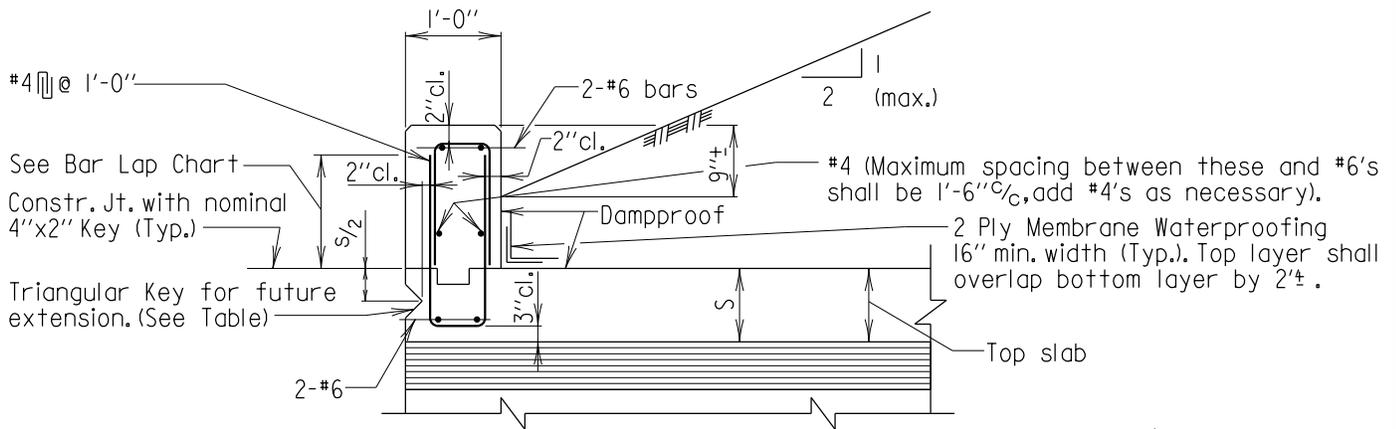


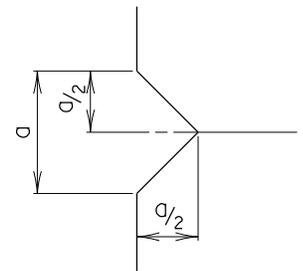
Chapter 06

**BOX CULVERTS**  
**(BC)**



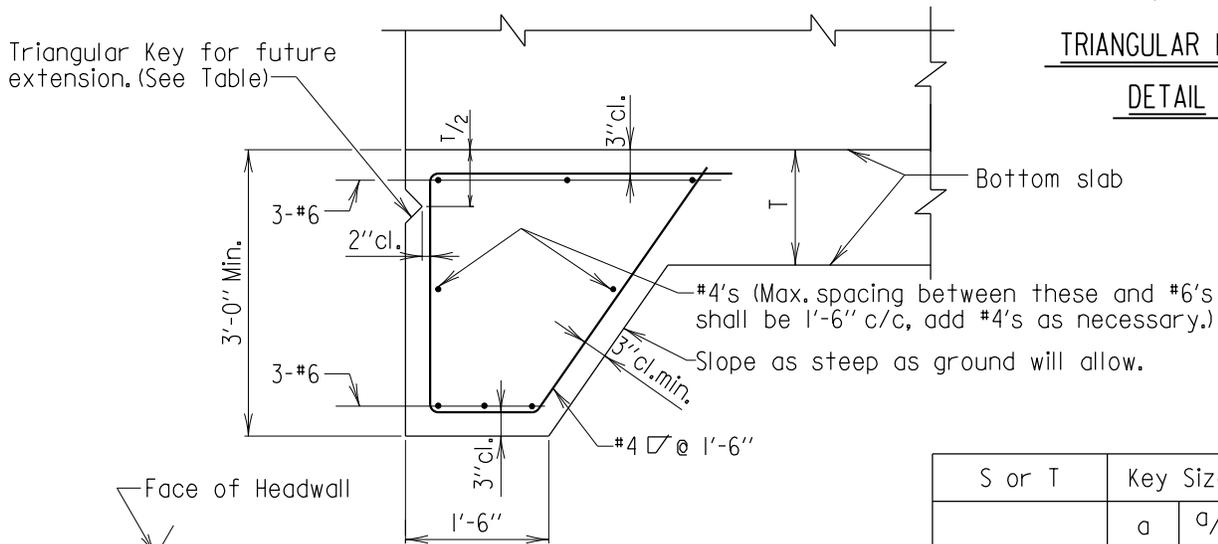
**HEADWALL SECTION**

Scale: 1/2" = 1'-0"



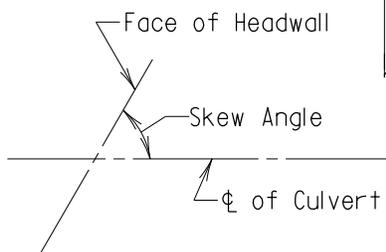
**TRIANGULAR KEY**

**DETAIL**



**TOE WALL SECTION**

Scale: 1/2" = 1'-0"



**SKEW ANGLE**

S or T	Key Size	
	a	a/2
Less than 12"	3"	1 1/2"
12" to 18"	4"	2"
18" and over	6"	3"

