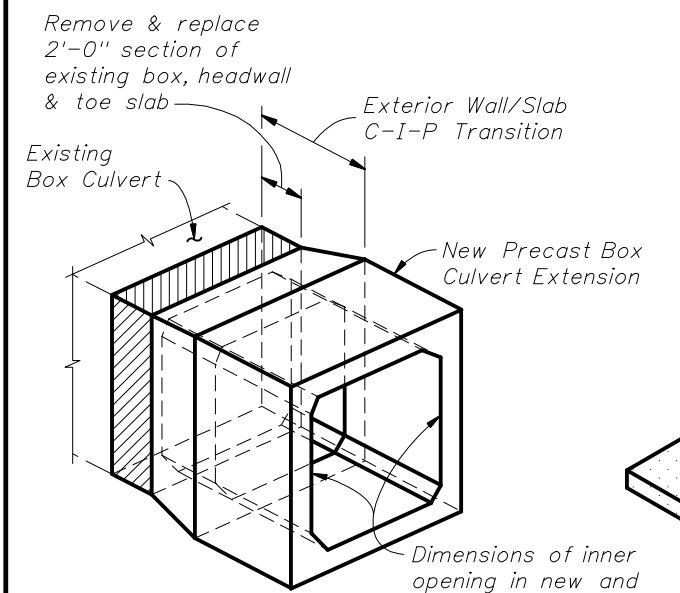
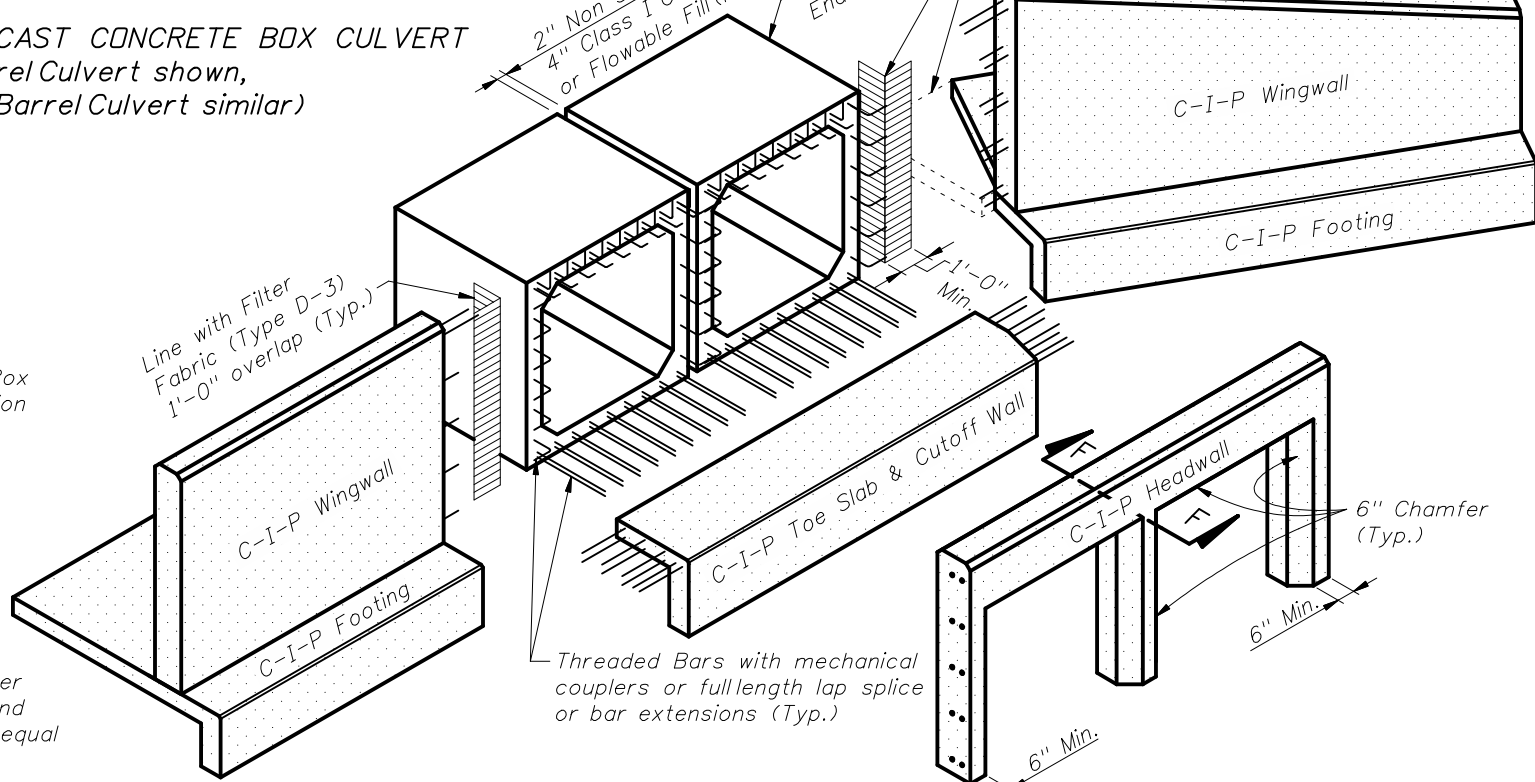


ISOMETRIC VIEW OF PRECAST CONCRETE BOX CULVERT
(Double Barrel Culvert shown,
Single or Multi-Barrel Culvert similar)



DETAIL E
PICTORIAL VIEW OF EXTERIOR
WALL/SLAB TRANSITION



EXPLODED VIEW OF CONNECTIONS AT END OF CULVERT
(Double Barrel Culvert shown, Single or Multi-Barrel Culvert similar)

PERMITTED PRECAST ALTERNATE BOX SECTIONS				
TYPE	DESCRIPTION	SINGLE BARREL	MULTIPLE BARRELS	DESIGN NOTES
A	Single Cell Monolithic (Four Sided)			Index No. 292 or Contractor Design
B	Single Cell Two-Piece (Four Sided)			Contractor Design
C	Multi-cell Monolithic	Not Applicable		Contractor Design

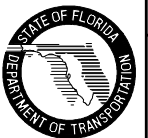
GENERAL NOTES:

- Specifications:
 - General:
 - FDDT Standard Specifications for Road and Bridge Construction, Section 410 (current edition, and supplements thereto).
 - Concrete (Precast):
 - Class III (5,000 psi) for slightly aggressive environments.
 - Class IV (5,500 psi) for moderately to extremely aggressive environments.
 - Concrete (Cast-In-Place):
 - Class II (3,400 psi) for slightly aggressive environments.
 - Class IV (5,500 psi) for moderately to extremely aggressive environments.
 - Reinforcing Steel:
 - ASTM A615 Grade 60 deformed bar unless otherwise noted, with a minimum clearance of 2" for slightly and moderately aggressive environments or 3" for extremely aggressive environments, unless otherwise shown. Equal area substitution of welded wire (WWR) reinforcement is permitted.
- This Index works with LFD designs using Index No. 290, or LRFD designs with the Department's standard C-I-P Concrete Box Culvert design details shown in the plans. Work this Index with the Cast-In-Place Concrete Box Culvert Details shown in the plans and the Precast Concrete Box Culverts shown in the shop drawings.
- All joints between precast sections must be tongue & groove with joint sealant. Joints between cast-in-place & precast sections shall have longitudinal reinforcing extending from top, bottom & both side slabs of the precast box tied to the cast-in-place reinforcement. Single barrel culverts may have precast headwalls cast integrally with the end segment when approved by the Engineer.
- Extension of existing multiple barrel box culverts with multiple single cell precast box culverts is not permitted unless approved by the District Structures Engineer. Full transition details must be shown in the shop drawings when approved.
- Culverts larger than the specified size may be substituted with no additional payment to the Contractor. Substitution must be approved by the Engineer, minimum earth cover and invert elevations shown in the Contract Documents must be maintained.

