



Single Precast Reinforced Concrete Box Culvert Standards

General Notes:

1.

The precast RCB culvert sections are designed for HL-93 live load and earth fills of varying heights.
2.

Vertical earth pressure, EV=0.120 kcf.
Horizontal earth pressure, EHmax = 0.060 kcf max, EHmin = 0.030 kcf.
3.

The precast RCB culvert sections are designed for class 2 exposure conditions.
4.

The clear distance from face of concrete to near edge or end of reinforcing bar to be 1½" min. and 2" max. unless otherwise noted.
5.

The reinforcement supplied for this structure shall be plain and/or deformed welded wire reinforcement (WWR) Fy = 65 ksi, and/or Grade 60 reinforcing steel in accordance with the standard specifications. The reinforcement areas are based on welded wire reinforcement. If reinforcing bars are substituted for welded wire reinforcement, the reinforcement areas shall be increased by 8%. The barrel sections in these standards were designed with plain WWR, Fy = 65 ksi.
6.

All dimensions are in feet and inches unless otherwise noted or shown.
7.

Any of the following combinations of reinforcement may be used:
a. 1 or 2 layers of welded wire reinforcement or
b. 1 layer of welded wire reinforcement and 1 layer of reinforcement bars or
c. 1 layer of reinforcement bars.
The reinforcement shall be developed in accordance with AASHTO LRFD specifications.
8.

The maximum size of reinforcement bars shall be #6, except for parapet reinforcement as detailed.
9.

The maximum welded wire reinforcement size shall be a W23/D23 per layer (maximum of 2 layers).
10.

The spacing center to center of the transverse wires or bars shall not be less than 2" nor more than 4". The spacing center to center of the longitudinal wires or bars shall not be more than 8".
11.

Welding will not be allowed on reinforcement bars or welded wire reinforcement, except that the original welding required to manufacture the wire reinforcement is acceptable.
12.

When reinforcement is cut, additional reinforcement shall be added on both sides of the cut member to replace or exceed the cut reinforcement.
13.

Eriksson Culvert software version 4.3.1.0 was used for the design of the barrel sections for these standards.
14.

These culvert standards label all reinforcing steel with English notation (#3 is ⅜ inch diameter bar). English reinforcing steel received at the precast plant may display the following "bar designation". The "bar designation" is the stamped impression on the reinforcing bars, and is equivalent to the bar diameter in millimeters.
- | | | | | | | | | | |
|-----------------|----|----|----|----|----|----|----|----|----|
| English Size | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 |
| Bar Designation | 10 | 13 | 16 | 19 | 22 | 25 | 29 | 32 | 36 |
15.

The first precast barrel section adjacent to the outlet precast end section may be a double groove barrel to facilitate placement of outlet end sections and allow inlet and outlet end sections to be similar.

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PRCB 12-20	Culvert Barrel Details, 12' Spans
PRCB 14-20	Culvert Barrel Details, 14' Spans
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PES 6-20-T3	Type 3 End Section Details, 7.5° to 45° Skews, 6' to 12' Spans, Sheet 2 of 2
PES 7-20-T3	Type 3 End Section Details, 7.5° to 45° Skews, 14' to 16' Spans, Sheet 1 of 2
PES 8-20-T3	Type 3 End Section Details, 7.5° to 45° Skews, 14' to 16' Spans, Sheet 2 of 2
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PES 11-20	Alternate Curtain Wall Details
PEP 12-20	Embankment Protection Details, 0° to 45° Skews

Specifications:

Design:
AASHTO LRFD Bridge Design Specifications, 8th Ed., Series of 2017.

Construction:
Iowa Department of Transportation Standard Specifications for Highway and Bridge Construction, current series, plus applicable General Supplemental Specifications, Developmental Specifications, Supplemental Specifications and Special Provisions

Design Stresses:

Design stresses for the following materials are in accordance with the AASHTO LRFD Bridge Design Specifications, 8th Ed., Series of 2017:


Bar reinforcement in accordance with AASHTO LRFD Section 5, Grade 60.


Welded wire reinforcement in accordance with AASHTO LRFD Section 5.

Concrete in accordance with AASHTO LRFD Section 5, f'c for barrel sections as noted on culvert barrel detail standards, for end section design f'c = 5 ksi.

ENGLISHIGNEDPRECASTCULVERTS.DGN - PRCB G1-20 - THIS SHEET ISSUED 12-2020.

LATEST REVISION DATE


APPROVED BY BRIDGE ENGINEER

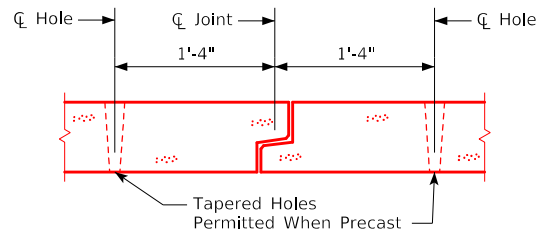


Standard Design
Single Precast Reinforced Concrete Box Culverts
December, 2020

Index and General Notes

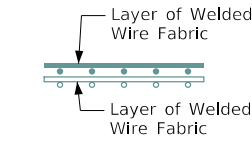
PRCB G1-20

REVISED 10-2021: Updated Note 3.
REVISED 01-2023: Added note to burr threads of Concrete Box Ties.
ENGLISHIGNEDPRECASTCULVERTS.DGN - PRCB G2-20 - THIS SHEET ISSUED 12-2020.



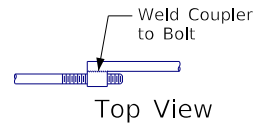
Typical Tie Layout

Note:
Holes shall be cast or drilled 1'-4" from centerline of joints as shown above, unless forms are set up for 1'-4" spacing from outside of joint.