**Notes:**

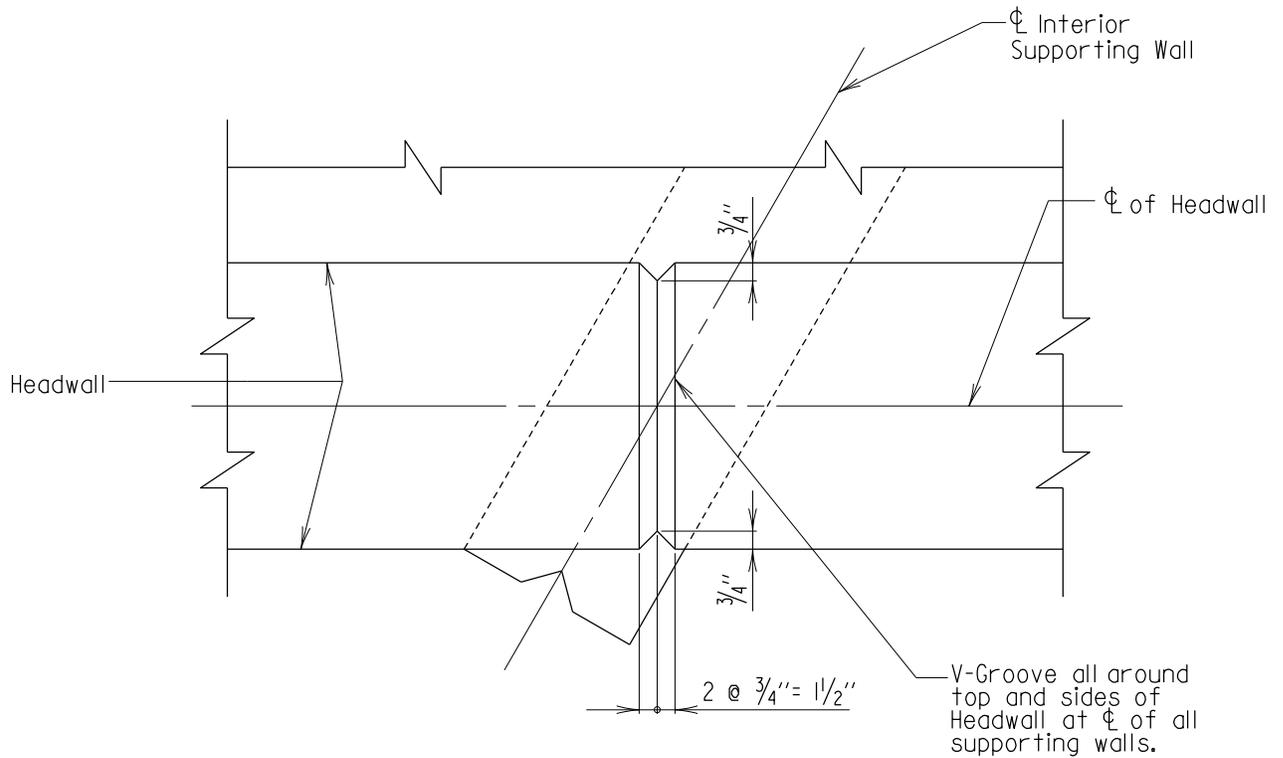
1. When skew angle of box culvert is less than 70° see main box culvert sheets for additional reinforcing steel. (See Above)
2. Normal box culvert reinforcing steel not shown.
3. Maximum height of headwall is 4'-6" see main box culvert sheets for added reinforcing steel if this height is exceeded.
4. All keys are nominal size.

5. Design is valid for live load surcharge.

APPROVAL
<i>E.S. Friedman</i> DIRECTOR OFFICE OF STRUCTURES
DATE: 10/09/2007
VERSION
1.0

STATE OF MARYLAND DEPARTMENT OF TRANSPORTATION STATE HIGHWAY ADMINISTRATION OFFICE OF STRUCTURES	
<b>BOX CULVERT HEADWALL AND TOEWALL DETAILS</b>	
DETAIL NO. BC-101	SHEET <u>1</u> OF <u>1</u>