INSTRUCTIONS TO DESIGNER:

- Show Differential Settlement (ΔY) and Effective Length (L) for single curvature deflection in the Contract Plans where significant long-term settlement is anticipated. See Sheet 5 of 5 for details.

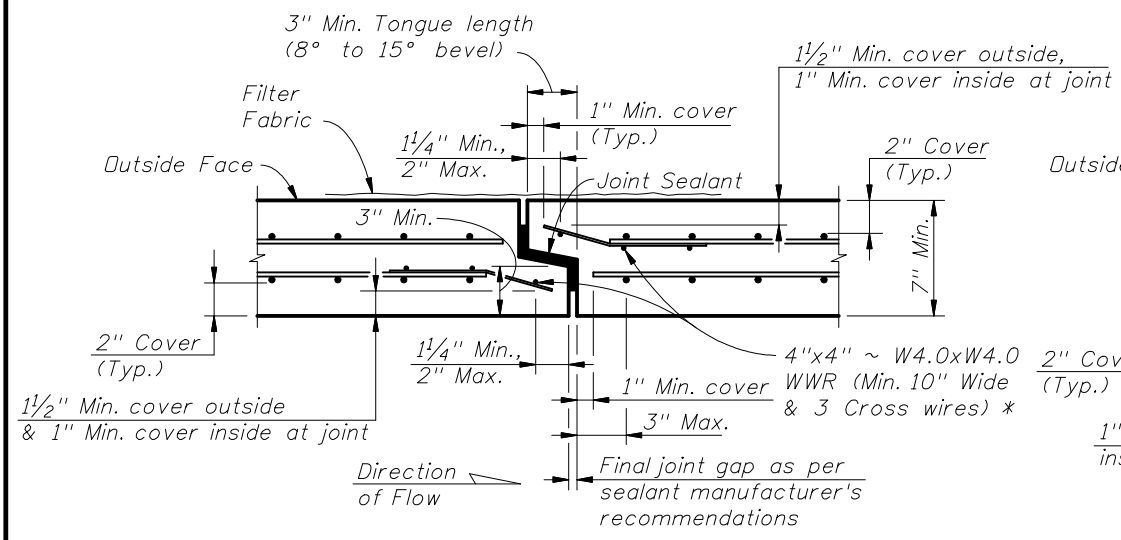
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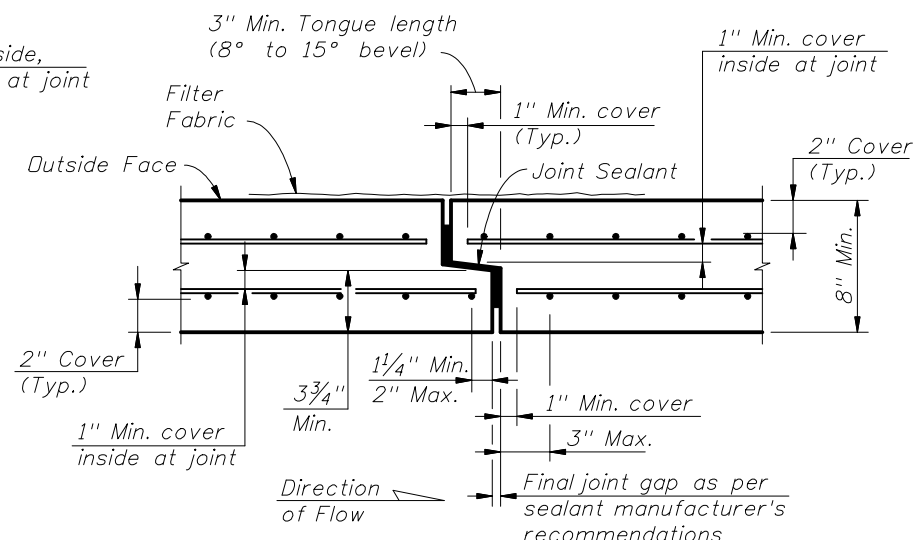
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SUPPLEMENTAL DETAILS FOR PRECAST
CONCRETE BOX CULVERTS

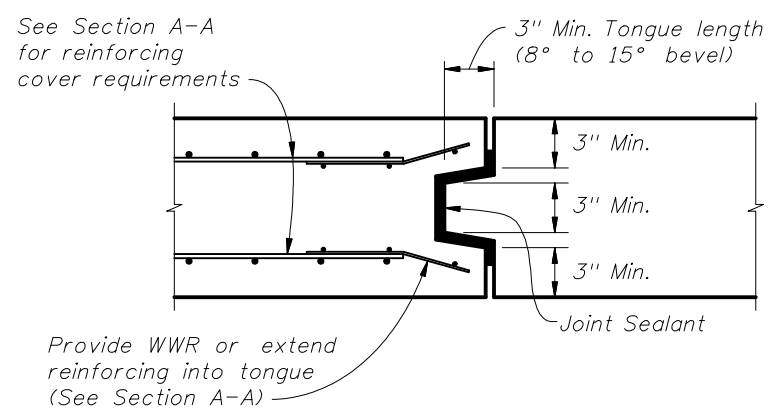
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SECTION A-A
(2" Cover - Thin Wall Detail)

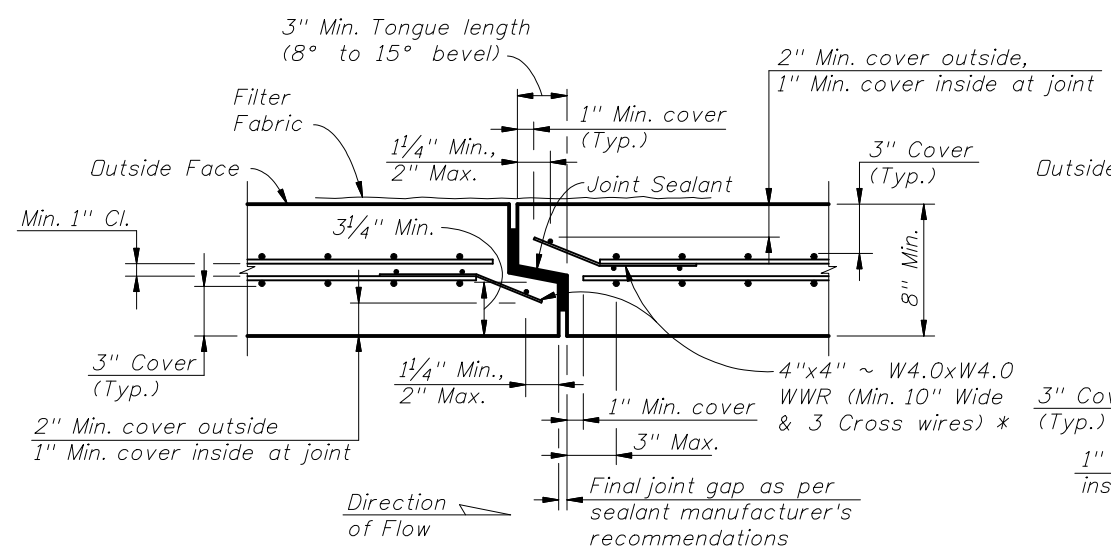


SECTION A-A
(2" Cover - Thick Wall Detail)



