVE A 1" CHAMFER
9. PLASTIC BAR CHAIRS SHALL BE USED TO ENSURE PROPER BAR CLEARANCE.
10. JOINT GASKET MATERIAL SHALL CONFORM TO ASTM D1056 GRADE 2A1 OR 2A2.
11. MECHANICAL CONNECTORS FOR REINFORCING BAR SPLICES BY DAYTON SUPERIOR SHALL CONFORM TO SPECIFICATION SECTION 709-10. COUPLERS TO BE SECURED TO FORM WORK BY THE USE OF 3" x 2" WOOD MOUNTING STRIPS.

DRAWING SCHEDULE

Sheet Number	Sheet Title
1	COVER SHEET
2	MISC TABLES
3	PRODUCTION NOTES 1
4	PRODUCTION NOTES 2
5	CULVERT PLAN
6	INVERT SLAB PLAN
7	ELEVATION VIEW
8	INLET END PLAN
9	INLET END ELEVATION
10	OUTLET END PLAN
11	OUTLET END ELEVATION
12	TYPICAL FRAME SECTION
13	TYPICAL WINGWALL SECTION
14	FRAME REINFORCING PLAN
15	FRAME REINFORCING SECTION
16	WINGWALL REINFORCING

DRAWING SCHEDULE

Sheet Number	Sheet Title
17	CUT-OFFF WALL DETAILS
18	HEADWALL 1 DETAILS
19	HEADWALL 2 DETAILS
20	BC-1 DETAILS
21	BC-2 DETAILS
22	SKEWED SECTION REINFORCING
23	REINFORCING SCHEDULES
24	REINFORCING SCHEDULES 2
25	REINFORCING SCHEDULES 3
26	REINFORCING SCHEDULES 4
27	OVERTURNING
28	LIFTING & FOOTING DETAILS
29	SHIPPING DETAILS
30	MISC DETAILS
31	INSTALLATION 1

NOTE: DIMENSIONS AND FEATURES APPEARING THROUGHOUT THIS DRAWING SET THAT APPEAR IDENTICAL TO ITEMS PREVIOUSLY DIMENSIONED OR IDENTIFIED, UNLESS OTHERWISE NOTED, SHALL BE CONSIDERED "TYPICAL"

NYS PE STAMP — NYSDOT APPROVAL STAMP

PLAN SHEETS: 38-49
PAY ITEMS:
PCC SPAN UNIT = 562.0101
INVERT SLAB = 562.02
WINGWALLS = 562.03
DESCRIPTION OF WORK:

ROUTE 7 OVER ROUTE 22
S.H. 3476
TOWN OF PITTSBURGH
COUNTY: PITNOSCAPE

Concrete Engineering Solutions, LLC

WINN CONSTRUCTION SERVICES
74 HUDSON RIVER ROAD
WATERFORD, NY 12188

LHV PRECAST, INC.

CONTRACT NO. 1001.32
DESIGNED
CHECKED
SHEET NO. C1-101.26
COVER SHEET
D264902
SITE 1
MOSES ROAD OVER KINNIKINICK STREAM
DRAWING NO. 1
SHEET NO. 1 OF 31

5/19/2023

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Project Photos

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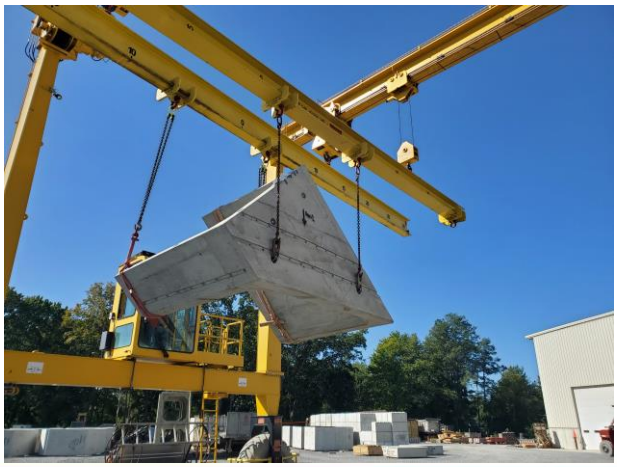
Project Photos



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Project Photos

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Project Photos

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Project Photos

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Case Study

New York State Department of Transportation
Contract #D264939
NY Route 41 Over Wilkens Brook