BOX CULVERT



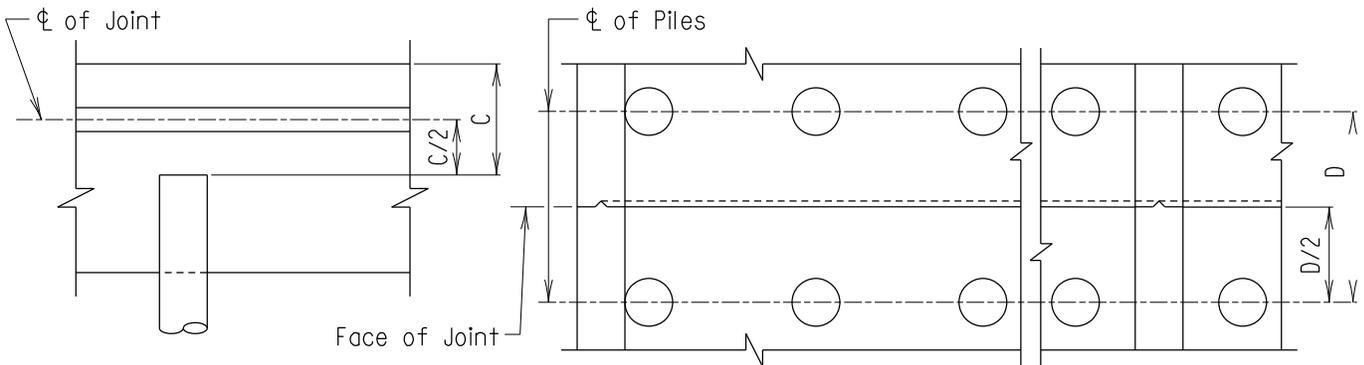
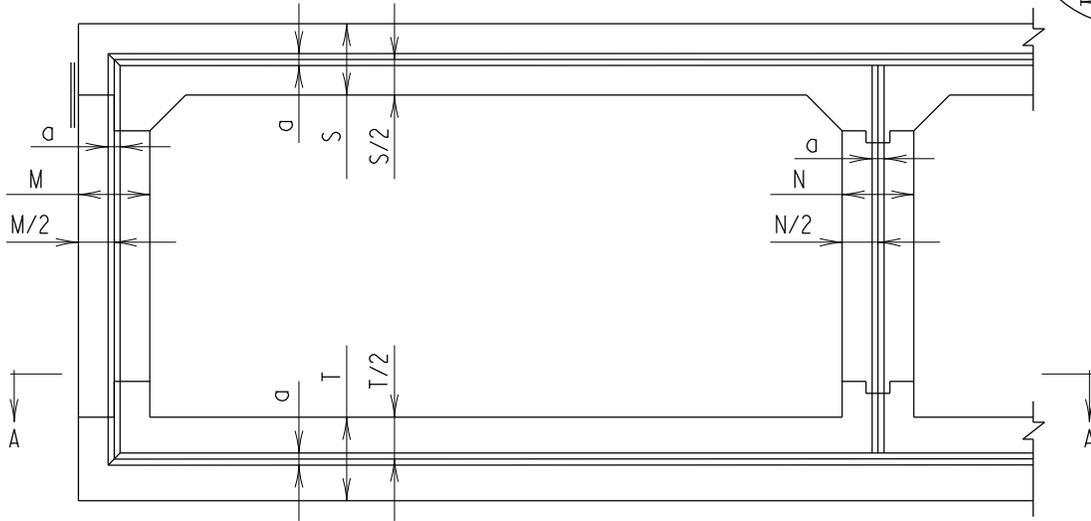
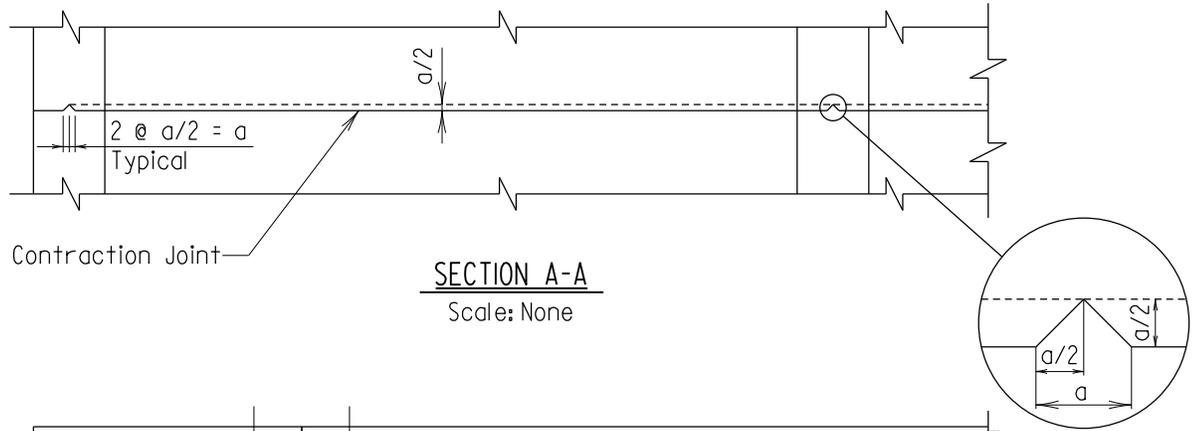
PLAN

Scale: 1/2" = 1'-0"

APPROVAL
<i>E.S. Friedman</i> DIRECTOR OFFICE OF STRUCTURES
DATE: 06/20/1975
VERSION
1.0

STATE OF MARYLAND DEPARTMENT OF TRANSPORTATION STATE HIGHWAY ADMINISTRATION OFFICE OF STRUCTURES	
HEADWALL FOR MULTI-CELLED BOX CULVERT GROOVE DETAILS	
DETAIL NO. BC-102	SHEET <u>1</u> OF <u>1</u>

BOX CULVERT



M,N,S,T	Key Size	
	a	a/2
Less than 12"	3"	1 1/2"
12" to 18"	4"	2"
18" or over	6"	3"

ELEVATION  
VERTICAL LOCATION OF  
KEY WHEN PILES ARE USED  
Scale: None

PLAN  
HORIZONTAL LOCATION OF  
KEY WHEN PILES ARE USED  
Scale: None

Notes:

1. Reinforcing steel not to pass through contraction joint.
2. Full face of contraction joint to be damproofed.
3. When piles are utilized, key in bottom shall be placed midway between top of bottom slab and top of pile vertically, and between rows of piles horizontally. (See Above)