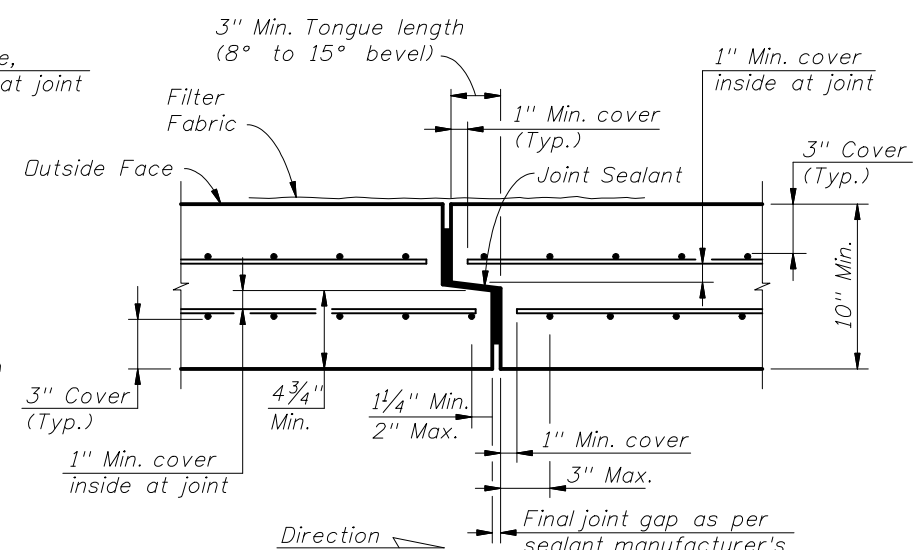
ALTERNATE BOTTOM SLAB TRANSVERSE JOINT
TYPICAL SECTION
(DOUBLE-SIDED TONGUE & GROOVE JOINT)
(All reinforcing not shown for clarity)

NOTE:
Bottom Slab Joints in Type B Boxes may be single tongue & groove joints as shown in Section A-A when the Top Slab Joints are oriented as shown in Schematic A.

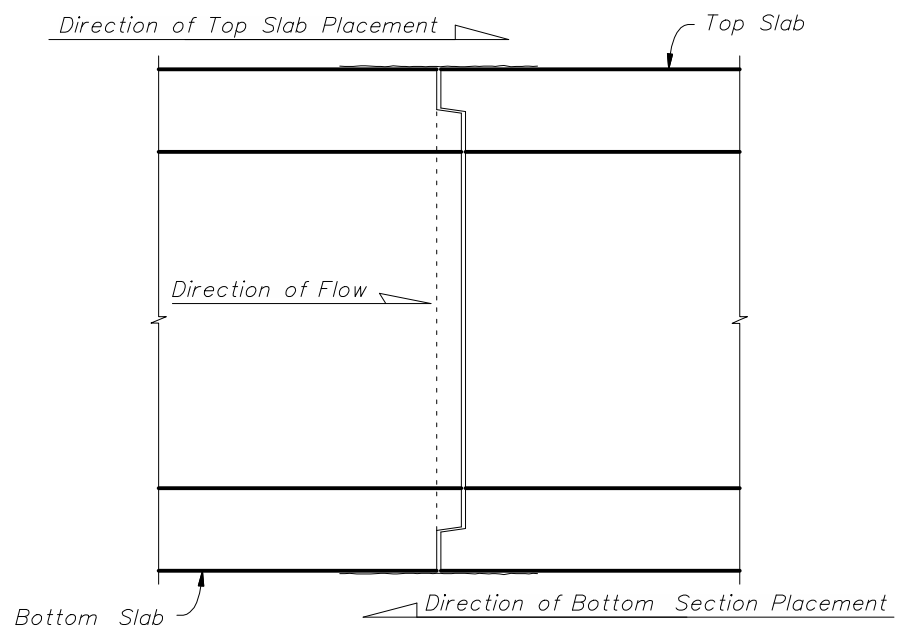


SECTION A-A
(3" Cover - Thin Wall Detail)

* At the Contractor's option when the box culvert reinforcing utilizes WWR, extend wall and slab reinforcing into the joint and bend to maintain cover in lieu of 4"x4" ~ W4.0xW4.0 WWR at joint. Transverse wire in tongue may be cut at corners of box to allow bending of the WWR.



SECTION A-A
(3" Cover - Thick Wall Detail)