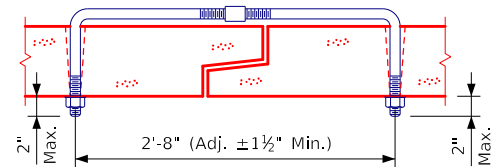


Fabric Layer Detail

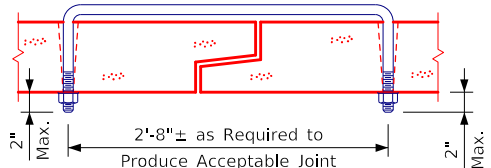
Note:
When more than one layer of welded wire fabric is used to obtain the required reinforcement areas, the wires of the welded wire fabric shall be placed as shown.



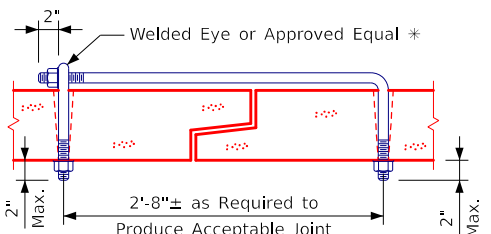
Top View



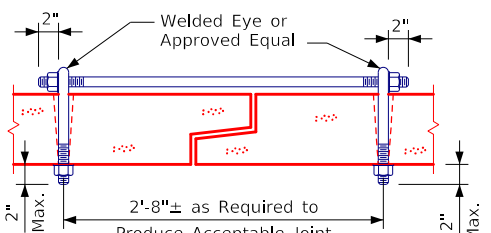
Adjustable Tie



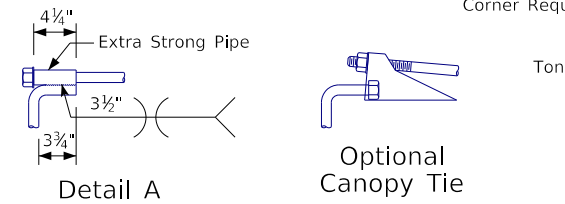
U Bolt Tie ⑥



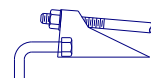
Eye Bolt Tie



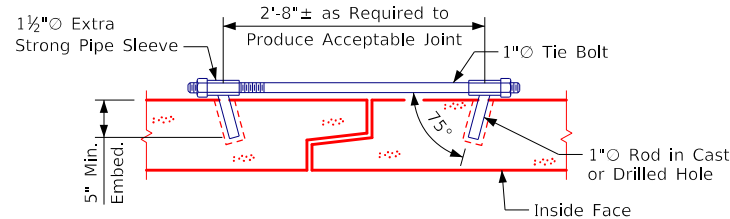
Double Eye Bolt Tie



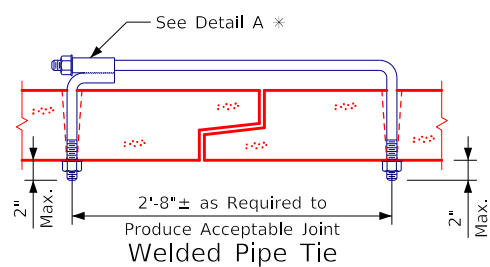
Detail A



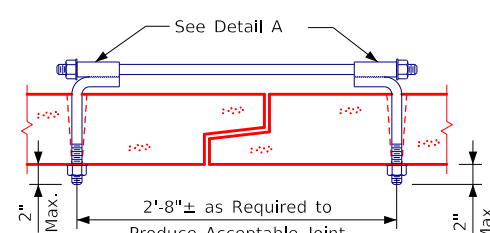
Optional Canopy Tie



Concealed Double Welded Pipe Tie



Welded Pipe Tie

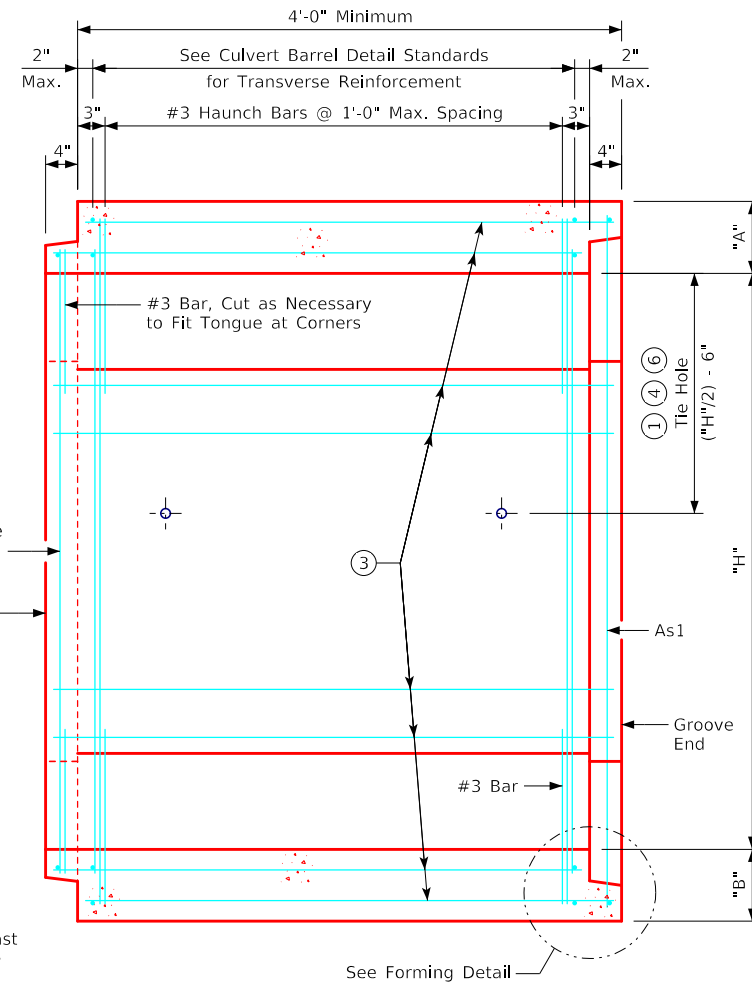


Double Welded Pipe Tie

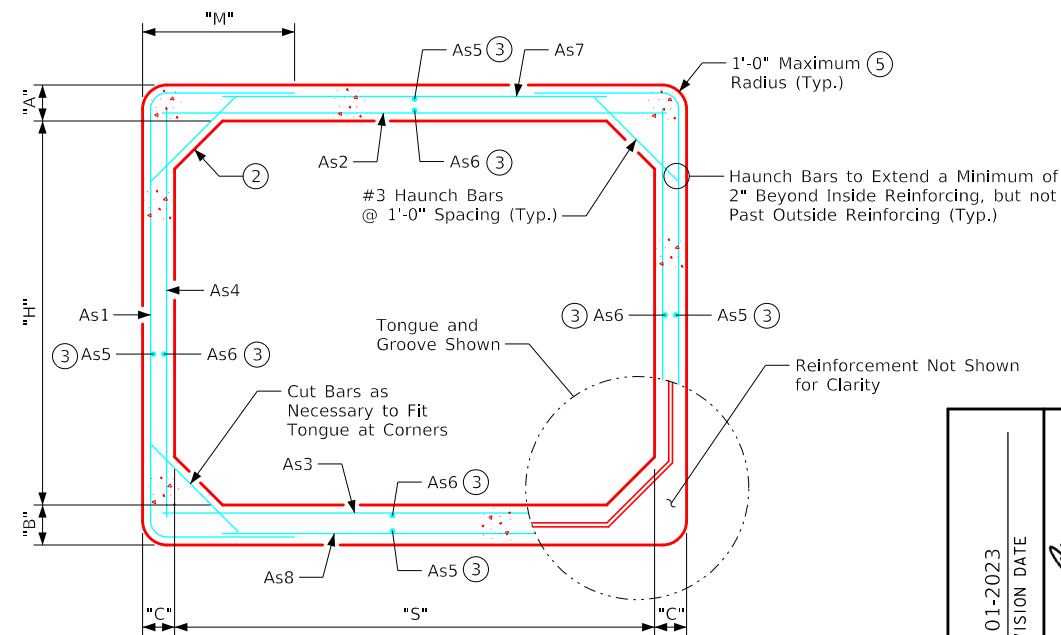
Approved Concrete Box Ties

Note:
Burr threads of Concrete Box Ties without damaging galvanizing to prevent nut rotation after tightening is complete.

* The connections shall be placed at the downstream end when the connections are placed inside of structure.



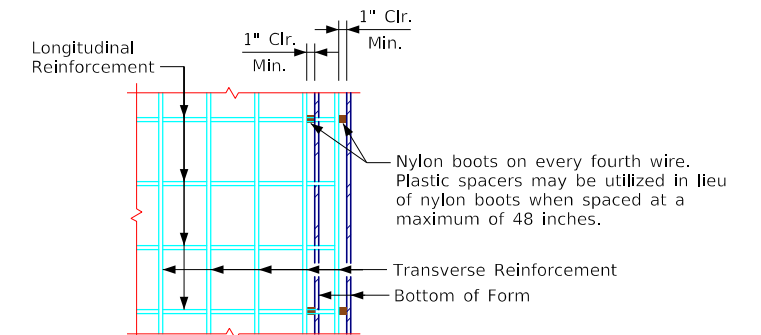
Longitudinal Barrel Section
(Reinforcement Bar Option Shown)



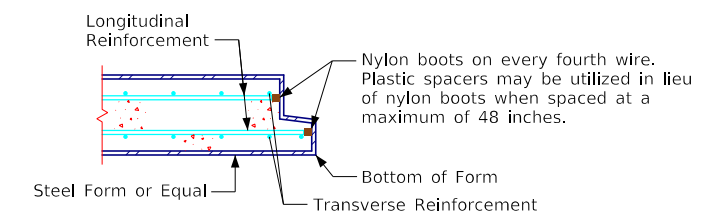
Transverse Barrel Section
(Reinforcement Bar Option Shown)

Notes:

- ① Culvert ties are to be 1"Ø rods. See this sheet for connection details.
- ② Haunch sizes are to be 12" vertical, 12" horizontal on all box sizes.
- ③ Longitudinal reinforcement denoted as As5 & As6 must be placed in slab, floor, and walls and must be 0.06 IN.²/FT. MIN.
- ④ Refer to applicable end section detail sheet for barrel to end section connection tie hole locations.
- ⑤ Optional squared corners with 3/4" to 2" chamfer.
- ⑥ U bolt ties are required for cattle paths with nuts on fill side.