APPROVAL
<i>E.S. Friedman</i> DIRECTOR OFFICE OF STRUCTURES
DATE: 11/17/1997
VERSION
1.0

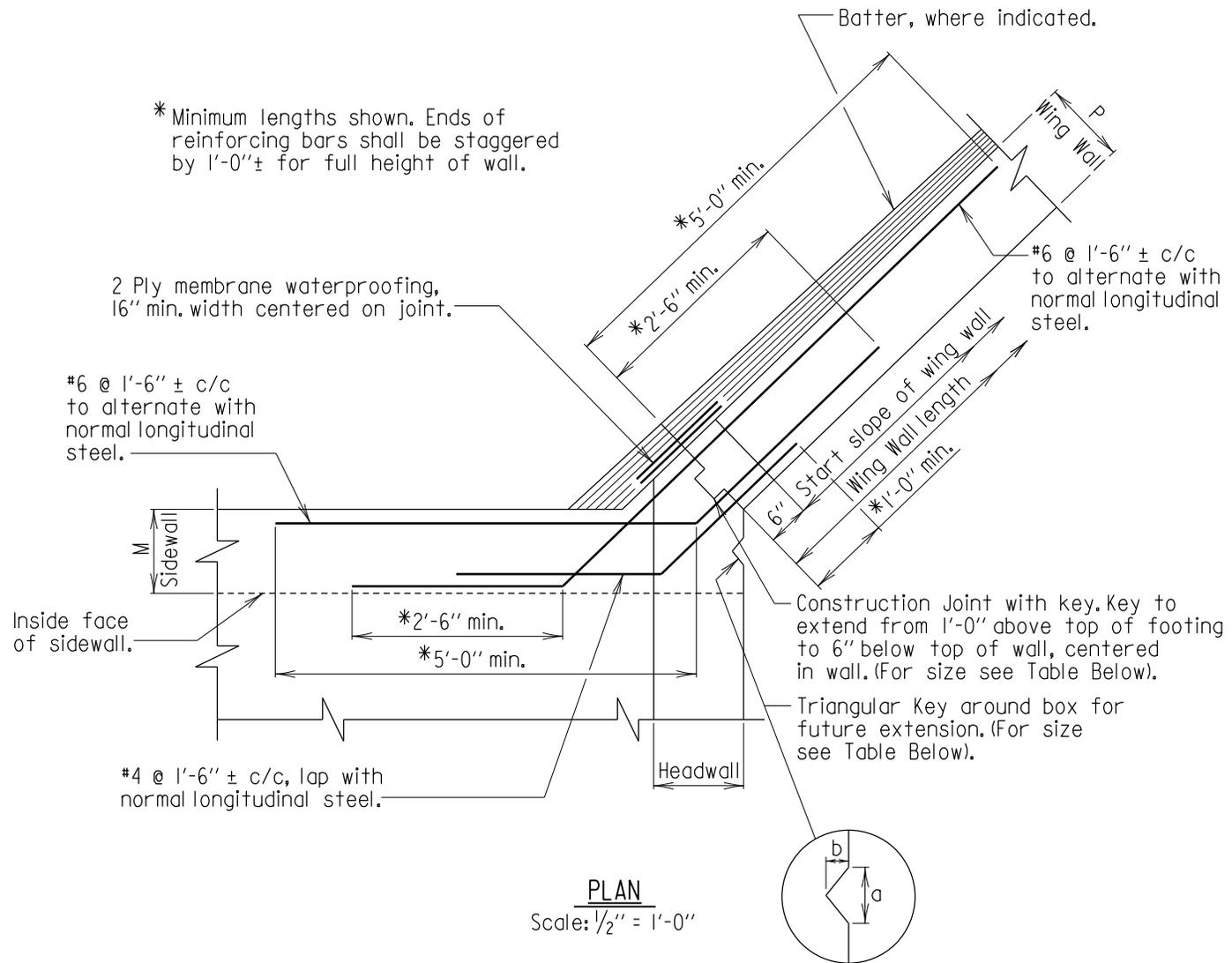
STATE OF MARYLAND  
DEPARTMENT OF TRANSPORTATION  
STATE HIGHWAY ADMINISTRATION  
OFFICE OF STRUCTURES

CONTRACTION JOINT FOR BOX CULVERT BARREL

DETAIL NO. BX-201

SHEET 1 OF 1

BOX CULVERT



\* Minimum lengths shown. Ends of reinforcing bars shall be staggered by 1'-0"± for full height of wall.

2 Ply membrane waterproofing, 16" min. width centered on joint.

#6 @ 1'-6" ± c/c to alternate with normal longitudinal steel.

Inside face of sidewall.

#4 @ 1'-6" ± c/c, lap with normal longitudinal steel.

#6 @ 1'-6" ± c/c to alternate with normal longitudinal steel.

Construction Joint with key. Key to extend from 1'-0" above top of footing to 6" below top of wall, centered in wall. (For size see Table Below).

Triangular Key around box for future extension. (For size see Table Below).

PLAN  
Scale: 1/2" = 1'-0"

M or P	Triangular Key Size		Wing Wall Key Size
	a	b	
Less than 12"	3"	1 1/2"	3" x 1 1/2"
12" to 18"	4"	2"	4" x 2"
18" or over	6"	3"	6" x 3"

- Notes:
1. Normal reinforcing steel not shown.
  2. All keys are nominal size.
  3. This joint detail to be used for all walls less than 15' in length.

APPROVAL
<i>E.S. Friedman</i> DIRECTOR OFFICE OF STRUCTURES
DATE: 10/09/2007
VERSION
1.0

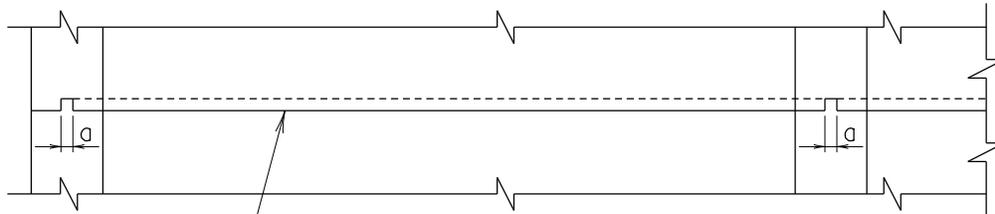
STATE OF MARYLAND  
DEPARTMENT OF TRANSPORTATION  
STATE HIGHWAY ADMINISTRATION  
OFFICE OF STRUCTURES