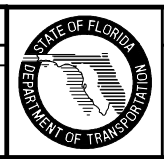


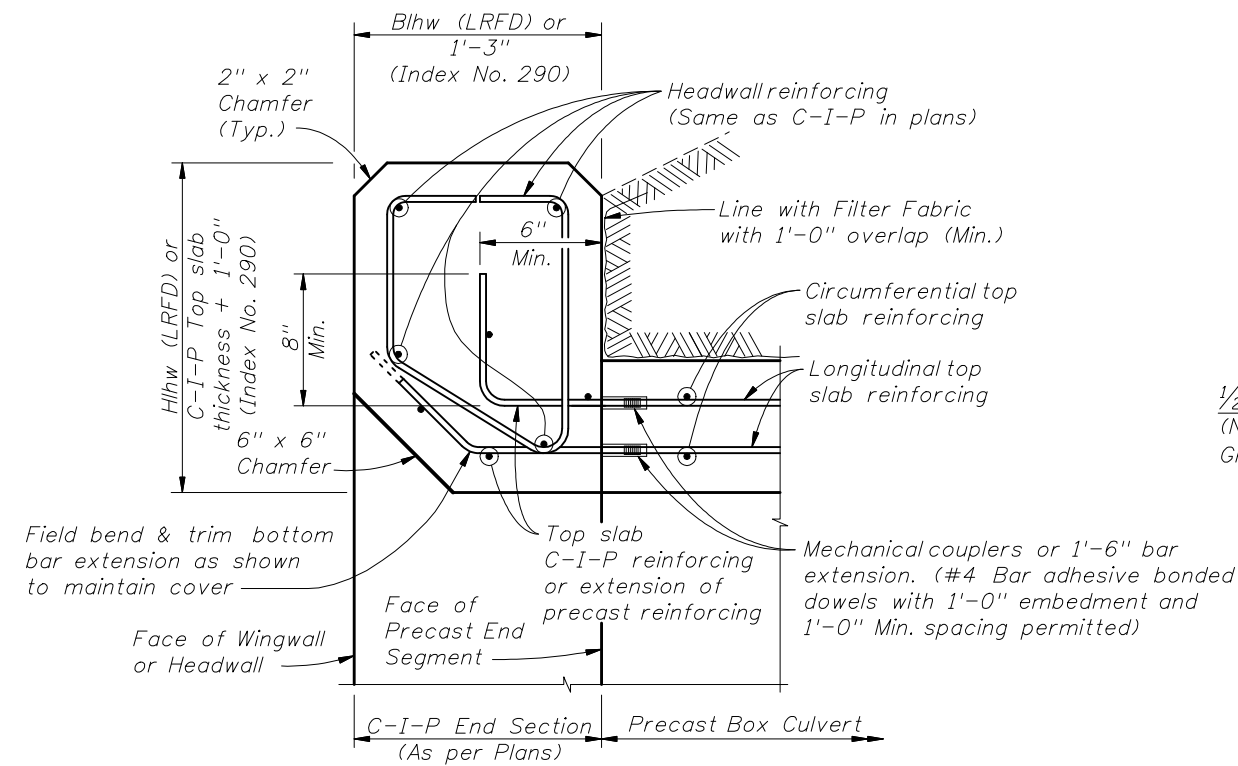
SCHEMATIC A
TYPE B BOX SECTION PLACEMENT
FOR SINGLE TONGUE & GROOVE JOINTS

PRECAST SEGMENT TO SEGMENT TONGUE & GROOVE TRANSVERSE JOINTS

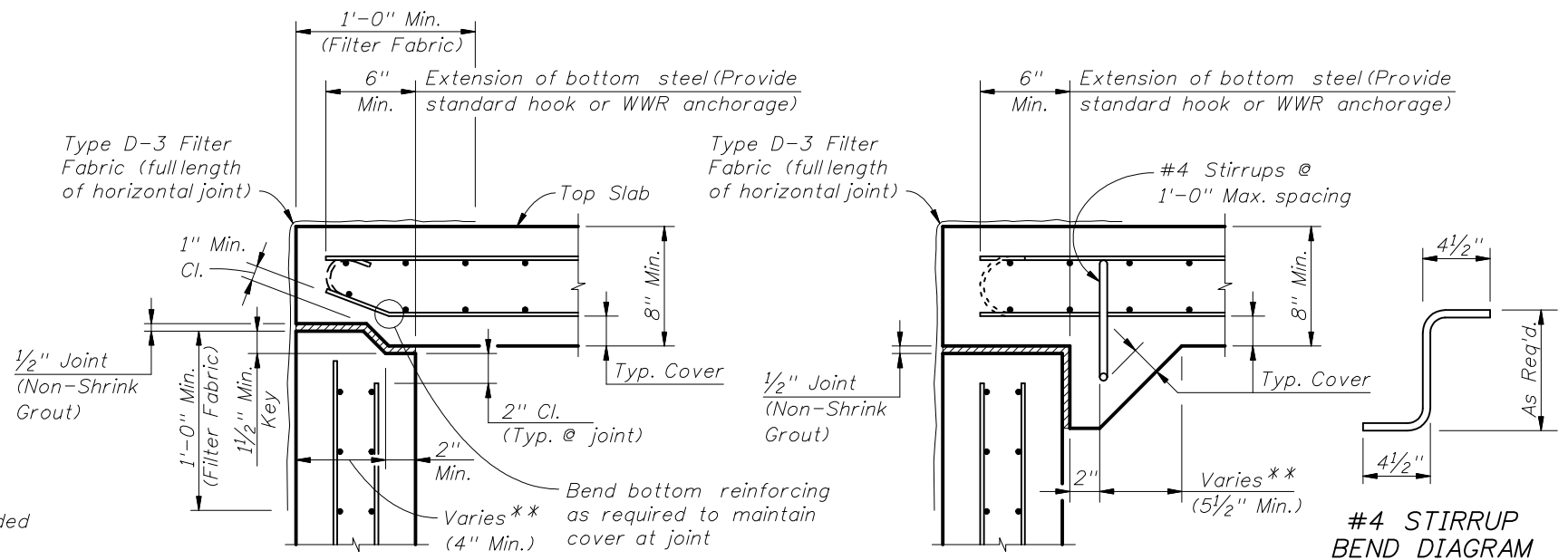
TWO-PIECE PRECAST SEGMENT
ADDITIONAL JOINT DETAILS
(TYPE B BOX)

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SECTION C-C
C-I-P HEADWALL DETAILS AND CONNECTION TO PRECAST BOX

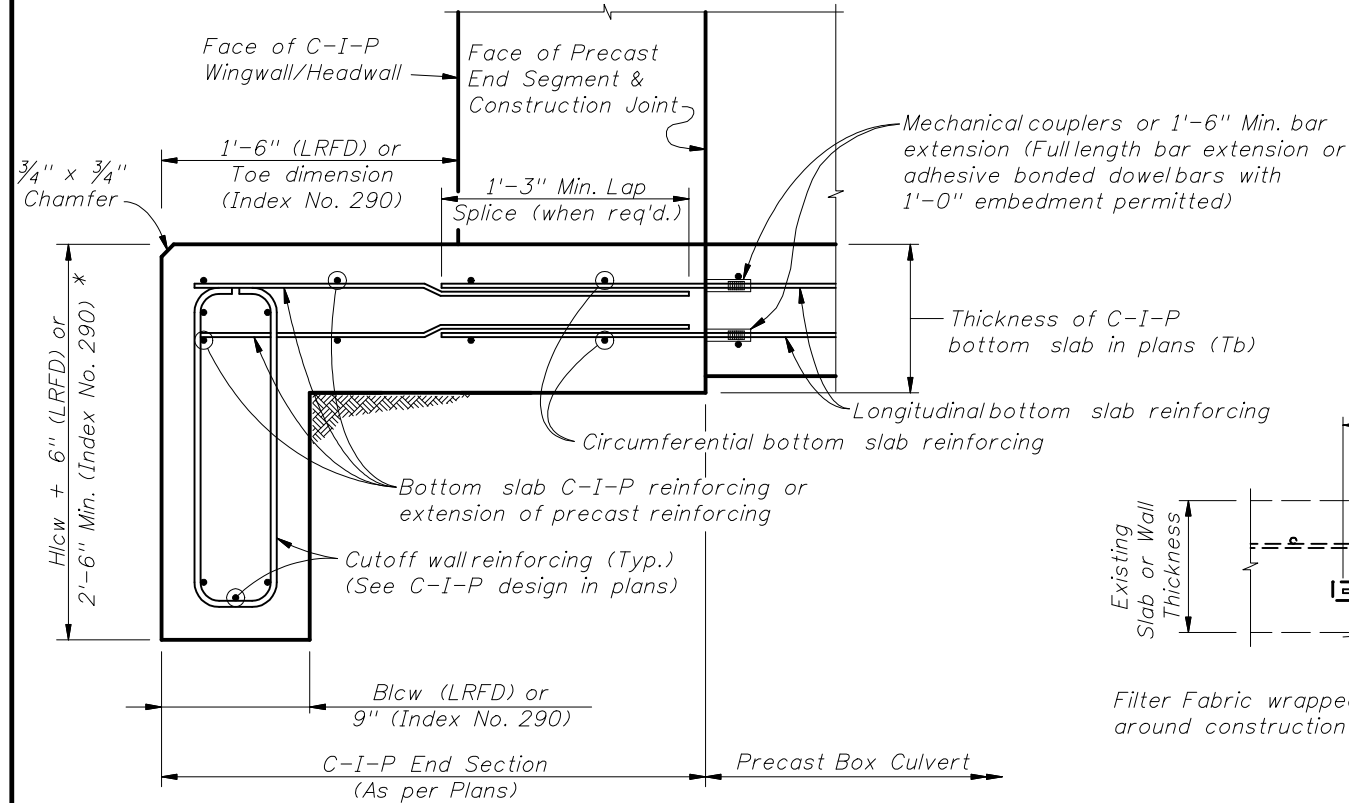


SECTION B-B
TOP SLAB TO WALL JOINT (KEYED JOINT)

SECTION B-B
TOP SLAB TO WALL JOINT (HAUNCHED JOINT)

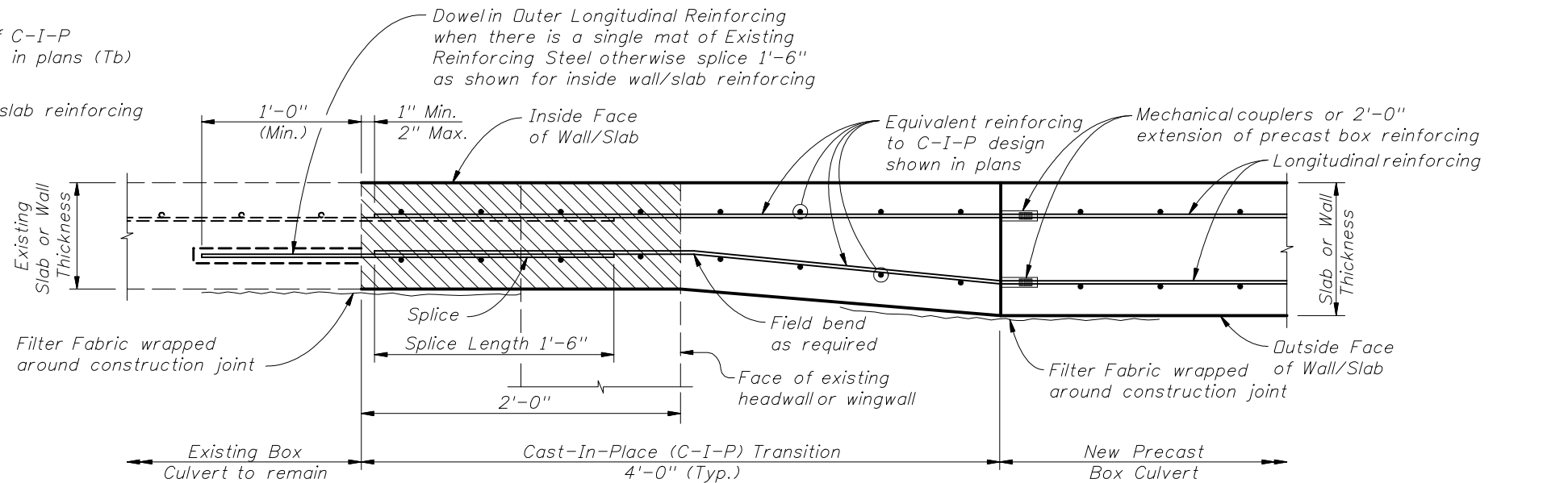
** Provide adequate width to satisfy shear strength requirements at joint

TYPE B BOX LONGITUDINAL JOINTS



SECTION D-D
C-I-P TOE SLAB & CUTOFF WALL DETAILS AND CONNECTION TO PRECAST BOX

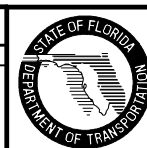
* Provide additional 6" depth of cutoff wall at no additional cost.