Town of Coventry, NY

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NYSDOT Culvert C920116

- Design Parameters
  - Clear Span = 10’-0”
  - Clear Rise = 6’-0”
  - Length = 58’-2”
  - Minimum Fill Depth = 2’
  - Maximum Fill Depth = 3.8’
  - Direction of Traffic – Parallel to Main Reinforcing
  - Design Load = AASHTO HL93
  - Culvert Type – 4-Sided Sing-Cell Monolithic

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Section Lengths

Span	10.00 ft	Top Slab	12.00 in	Wash	0.00 in		
Rise	6.00 ft	Bottom Slab	10.00 in	V-Bottom	0.00 in Min	0.00 in Max	
Length	58.17 ft	Walls	8.00 in	Joint Depth	4.00 in		
		Haunch	10.00 in				
Length along centerline		58.167 ft		Standard Section Length	5.792 ft	69.5 in	
		698.004 in		Array Spacing (Length + Jt)		70 in	
End Sect Skew Angle		0 deg		No of Std Sections	9	(includes inlet end)	
Outside culvert width		11.333 ft		Length with joints	52.46 ft	629.5 in	
Number of Sections		10		Add 1 for outlet end	1	1 jt	
Number of Joints		9		Outlet End Length	5.667 ft	68.00 in	
Joint Spacing		0.500 in					

	Inlet			Outlet		Slope
Invert Elevations	1393.020			1392.870		0.26%
Top-of-Concrete	1400.020			1399.870		
Upstream -	El A4	EL A3	Downstream -	EL A2	EL A1	
Headwall Elevations	1402.450	1400.700		1402.550	1401.100	Precast
Headwall Height (ft)	2.43 ft	0.68 ft		2.68 ft	1.23 ft	
Cut-Off Wall Elevations	1389.020			1388.870		Precast
Cut-Off Wall Depth	3.17 ft			3.17 ft		
			From Box Culvert Design Data			Adjusted
Grade Elevation at CL	1403.490	+/-	Min Fill	2.00 ft		2.00 ft
Earth Fill at Centerline	3.55 ft	+/-	Max Fill	3.80 ft		3.88 ft
			Top Slab Thickness	13 in		12 in

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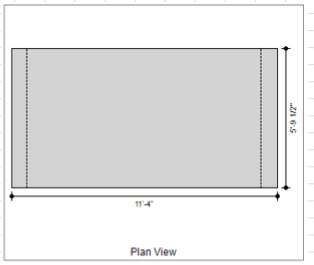
Culvert Design

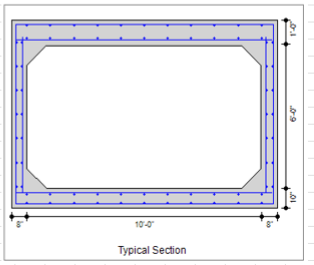
DESIGN CRITERIA				Member Thickness		
1	Live Load	HL-93		Roof	12	in
2	Design Span	10.00	ft	Wall	8	in
3	Design Rise	6.00	ft	Base	10	in
4	Earth Fill, Min	2.00	ft	Haunch	10	in
5	Earth Fill, Max	3.88	ft			
6	Overall Length	58.2	ft			
7	Section Length	5.792	ft			
8	Concrete Strength, f'c	5000	psi	Concrete Vol	Weight	
9	Design Skew	15.84	Deg	1.12 cy/ft	2.26 Ton/ft	
				6.47 cy/sect	13.10 Ton/Sect	

Location	Type	Cover	Bar Size		Spacing	As Prov	Length	Horiz	Vert	Qty	Wgt (lbs)
AE100	Str	2.00in	#7	@	8.00 in	0.90 in²	10.83 ft			9	199
AE200	Str	2.00in	#7	@	7.00 in	1.03 in²	10.83 ft			10	221
AE300	Str	2.00in	#4	@	12.00 in	0.20 in²	10.83 ft			6	43
AE400	Str	2.00in	#4	@	12.00 in	0.20 in²	10.83 ft			6	43
AE1	"U"	2.00in	#5	@	8.00 in	0.47 in²	13.50 ft	3.00	7.50	18	253
BE1	Str	2.00in	#4	@	12.00 in	0.20 in²	6.50 ft			12	52
CE100	Str		#4	@	12.00 in	0.20 in²	5.92 ft			11	43
CE200	Str		#4	@	12.00 in	0.20 in²	5.92 ft			11	43
CE1-TF	Str		#4	@	12.00 in	0.20 in²	5.58 ft			12	45
CE1-IF	Str		#4	@	12.00 in	0.20 in²	5.92 ft			14	55
CE1-OF	Str		#4	@	12.00 in	0.20 in²	5.58 ft			26	97
									Total		1097