**BOX CULVERT WING WALL CONSTRUCTION JOINT**

DETAIL NO. BC-202

SHEET    OF   

BOX CULVERT



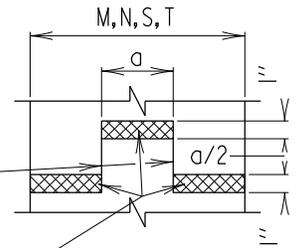
Expansion Joint

**SECTION A-A**

Scale: None

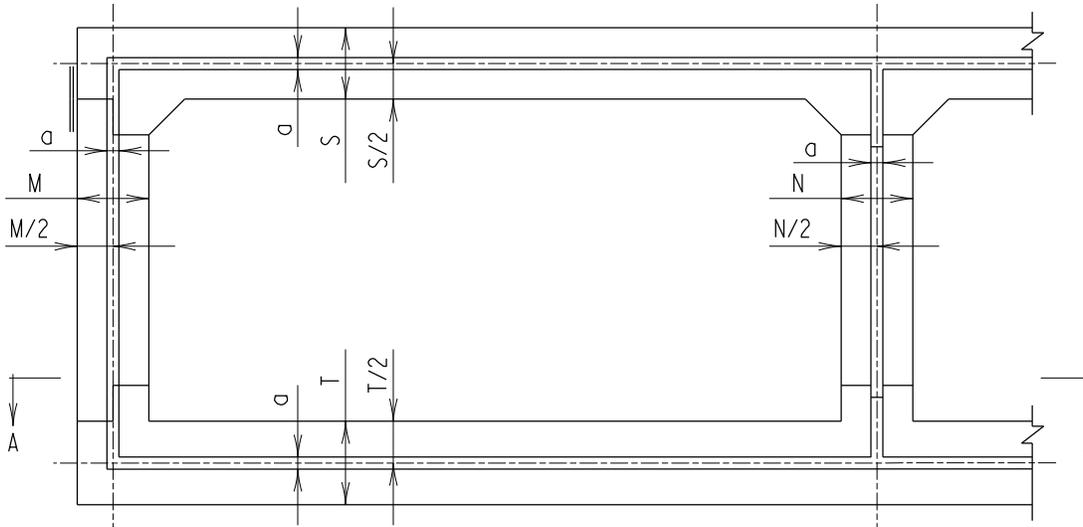
Single layer of tarpaper full length of key. Fasten to concrete with asphaltic cement.

1" Sponge type expansion joint filler material, full length of key. Fasten to one face with copper nails.



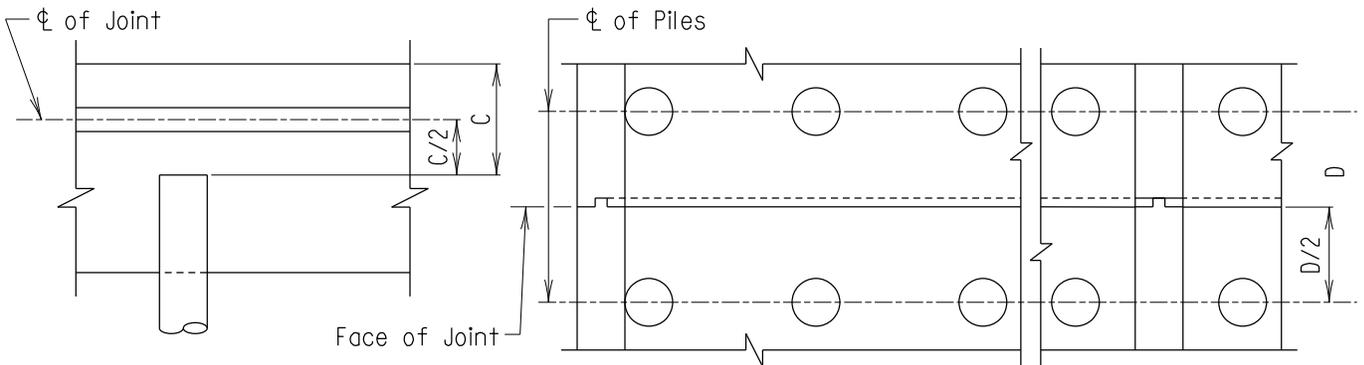
**TYPICAL SECTION OF WALLS AND SLABS**

Scale: None



**ELEVATION**

Scale: None



**ELEVATION VERTICAL LOCATION OF KEY WHEN PILES ARE USED**

Scale: None

**PLAN HORIZONTAL LOCATION OF KEY WHEN PILES ARE USED**

Scale: None

M, N, S, T	Key Size	
	a	a/2
Less than 12"	3"	1 1/2"
12" to 18"	4"	2"
18" or over	6"	3"

**Notes:**

1. Reinforcing steel not to pass through joint.
2. When piles are utilized, key in bottom shall be placed midway between top of bottom slab and top of pile vertically, and between rows of piles horizontally. (See Above)
3. All keys are nominal size.