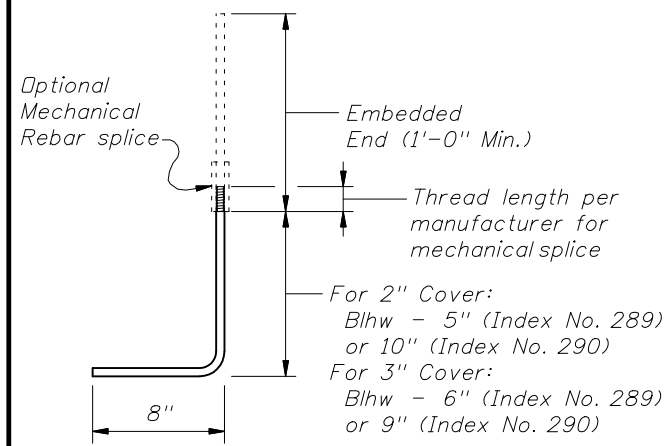


SECTION E-E
EXTERIOR WALL/SLAB TRANSITION DETAIL FOR PRECAST EXTENSION

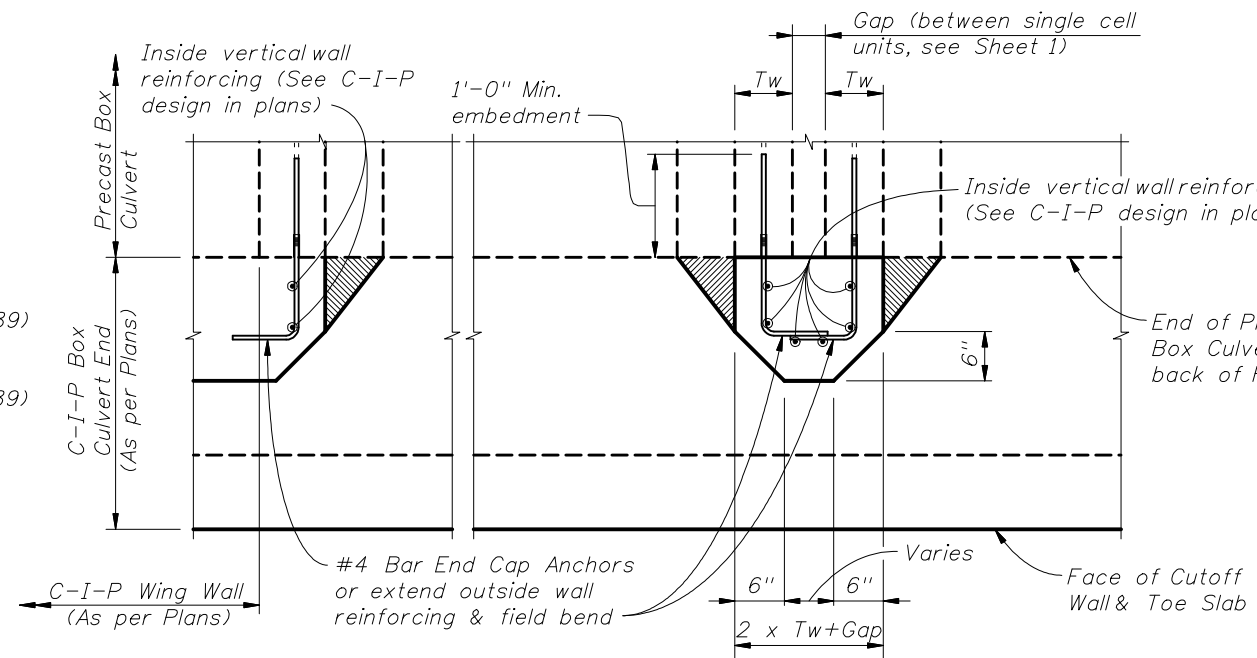
Section of Existing Box Culvert to be removed and replaced.

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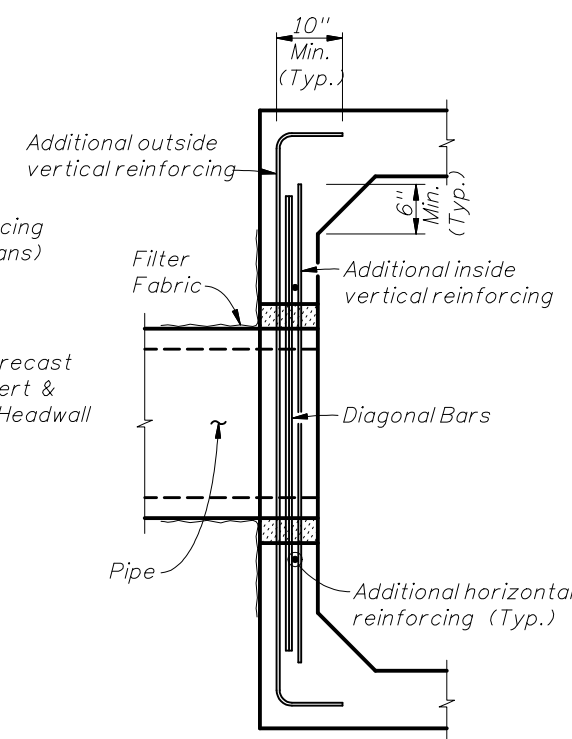