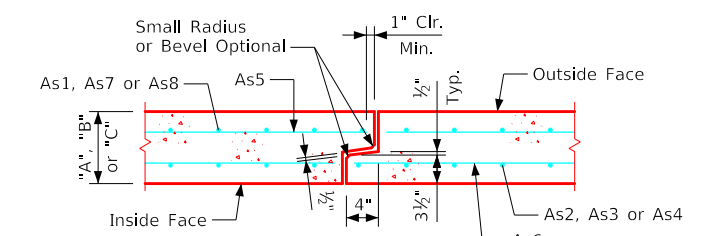


Plan




Section

Forming Detail

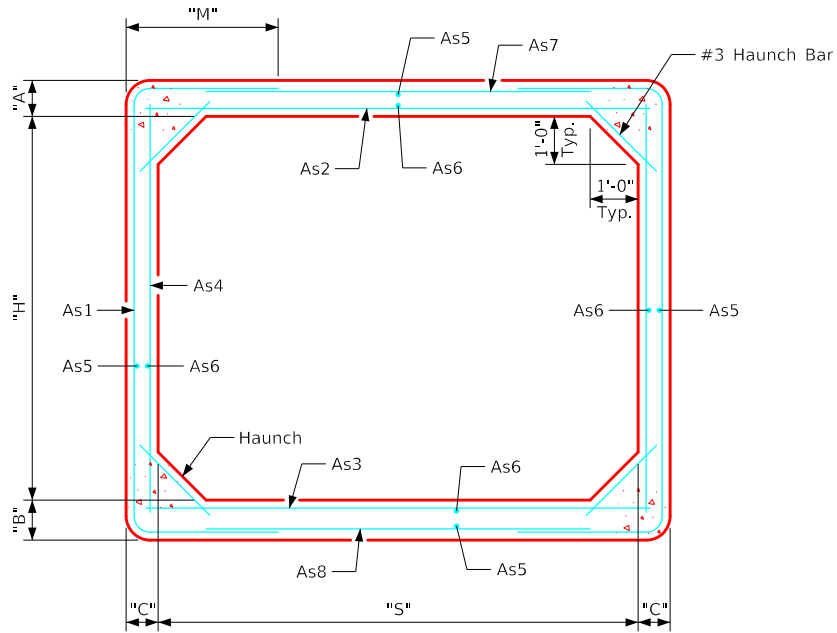


Tongue and Groove Joint Detail

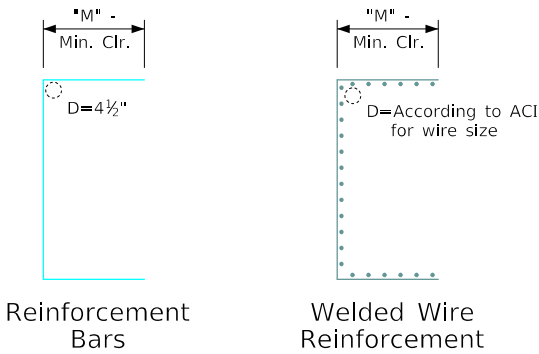
01-2023 LATEST REVISION DATE	 Standard Design Single Precast Reinforced Concrete Box Culverts December, 2020	PRCB G2-20	
		Typical Culvert Barrel Details	
		APPROVED BY BRIDGE ENGINEER	

ENGLISHIGNEDPRECASTCULVERTS.DGN - PRCB 10-20 - THIS SHEET ISSUED 12-2020.

Variable Dimensions and Quantities for 10' Span Barrel Sections																				
Dimensions									Reinforcement Requirements										Weight (LB/FT)	
									As1			As2		As3		As4		As7/As8		
Size	Class	f'c (KSI)	Fill (FT)	S (FT)	H (FT)	A (IN)	B (IN)	C (IN)	Area (IN²/FT)	Length	M	Area (IN²/FT)	Length	Area (IN²/FT)	Length	Area (IN²/FT)	Length	Area (IN²/FT)	Length	
10'x4'	1	5.0	2-11	10	4	9	10	8	0.72	9'-11"	2'-6"	0.56	10'-6"	0.57	10'-6"	0.20	4'-6"	0.24	9'-4"	3795
	2	5.0	12-21	10	4	9	10	8	1.29	10'-7"	2'-10"	0.98	10'-6"	0.99	10'-6"	0.20	4'-6"	0.24	9'-4"	3795
	3	5.0	22-25	10	4	10	10	9	1.26	10'-8"	2'-10"	0.98	10'-6"	1.01	10'-6"	0.23	4'-6"	0.24	9'-6"	4075
10'x5'	1	5.0	2-11	10	5	9	10	8	0.63	10'-7"	2'-4"	0.66	10'-6"	0.68	10'-6"	0.20	5'-6"	0.24	9'-4"	3995
	2	5.0	12-22	10	5	9	10	8	1.16	11'-3"	2'-8"	1.20	10'-6"	1.22	10'-6"	0.20	5'-6"	0.24	9'-4"	3995
	3	5.0	23-25	10	5	10	10	9	1.11	11'-6"	2'-9"	1.13	10'-6"	1.19	10'-6"	0.23	5'-6"	0.24	9'-6"	4300
10'x6'	1	5.0	2-11	10	6	9	10	8	0.59	11'-7"	2'-4"	0.74	10'-6"	0.77	10'-6"	0.20	6'-6"	0.24	9'-4"	4195
	2	5.0	12-22	10	6	9	10	8	1.01	12'-3"	2'-8"	1.28	10'-6"	1.34	10'-6"	0.20	6'-6"	0.24	9'-4"	4195
	3	5.0	23-25	10	6	10	10	9	1.01	12'-4"	2'-8"	1.25	10'-6"	1.28	10'-6"	0.23	6'-6"	0.24	9'-6"	4525
10'x7'	1	5.0	2-11	10	7	9	10	8	0.54	12'-7"	2'-4"	0.81	10'-6"	0.84	10'-6"	0.20	7'-6"	0.24	9'-4"	4395
	2	5.0	12-22	10	7	9	10	8	0.92	13'-1"	2'-7"	1.40	10'-6"	1.46	10'-6"	0.20	7'-6"	0.24	9'-4"	4395
	3	5.0	23-25	10	7	10	10	9	0.93	13'-4"	2'-8"	1.35	10'-6"	1.41	10'-6"	0.23	7'-6"	0.24	9'-6"	4750
10'x8'	1	5.0	2-10	10	8	9	10	8	0.53	13'-7"	2'-4"	0.89	10'-6"	0.95	10'-6"	0.20	8'-6"	0.24	9'-4"	4595
	2	5.0	11-21	10	8	9	10	8	0.83	14'-3"	2'-8"	1.44	10'-6"	1.47	10'-6"	0.20	8'-6"	0.24	9'-4"	4595
	3	5.0	22-25	10	8	10	11	8	0.86	14'-1"	2'-6"	1.50	10'-6"	1.56	10'-6"	0.20	8'-6"	0.27	9'-4"	4875
10'x9'	1	5.0	2-11	10	9	9	11	8	0.53	14'-10"	2'-5"	0.96	10'-6"	1.02	10'-6"	0.20	9'-6"	0.24	9'-4"	4935
	2	5.0	12-21	10	9	9	10	8	0.78	15'-5"	2'-9"	1.53	10'-6"	1.58	10'-6"	0.20	9'-6"	0.24	9'-4"	4795
	3	5.0	22-25	10	9	10	11	8	0.83	15'-3"	2'-7"	1.58	10'-6"	1.64	10'-6"	0.20	9'-6"	0.27	9'-4"	5075
10'x10'	1	5.0	2-11	10	10	9	10	8	0.54	16'-7"	2'-10"	1.04	10'-6"	1.13	10'-6"	0.20	10'-6"	0.24	9'-4"	4995
	2	5.0	12-21	10	10	9	10	8	0.80	16'-11"	3'-0"	1.61	10'-6"	1.67	10'-6"	0.24	10'-6"	0.24	9'-4"	4995
	3	5.0	22-25	10	10	10	11	9	0.78	16'-11"	2'-11"	1.53	10'-6"	1.61	10'-6"	0.23	10'-6"	0.27	9'-6"	5570
10'x11'	1	5.0	2-9	10	11	9	10	8	0.59	18'-5"	3'-3"	1.10	10'-6"	1.16	10'-6"	0.29	11'-6"	0.24	9'-4"	5195
	2	5.0	10-16	10	11	9	10	8	0.60	18'-7"	3'-4"	1.37	10'-6"	1.44	10'-6"	0.35	11'-6"	0.24	9'-4"	5195
	3	5.0	17-20	10	11	9	10	9	0.68	18'-7"	3'-4"	1.49	10'-6"	1.56	10'-6"	0.32	11'-6"	0.24	9'-6"	5510
	4	5.0	21-25	10	11	10	11	11	0.69	18'-7"	3'-3"	1.34	10'-6"	1.43	10'-6"	0.27	11'-6"	0.27	9'-10"	6435
10'x12'	1	5.0	2-12	10	12	9	11	8	0.59	21'-4"	4'-2"	1.16	10'-6"	1.22	10'-6"	0.41	12'-6"	0.27	9'-4"	5535
	2	5.0	13-19	10	12	9	10	10	0.62	20'-1"	3'-7"	1.37	10'-6"	1.46	10'-6"	0.39	12'-6"	0.24	9'-8"	6075
	3	5.0	20-25	10	12	10	11	11	0.69	20'-3"	3'-7"	1.40	10'-6"	1.52	10'-6"	0.36	12'-6"	0.27	9'-10"	6710