APPROVAL
<i>L.S. Freedom</i> DIRECTOR OFFICE OF STRUCTURES
DATE: 03/22/2006
VERSION
1.0

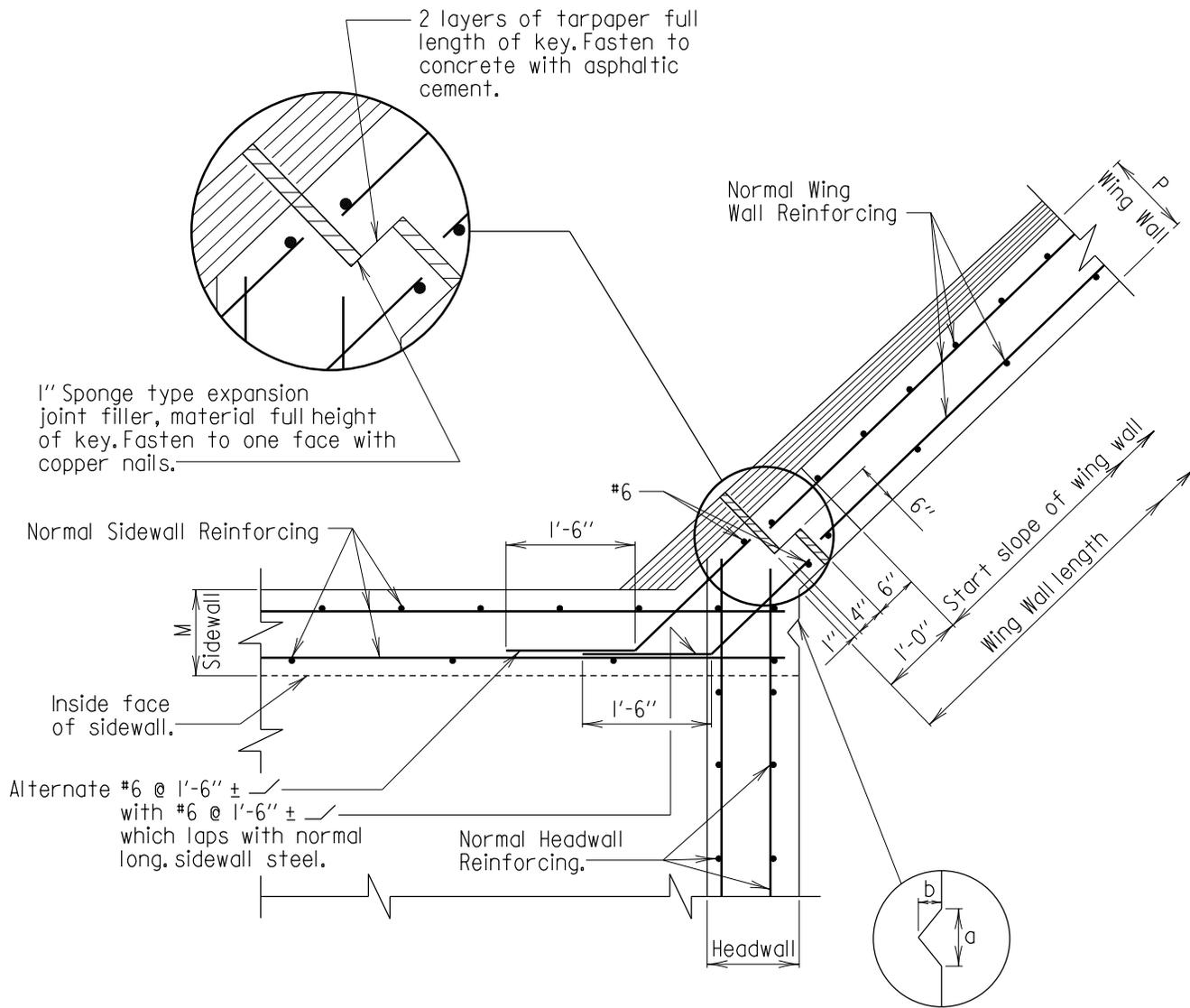
STATE OF MARYLAND  
DEPARTMENT OF TRANSPORTATION  
STATE HIGHWAY ADMINISTRATION  
OFFICE OF STRUCTURES

**EXPANSION JOINT FOR BOX CULVERT BARREL**

DETAIL NO. BC-301

SHEET 1 OF 1

BOX CULVERT



M or P	Triangular Key Size	
	a	b
Less than 12"	3"	1 1/2"
12" to 18"	4"	2"
18" or over	6"	3"

PLAN  
Scale: 1/2" = 1'-0"

Notes:

1. Reinforcing steel not to pass through joint.
2. All keys are nominal size.
3. Expansion joint to extend from top of footing to top of wall.
4. This joint detail to be used for all walls greater than 15' in length.

APPROVAL
<i>C.S. Freeman</i> DIRECTOR OFFICE OF STRUCTURES
DATE: 10/09/2007
VERSION
1.0

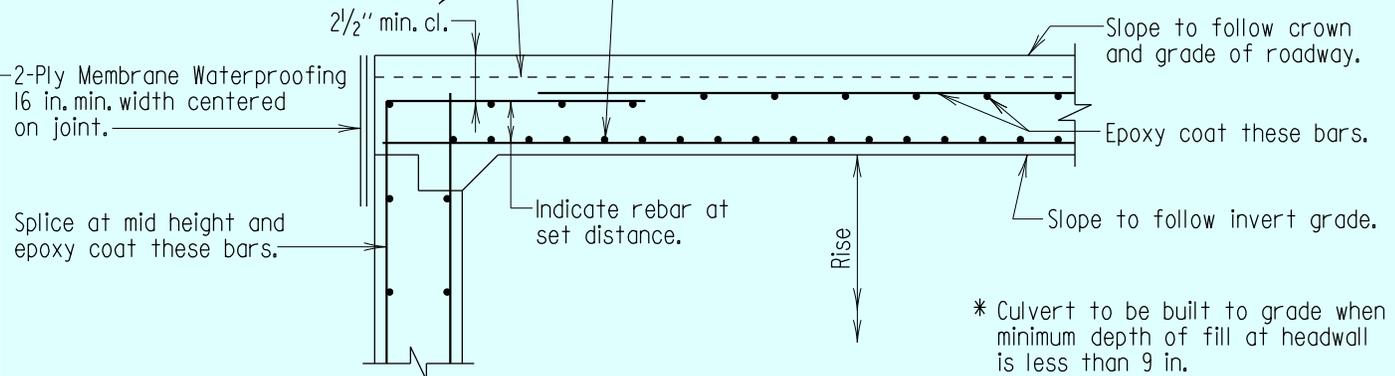
STATE OF MARYLAND DEPARTMENT OF TRANSPORTATION STATE HIGHWAY ADMINISTRATION OFFICE OF STRUCTURES
BOX CULVERT WING WALL EXPANSION JOINT
DETAIL NO. BC-302
SHEET <u>1</u> OF <u>1</u>