ETC	ASTM	
MK#	MK#	Bar Locations
AE100	As2	Top Slab Inside
AE200	As3	Bottom Slab Inside
AE300	As7	Top Slab Outside
AE400	As8	Bottom Slab Outside
AE1	As1	Wall Outside
BE1	As4	Wall Inside
CE100	As5	Top Slab Longit Ins.
CE200		Bot Slab Longit Ins
CE1-TF	As6	Top Slab Longit Out
CE1-IF		Wall Inside Longit
CE1-OF		Wall & Base Outside



Plan View



Typical Section

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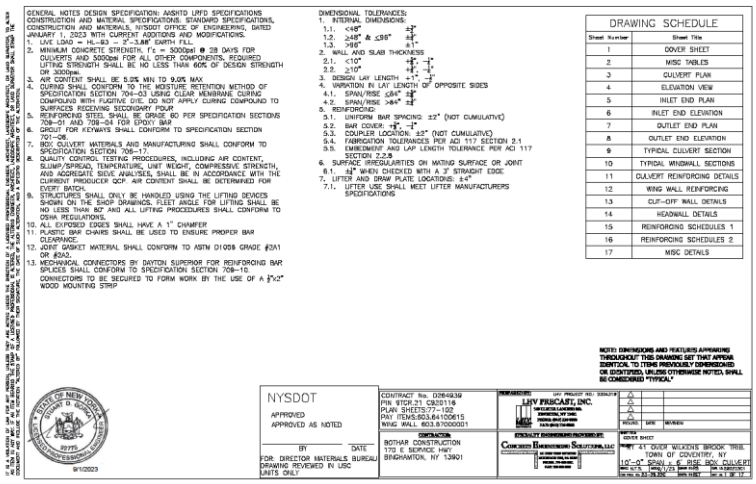
Shop Drawings



GENERAL NOTES DESIGN SPECIFICATION: AASHTO LRFD SPECIFICATIONS CONSTRUCTION AND MATERIAL SPECIFICATIONS: STANDARD SPECIFICATIONS, CONSTRUCTION AND MATERIALS, NYSDOT OFFICE OF ENGINEERING, DATED JANUARY 1, 2023 WITH CURRENT ADDITIONS AND MODIFICATIONS.

1. LIVE LOAD = HL-93 – 3'-3.88" EARTH FILL.
2. MINIMUM CONCRETE STRENGTH, f'c = 5000psi @ 28 DAYS FOR CULVERTS AND 5000psi FOR ALL OTHER COMPONENTS. REQUIRED LIFTING STRENGTH SHALL BE NO LESS THAN 60% OF DESIGN STRENGTH OR 3000psi.
3. AIR CONTENT SHALL BE 5.2% MIN TO 9.0% MAX.
4. CURING SHALL CONFORM TO THE MOISTURE RETENTION METHOD OF SPECIFICATION SECTION 704-03 USING CLEAR MEMBRANE CURING COMPOUND WITH FUGITIVE DYE. DO NOT APPLY CURING COMPOUND TO SURFACES RECEIVING SECONDARY POUR.
5. REINFORCING STEEL SHALL BE GRADE 60 PER SPECIFICATION SECTIONS 709-01 AND 709-04 FOR EPOXY BAR.
6. GROUT FOR KEYWAYS SHALL CONFORM TO SPECIFICATION SECTION 701-06.
7. BOX CULVERT MATERIALS AND MANUFACTURING SHALL CONFORM TO SPECIFICATION SECTION 706-17.
8. QUALITY CONTROL TESTING PROCEDURES, INCLUDING AIR CONTENT, SLUMP/SPREAD, TEMPERATURE, UNIT WEIGHT, COMPRESSIVE STRENGTH, AND AGGREGATE SIEVE ANALYSES, SHALL BE IN ACCORDANCE WITH THE CURRENT PRODUCER QCP. AIR CONTENT SHALL BE DETERMINED FOR EVERY BATCH.
9. STRUCTURES SHALL ONLY BE HANDLED USING THE LIFTING DEVICES SHOWN ON THE SHOP DRAWINGS. FLEET ANGLE FOR LIFTING SHALL BE NO LESS THAN 60° AND ALL LIFTING PROCEDURES SHALL CONFORM TO OSHA REGULATIONS.
10. ALL EXPOSED EDGES SHALL HAVE A 1" CHAMFER.
11. PLASTIC BAR CHAIRS SHALL BE USED TO ENSURE PROPER BAR CLEARANCE.
12. JOINT GASKET MATERIAL SHALL CONFORM TO ASTM D1056 GRADE 2A1 OR 2A3.
13. MECHANICAL CONNECTORS BY DAYTON SUPERIOR FOR REINFORCING BAR SPLICES SHALL CONFORM TO SPECIFICATION SECTION 709-10. CONNECTORS TO BE SECURED TO FORM WORK BY THE USE OF A ¾"x2" WOOD MOUNTING STRIP.