#4 BAR END CAP ANCHOR BAR BEND DIAGRAM

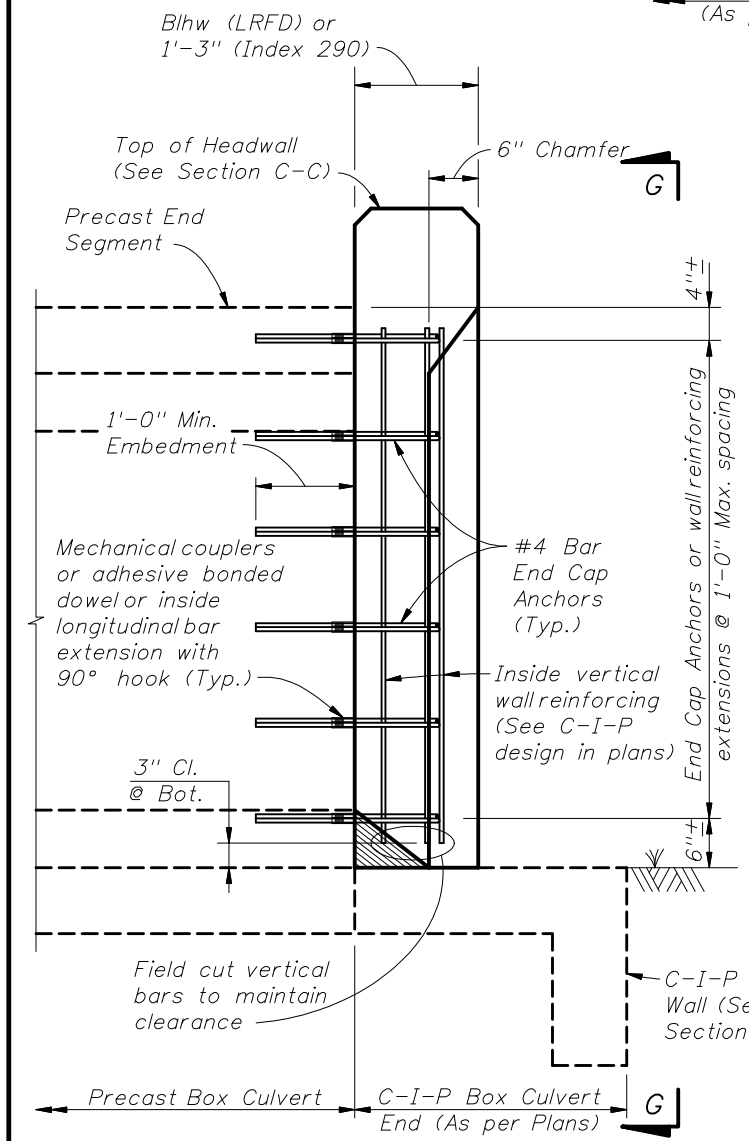


SECTION H-H

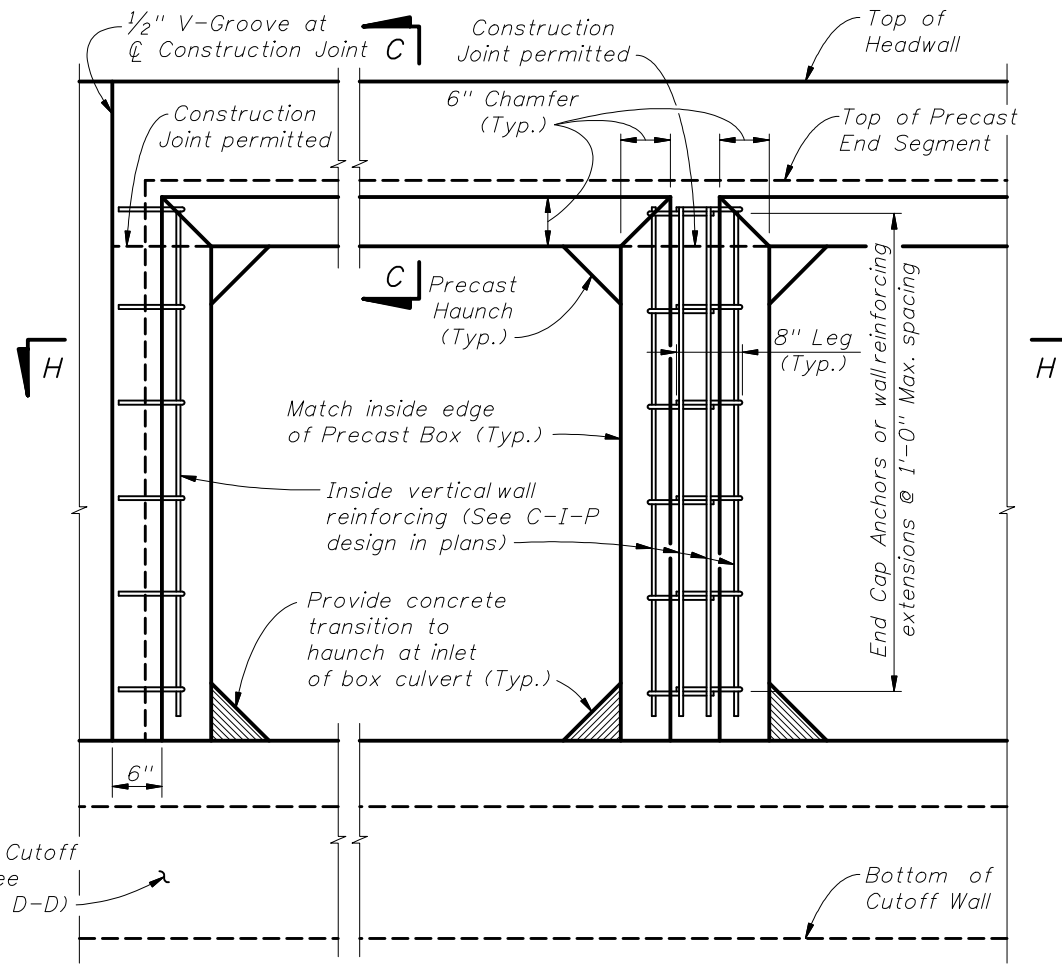


SECTION I-I

(Showing additional blockout reinforcing only)

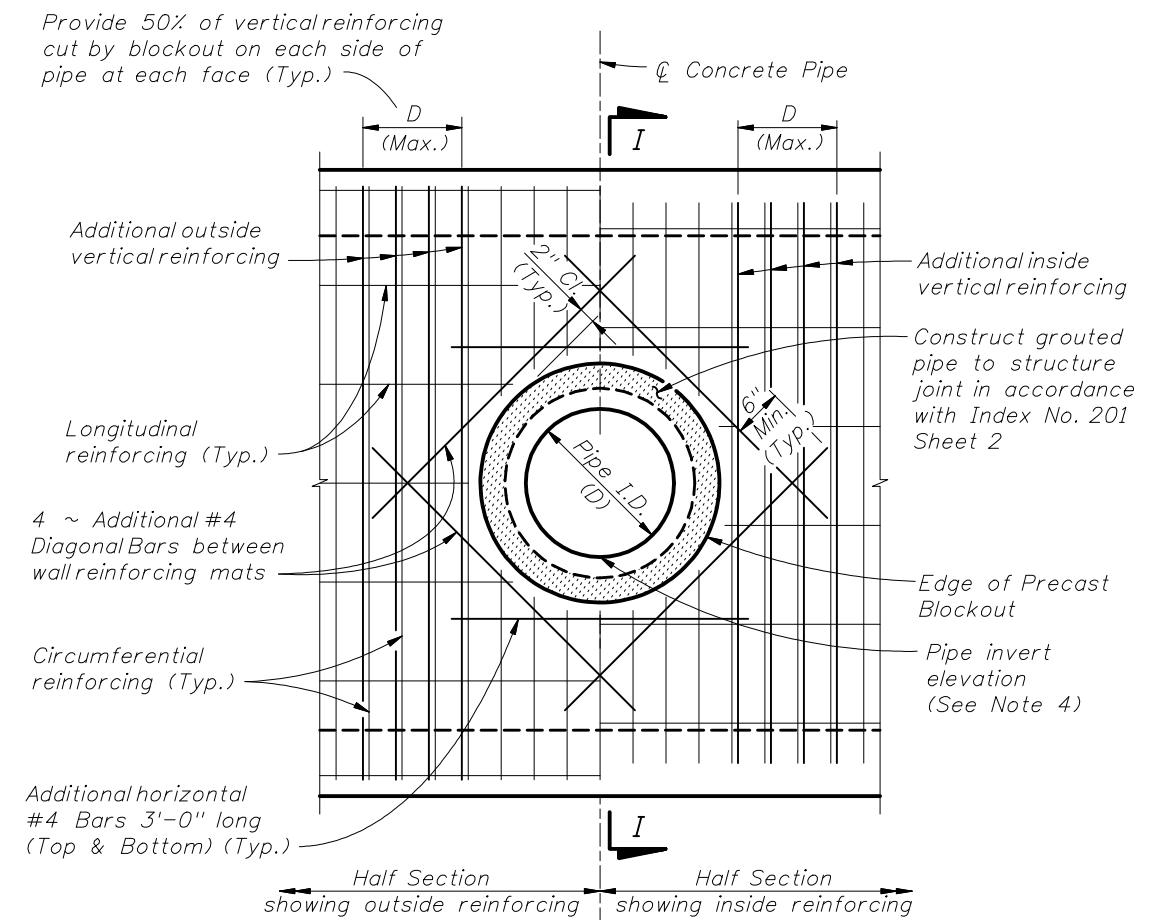


SECTION F-F



VIEW G-G

(Headwall, Toe Slab and Cutoff Wall Reinforcing not shown for clarity)



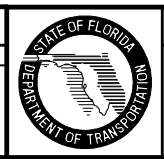
ELEVATION VIEW

PIPE BLOCKOUT DETAILS

- PIPE BLOCKOUT NOTES:**
1. Cut box culvert reinforcement as required to maintain 2" cover.
 2. For Precast Sections construct opening a minimum of 1'-6" away from any box to box joint, except opening may be a minimum of 1'-0" away from joint when at least 2'-0" of clearance to the box to box joint is provided on the opposite side of the pipe opening.
 3. Pipe blockout diameter to be 6" greater than pipe outside diameter.
 4. See Drainage Plans for size, placement, and invert elevation.