BOX CULVERT

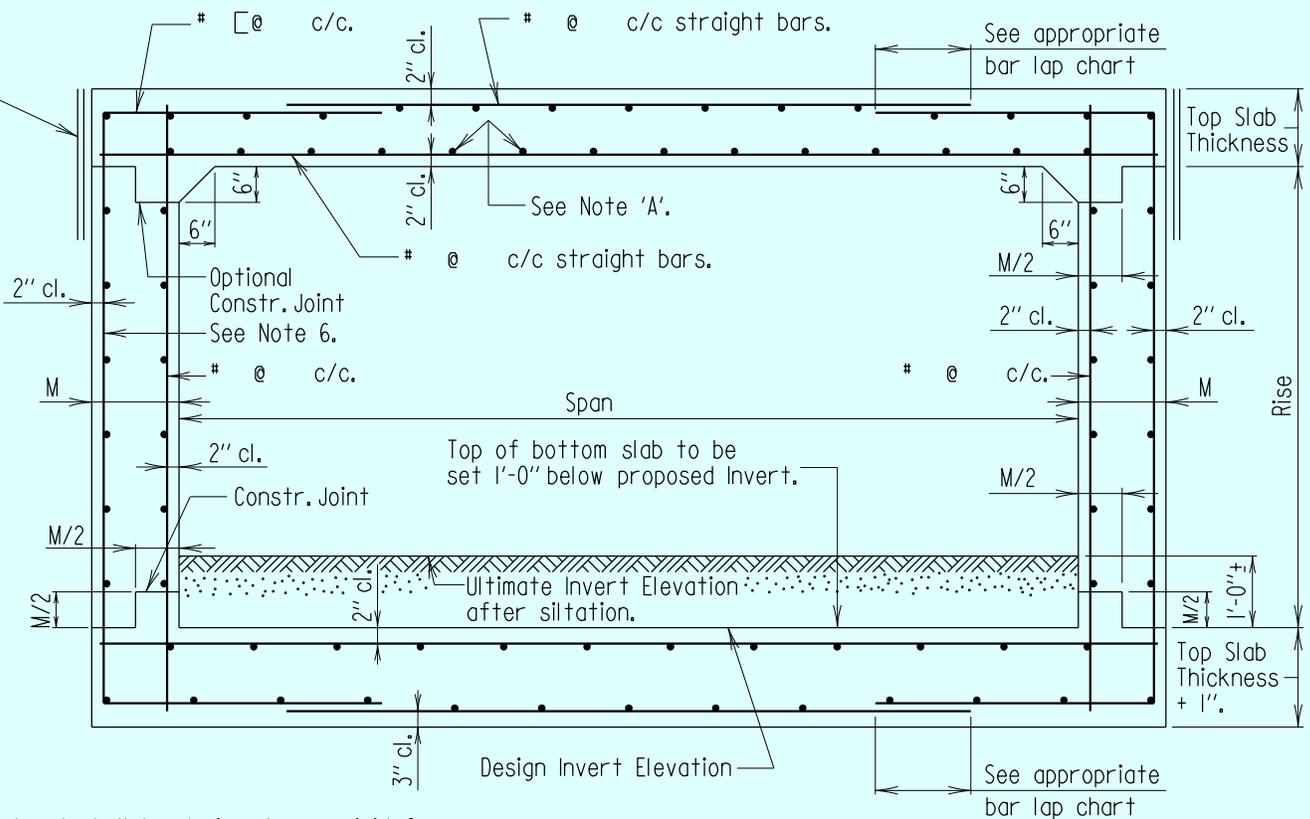
If minimum clearance exceeds 6 in., then an additional mat of epoxy coated 6 x 6 - W2.9 x W2.9 welded wire fabric shall be placed 3 in. clear from finished top of slab for full length and width of culvert.

**Note : A**

When depth of fill over top slab is equal to or less than 2'-0" the longitudinal bars in the bottom of the top slab shall be # @ c/c ±. All other longitudinal bars to be #4 @ 1'-6" c/c ±.



**DETAIL OF TOP SLAB  
WHEN CULVERT IS BUILT TO GRADE \***



**Note:**

1. Box Culvert shall be designed as a rigid frame.
2. Reinforcing in bottom slab same as top slab except for any longitudinal steel added when depth of fill on top slab is 2'-0" or less.
3. Minimum thickness of sidewalls to be 11 in.
4. All longitudinal bars to be #4's spaced as shown with a maximum spacing of 1'-6" c/c; except for any additional steel that may be required when depth of fill on top slab is 2'-0" or less.
5. If piles are used; bottom slab shall be increased 9" in thickness and piles shall be equally spaced in the transverse direction as well as equally spaced in the longitudinal direction.
6. If rise exceeds 10'-0", this bar may be lapped at mid height at Contractors option.

**TYPICAL SECTION**

7. If bottom slab exceeds 18" in thickness, longitudinal bars shall become #4's @ 1'-0" max.
8. Concrete cover shall be increased from the cover indicated in typical section to 4" clear for all surfaces with direct exposure to salt water.

**\* FOR OFFICE USE ONLY \***

APPROVAL
<i>E.S. Friedman</i> DIRECTOR OFFICE OF STRUCTURES
DATE: 10/09/2007
VERSION
1.0

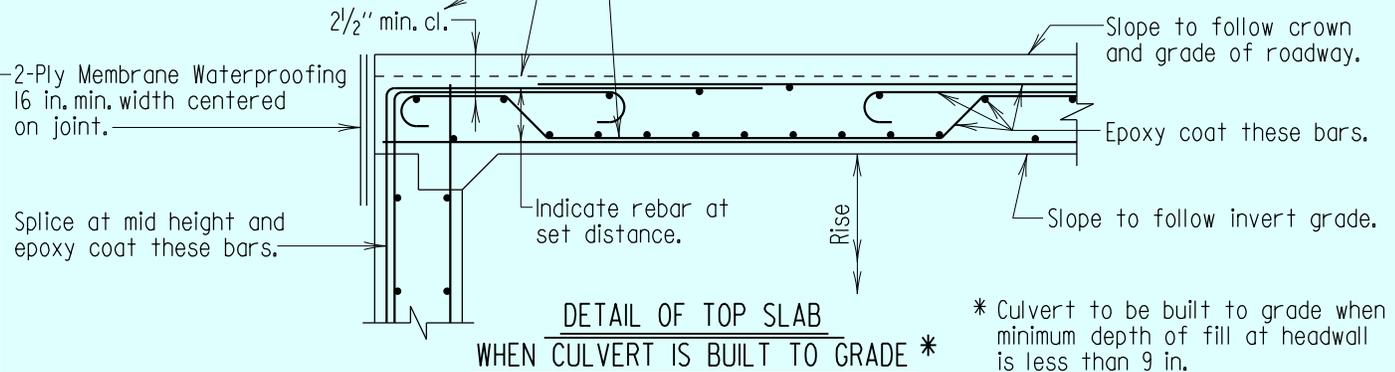
STATE OF MARYLAND DEPARTMENT OF TRANSPORTATION STATE HIGHWAY ADMINISTRATION OFFICE OF STRUCTURES	
<b>TYPICAL SECTION FOR SINGLE BOX CULVERT</b>	
DETAIL NO. BC-401	SHEET <u>  </u> OF <u>  </u>