DIMENSIONAL TOLERANCES:

1. INTERNAL DIMENSIONS:
   - 1.1. <48" ±¼"
   - 1.2. ≥48" & ≤96" ±½"
   - 1.3. >96" ±1"
2. WALL AND SLAB THICKNESS
   - 2.1. <10" +½", -¼"
   - 2.2. ≥10" +¾", -¼"
3. DESIGN LAY LENGTH +1", -½"
4. VARIATION IN LAY LENGTH OF OPPOSITE SIDES
   - 4.1. SPAN/RISE ≤84" ±½"
   - 4.2. SPAN/RISE >84" ±¾"
5. REINFORCING
   - 5.1. UNIFORM BAR SPACING: ±2" (NOT CUMULATIVE)
   - 5.2. BAR COVER: +⅜", -⅛"
   - 5.3. COUPLER LOCATION: ±2" (NOT CUMULATIVE)
   - 5.4. FABRICATION TOLERANCES PER ACI 117 SECTION 2.1
   - 5.5. EMBEDMENT AND LAP LENGTH TOLERANCE PER ACI 117 SECTION 2.2.5
6. SURFACE IRREGULARITIES ON MATING SURFACE OR JOINT
   - 6.1. ½" WHEN CHECKED WITH A 3' STRAIGHT EDGE
7. LIFTER AND DRAW PLATE LOCATIONS: ±4"
   - 7.1. LIFTER USE SHALL MEET LIFTER MANUFACTURERS SPECIFICATIONS

DRAWING SCHEDULE	
Sheet Number	Sheet Title
1	COVER SHEET
2	MISC TABLES
3	CULVERT PLAN
4	ELEVATION VIEW
5	INLET END PLAN
6	INLET END ELEVATION
7	OUTLET END PLAN
8	OUTLET END ELEVATION
9	TYPICAL CULVERT SECTION
10	TYPICAL WINGWALL SECTIONS
11	CULVERT REINFORCING DETAILS
12	WING WALL REINFORCING
13	CUT-OFF WALL DETAILS
14	HEADWALL DETAILS
15	REINFORCING SCHEDULES 1
16	REINFORCING SCHEDULES 2
17	MISC DETAILS

NOTE: DIMENSIONS AND FEATURES APPEARING THROUGHOUT THIS DRAWING SET THAT APPEAR IDENTICAL TO ITEMS PREVIOUSLY DIMENSIONED OR DESCRIBED, UNLESS OTHERWISE NOTED, SHALL BE CONSIDERED "TYPICAL"

NYSDOT
APPROVED
APPROVED AS NOTED
BY DATE
FOR: DIRECTOR MATERIALS BUREAU
DRAWING REVIEWED IN USC UNITS ONLY

CONTRACT No. D264839
PIN 9TCR.21, C8/2116
PLAN SHEETS:77–192
PAY ITEMS:563.8410615
WING WALL 603.87000001

CONTRACTOR
BOTHAR CONSTRUCTION
170 E SEMINOLE HWY
BINGHAMTON, NY 13901

LHV PRECAST, INC.

CONCRETE REINFORCING SOLUTIONS, LLC

PART 41 OVER WILKENS BROOK TRIB.
TOWN OF COVENTRY, NY
10'-0" SPAN x 6' RISE BOX CULVERT

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Project Photos

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Project Photos

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Project Photos

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Questions

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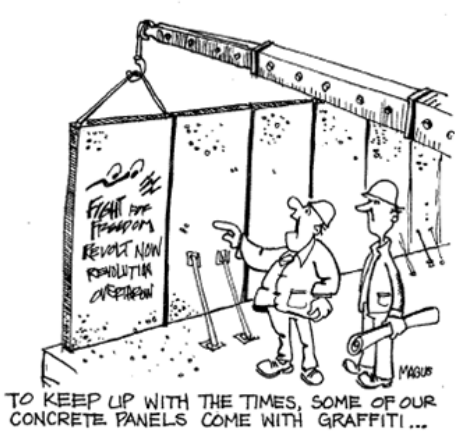
Contact Information



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Box Culvert Design And Detailing

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Executive Director
Precast Concrete Association of New York Inc.

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