C-I-P END CAP DETAILS AND CONNECTION TO PRECAST BOX

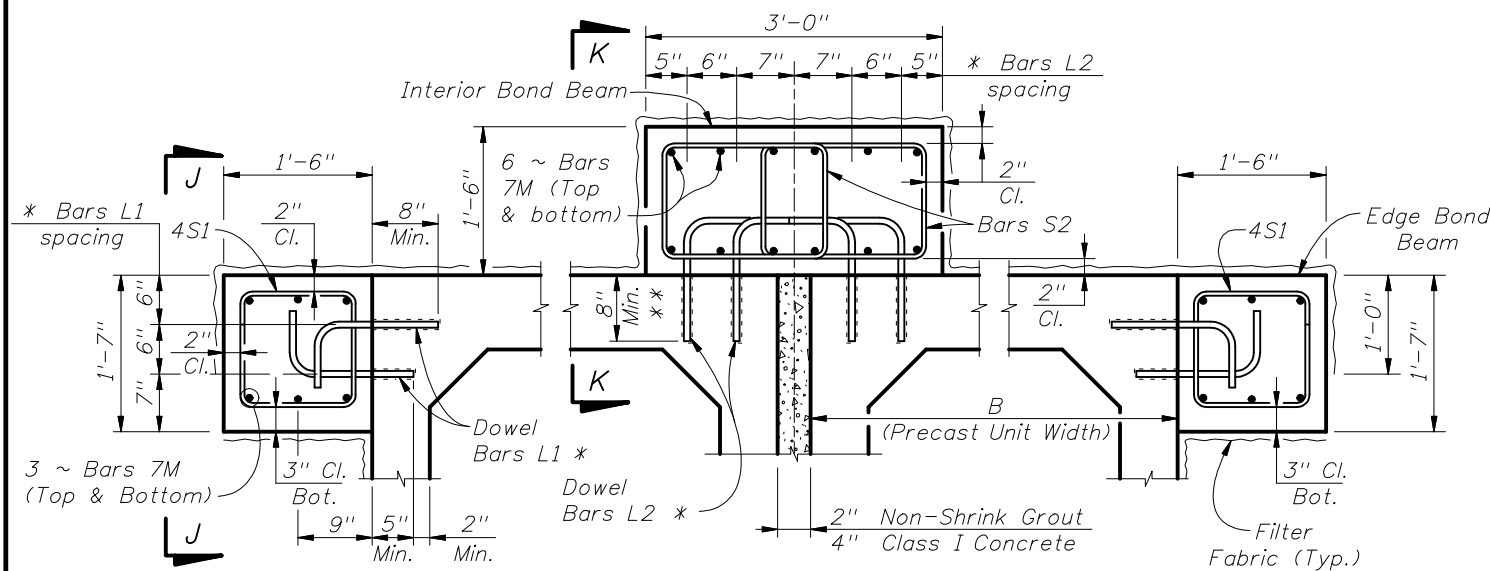
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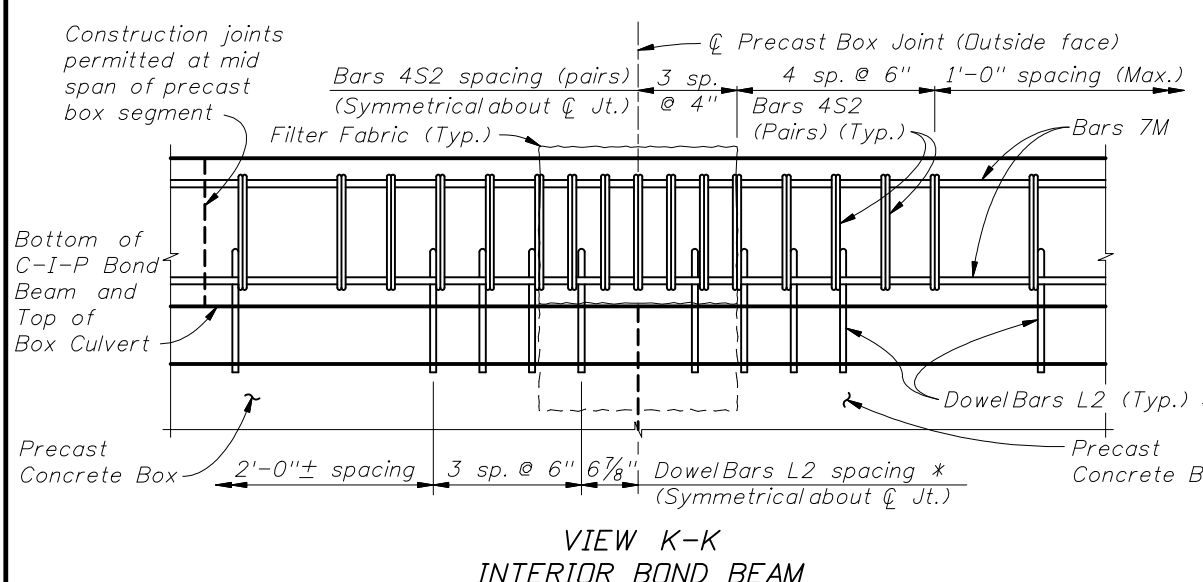
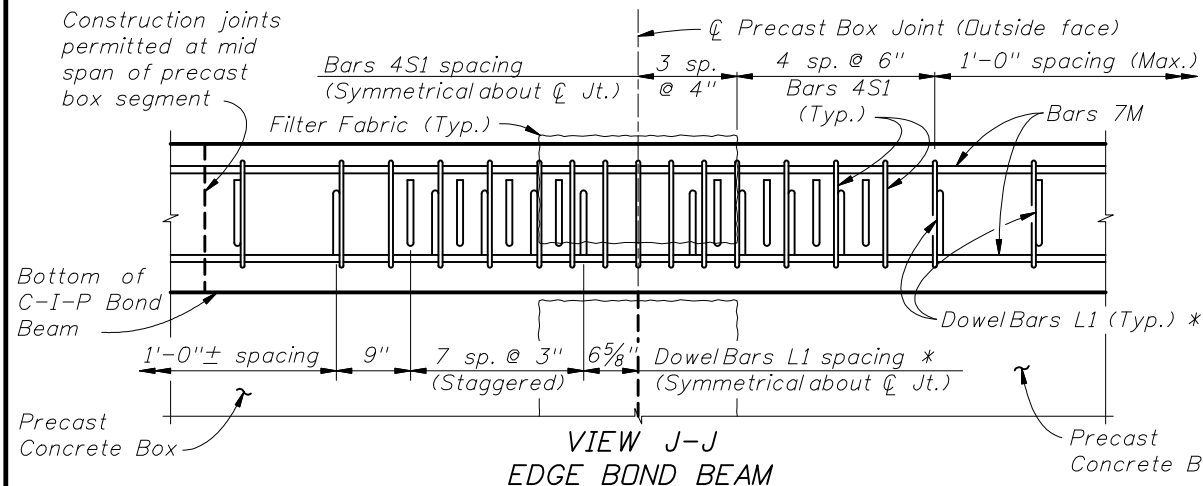
SUPPLEMENTAL DETAILS FOR PRECAST CONCRETE BOX CULVERTS

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* The Contractor may substitute mechanical couplers in lieu of adhesive bonded dowels. Shift dowels to clear box culvert reinforcing.