Typical Barrel Section





Bent Bar Details

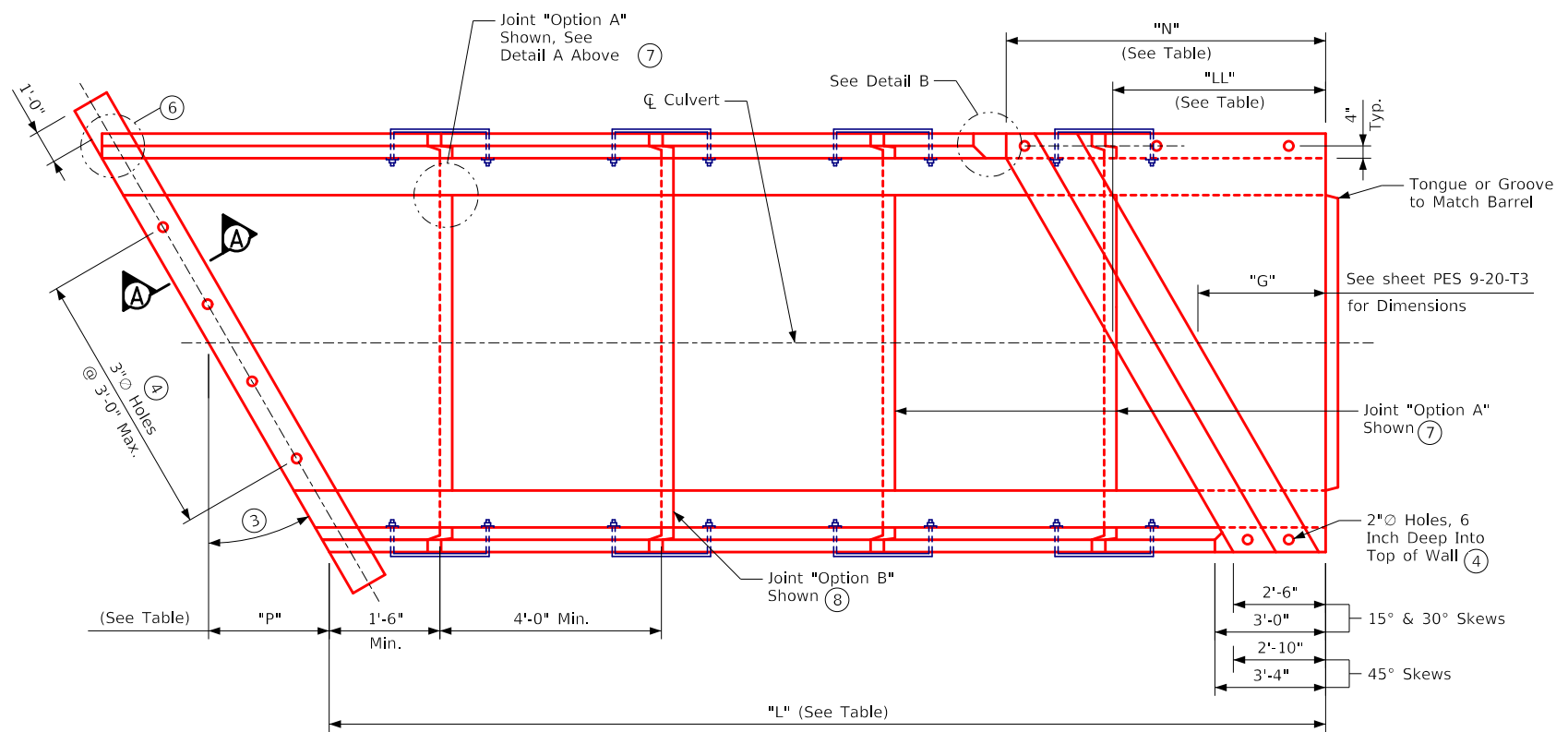
All dimensions are out to out.
D = pin diameter (min.).
Pin diameter may be increased if
needed to maintain clear cover.

Notes:

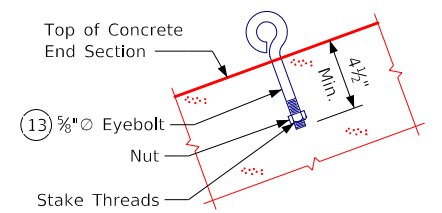
- Longitudinal reinforcement denoted as As5 and As6 must be placed in slab, floor, and walls and must be 0.06 in²/ft minimum.
- All reinforcement lengths and areas are minimum requirements.
- If reinforcing bars are substituted for welded wire reinforcing, dimension "M" and/or length of the As7/As8 reinforcement shall be adjusted to ensure adequate lap length is provided.
- Weight of sections assumes a density of 150 PCF and squared corners.
- See PRCB G1-20 and G2-20 for additional information and notes.

LATEST REVISION DATE	 APPROVED BY BRIDGE ENGINEER		
		Standard Design Single Precast Reinforced Concrete Box Culverts December, 2020	
		Culvert Barrel Details 10'-0" Span Barrel Sections	PRCB 10-20

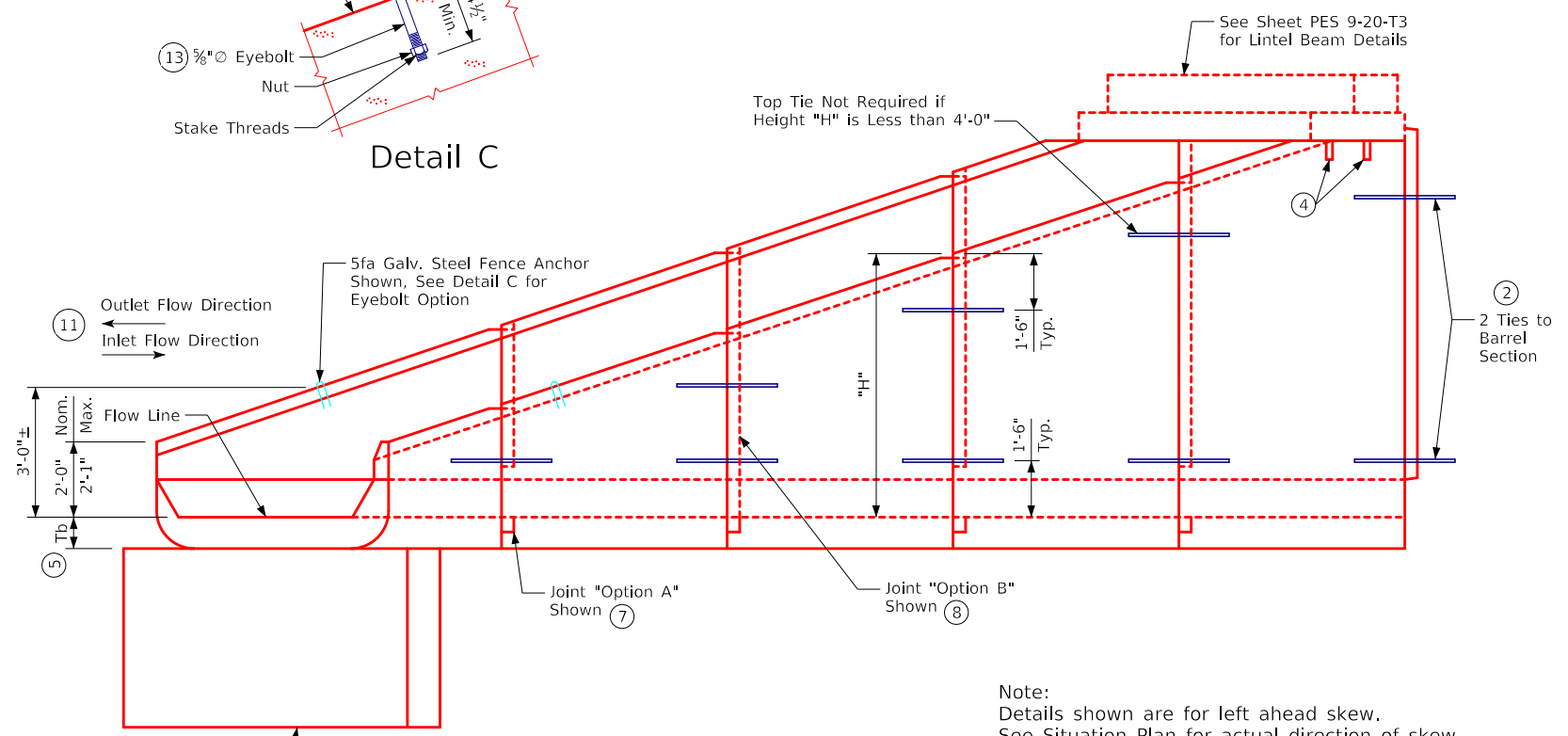
REVISED 10-2021: Added lintel beam connection hole location in Plan View.
ENGLISHIGNEDPRECASTCULVERTS.DGN - PES 5-20-T3 S1 - THIS SHEET ISSUED 12-2020.