** For top slabs less than 8" thick, reduce embedment of outside bars L2 to 1" less than thickness of top slab.



BOND BEAM NOTES:

1. Provide Bond Beams to mitigate settlement of precast box culverts when the differential settlement shown in the plans exceeds the following limits.

$$\frac{\Delta Y \times R \times W}{(L)^2} \leq \frac{1}{760}$$

Where:
 ΔY = Maximum Long-Term Differential Settlement (ft.)
 R = Exterior height of Box Culvert (ft.)
 W = Length of Box Culvert Segments (ft.)
 L = Effective length for single curvature deflection (ft.)

2. Extend Bond Beams to back face of headwalls and to limits of existing box culverts for extensions.
3. Multiple single barrel Two-Piece (Type B) precast box culverts are not permitted when Bond Beams are required. For single barrel Two-Piece (Type B) precast box culverts, construct Bond Beam along bottom edge of box culvert.

ESTIMATED BOND BEAM QUANTITIES			
ITEM	UNIT	QUANTITY PER BEAM	
		EDGE	INTERIOR
Class II or IV Concrete (Culvert)	CY/FT	0.088	0.167
Reinforcing Steel (Roadway)	LB/FT	25.88	56.08

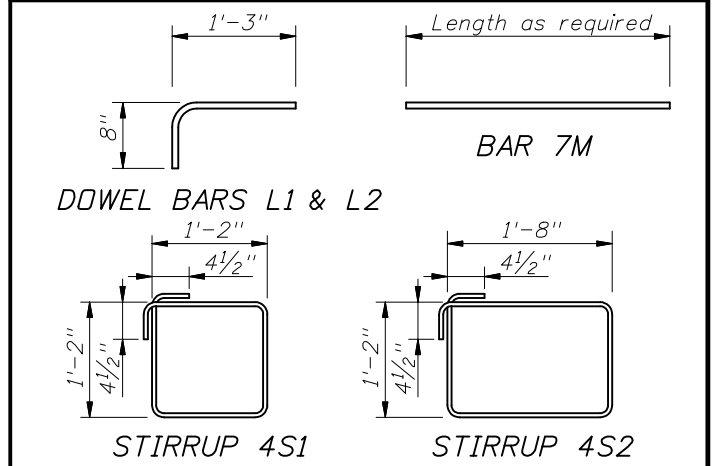
NOTE: Estimated quantities are based on a 8 ft. long precast box sections, and are provided for information only. No additional payment will be made for Bond Beams where these are required for the precast box culverts.

DESIGN NOTES:

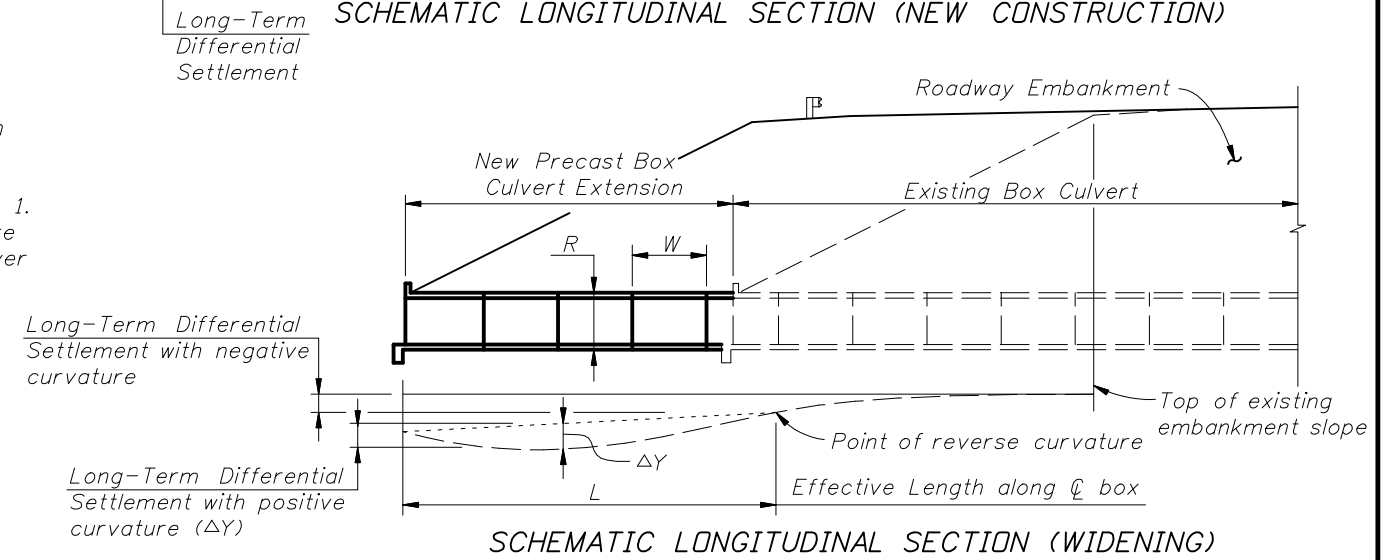
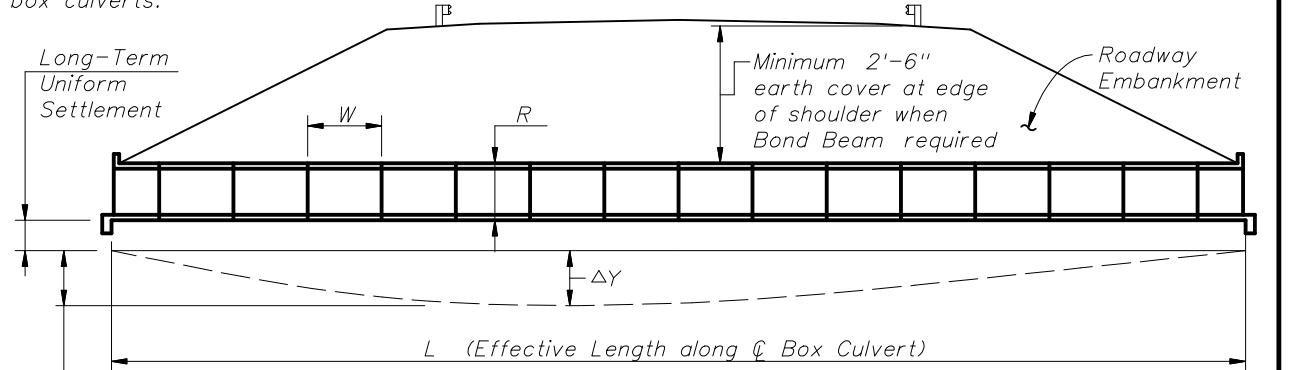
1. Bond beam design limitations are:
 Max. Design Earth Cover (H) = 30'
 Max. Precast Unit Length (W) = 8'
 Max. Precast Unit Width (B) = 14'
 Max. Factored Shear Force/Joint:
 - Edge Beam = 100 kips
 - Interior Beam = 200 kips
2. The precast unit length, width or earth cover limitations may be exceeded provided that the following equation is satisfied:
 $H \times W \times B \leq 3360$
3. Bond Beams are required when joint openings from differential settlement exceed 1/8" as determined in Bond Beam Note 1. The maximum design forces are based on 50% of the earth cover loads.

BILL OF REINFORCING STEEL			
MARK	SIZE	NO. REQ'D	LENGTH
L1	6 (See Note 3)	19 per Beam/8' Box	1'-11"
L2	6 (See Note 3)	40 per Beam/8' Box	1'-11"
M	7	12 per Barrel	As req'd.
S1	4	16 per Beam/8' Box	5'-5"
S2	4	32 per Beam/8' Box	6'-5"

REINFORCING STEEL BENDING DIAGRAMS



NOTES:
 1. All bar dimensions are out to out.
 2. Lap splice length for Bars 7M is 3'-0" minimum.
 3. #4 Bars may be substituted for Bars 6L1 & 6L2 for precast box widths (B) less than 7 ft.



DIFFERENTIAL SETTLEMENT COUNTERMEASURES FOR PRECAST BOX CULVERTS

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