Plan View

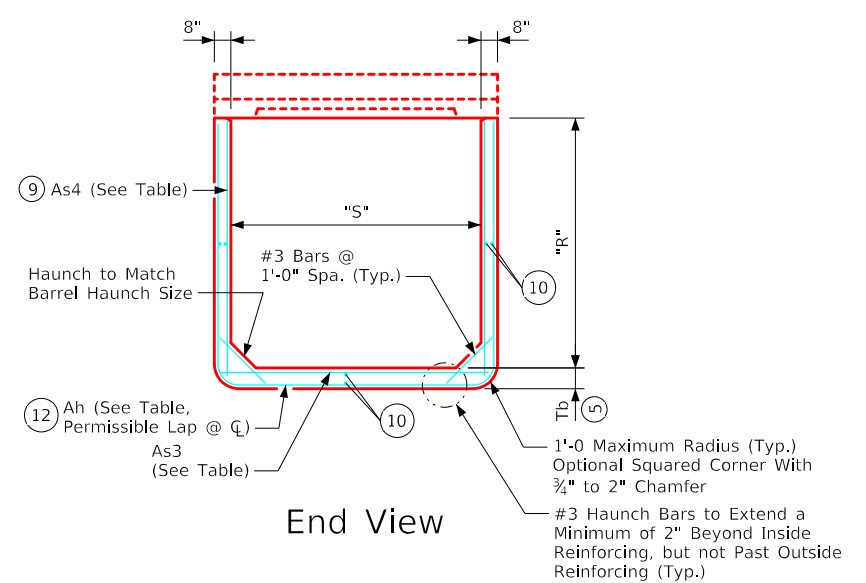


Detail C

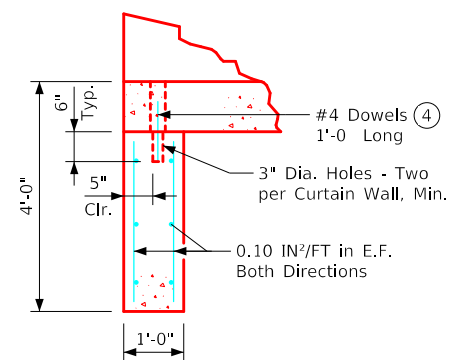


Elevation

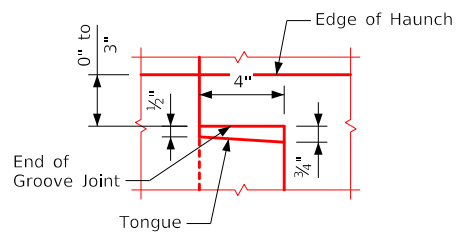
Note:
Details shown are for left ahead skew.
See Situation Plan for actual direction of skew.
Details for right ahead skews similar.
See sheet PES 6-20-T3 for additional information
and notes used in conjunction with this sheet.



End View

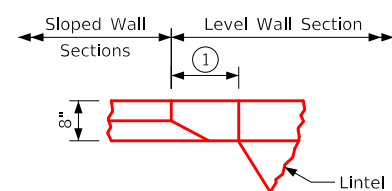


Section A-A

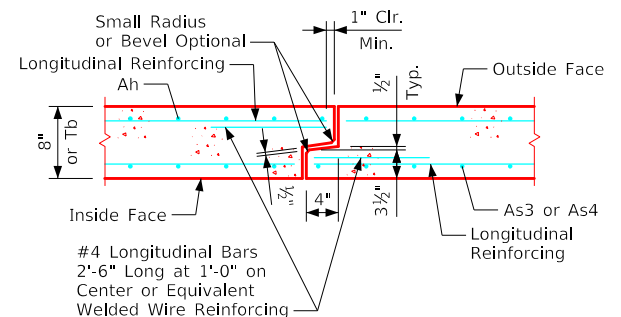


Detail A

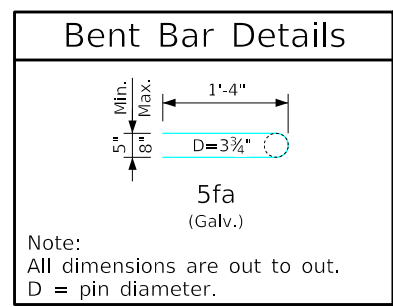
(Detail Shown at Floor; Similar at Walls)



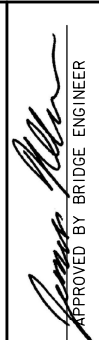

Detail B



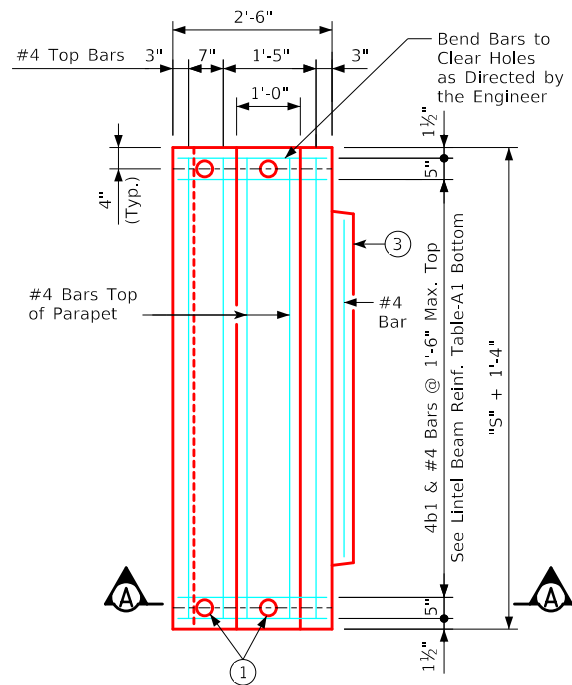
Tongue and Groove Joint Detail



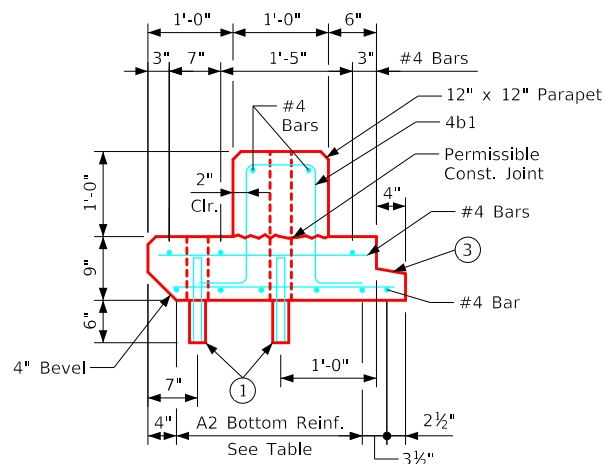
Note:
All dimensions are out to out.
D = pin diameter.

10-2021 LATEST REVISION DATE	 APPROVED BY BRIDGE ENGINEER	 Standard Design Single Precast Reinforced Concrete Box Culverts December, 2020	
		Type 3 End Section Details For Skews of 7.5° to 45°; 6' - 12' Spans	PES 5-20-T3 Sheet 1 of 2

ENGLISH\IGNEDPRECASTCULVERTS.DGN - PES 9-20-T3 - THIS SHEET ISSUED 12-2020.



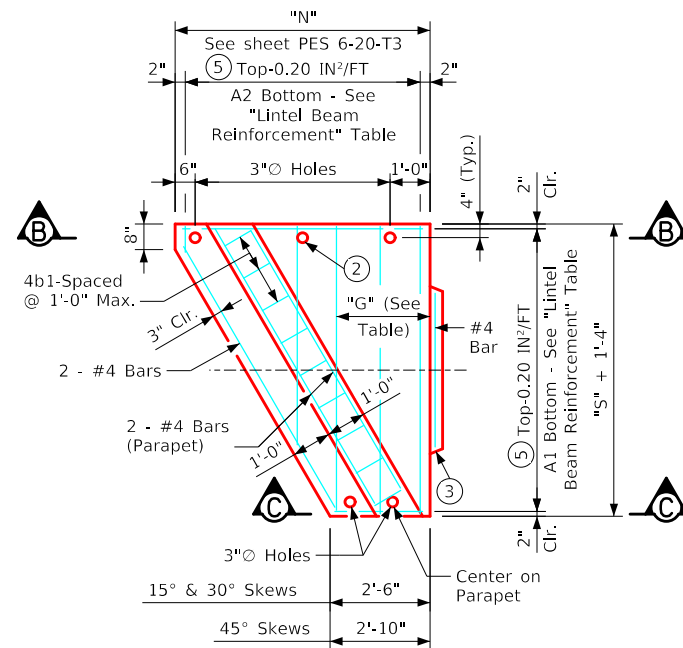
Plan of Square Lintel Beam
(Tongue Option Shown)



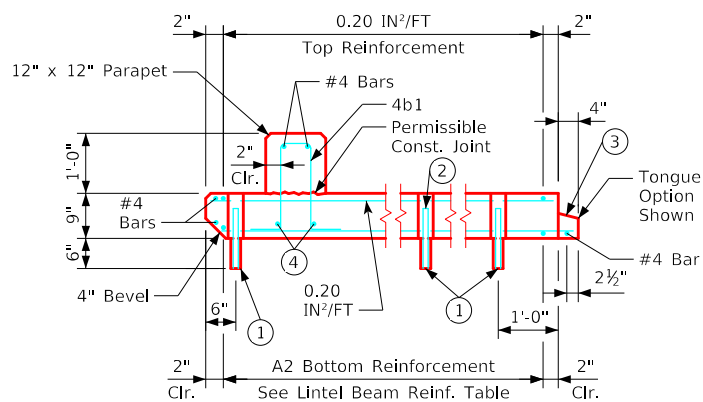
Section A-A
(Tongue Option Shown)

0° Skew Lintel Beam
(For Skews up to 7°30')

Lintel Beam Reinforcement				
Span S (FT)	Bottom Reinforcement			
	WWR Option		Rebar Option	
	A1 (IN ² /FT)	A2 (IN ² /FT)	A1	A2
6	0.13	0.26	#4 @ 12"	3 - #4 @ 12"
8	0.16	0.32	#4 @ 12"	4 - #4 @ 8"
10	0.20	0.40	#4 @ 12"	3 - #5 @ 12"
12	0.25	0.49	#5 @ 12"	4 - #5 @ 8"



Plan View



Section B-B

Skewed Lintel Beam
(For Skews of 7°30' to 45°)

Length G			
Along Barrel Q of Skewed Lintel Beam			
Span S (FT)	15° Skew	30° Skew	45° Skew
6	1'-4 ¹ / ₁₆ "	2'-3 ¹ / ₁₆ "	3'-8 ¹ / ₁₆ "
8	1'-8 ³ / ₁₆ "	2'-10 ³ / ₁₆ "	4'-8 ¹ / ₁₆ "
10	1'-11 ³ / ₁₆ "	3'-5 ⁹ / ₁₆ "	5'-8 ¹ / ₁₆ "
12	2'-2 ¹ / ₁₆ "	4'-0 ¹ / ₂ "	6'-8 ¹ / ₁₆ "

Lintel Beam Reinforcement				
Span S (FT)	Bottom Reinforcement			
	WWR Option		Rebar Option	
	A1 (IN ² /FT)	A2 (IN ² /FT)	A1	A2
6	0.28	0.55	#5 @ 12"	#5 @ 6"
8	0.38	0.76	#6 @ 12"	#6 @ 6"
10	0.50	1.00	#7 @ 12"	#7 @ 6"
12	0.65	1.30	#8 @ 12"	#8 @ 6"

Skewed Parapet Reinforcement				
Span S (FT)	15° Skew	30° Skew	45° Skew	
6	2 - #5	2 - #6	2 - #6	
8	2 - #6	2 - #6	2 - #7	
10	2 - #7	2 - #7	2 - #8	
12	2 - #7	2 - #8	3 - #8	

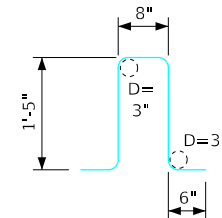
Notes:

Precast lintel beams shall be constructed in accordance with precast barrel and end section details and notes, except as modified below:

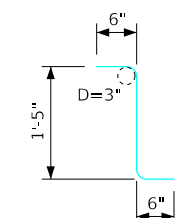
Reinforcing for precast lintels and parapets shall be either welded wire reinforcing (WWR) meeting the requirements of AASHTO LRFD Section 5 or reinforcing bars meeting the requirements of ASTM A615 (60 KSI). Wire spacing for WWR shall not exceed 4 inches for primary steel and 8 inches for distribution steel.

- Place #8 dowel, 1'-0" long into 2 inch dia. hole in the top of the wall section and 3 inch dia. hole in the lintel beam. Fill holes with grout.
- Cast additional 3 inch holes to maintain a 4 foot maximum hole spacing.
- Check the location to determine whether a tongue or a groove is used. Tongue and groove to terminate at culvert radius.
- See "Skewed Parapet Reinforcement" table.
- Areas shown are for welded wire fabric. If rebar is used, #4 at a max. of 11 inch spacing should be used.

Bent Bar Details



4b1



Alternate 4b1
(2 Required)

Note: All dimensions are out to out. D = pin diameter.

LATEST REVISION DATE

APPROVED BY BRIDGE ENGINEER



Standard Design
Single Precast Reinforced
Concrete Box Culverts
December, 2020

Type 3 Lintel
Beam Details

For Skews 0° to 45°; 6' - 12' Spans

PES 9-20-T3