BOX CULVERT

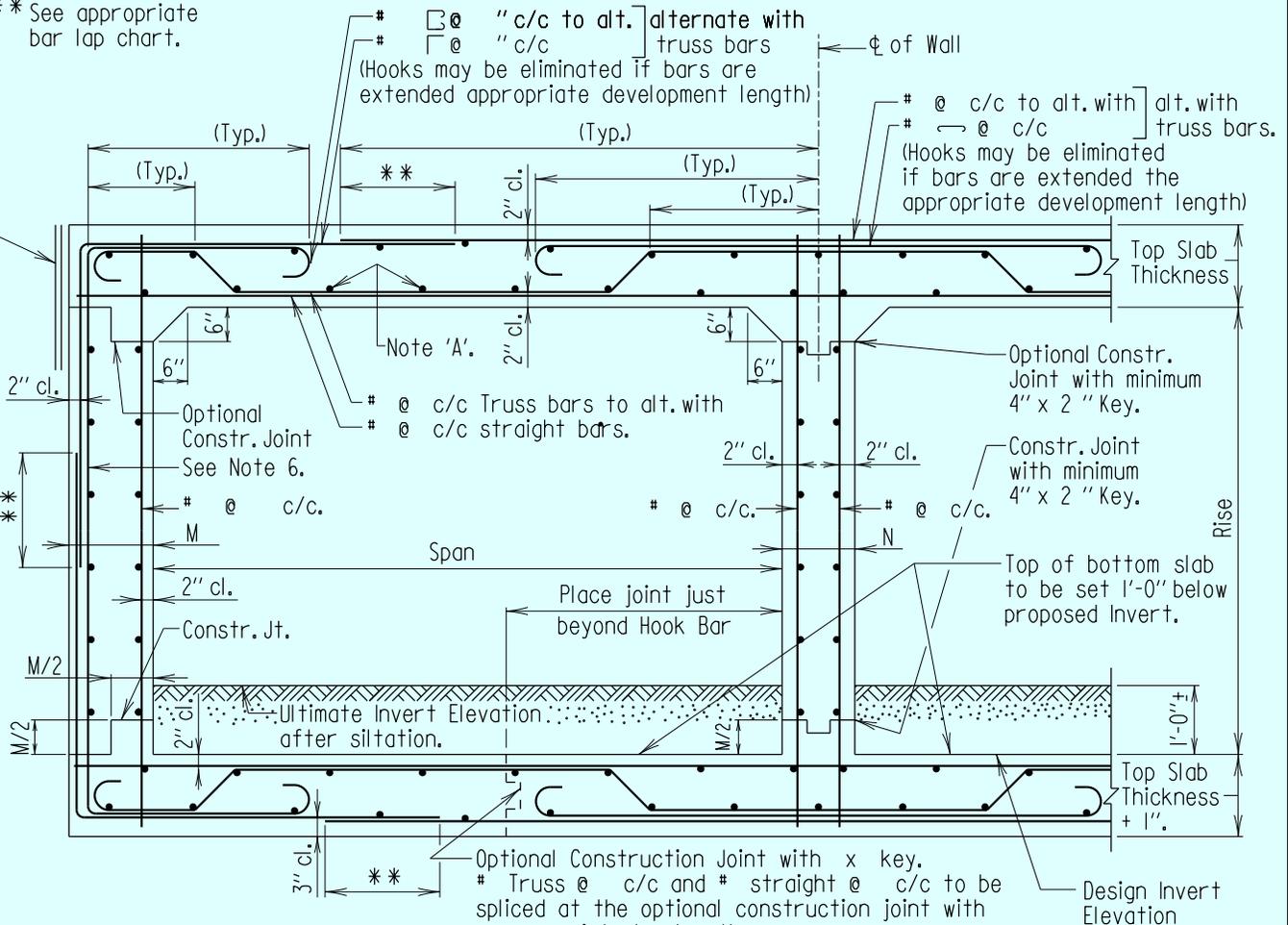
If minimum clearance exceeds 6 in., then an additional mat of epoxy coated 6 x 6 - W2.9 x W2.9 welded wire fabric shall be placed 3 in. clear from finished top of slab for full length and width of culvert.

**Note : A**

When depth of fill over top slab is equal to or less than 2'-0" the longitudinal bars in the bottom of the top slab shall be # @ c/c ±. All other longitudinal bars to be #4 @ 1'-6" c/c ±.



\*\* See appropriate bar lap chart.



**Note:**

1. Box Culvert shall be designed as a rigid frame.
2. Reinforcing in bottom slab same as top slab except for any longitudinal steel added when depth of fill on top slab is 2'-0" or less.
3. Minimum thickness of sidewalls to be 11 in.
4. All longitudinal bars to be #4's spaced as shown with a maximum spacing of 1'-6" c/c; except for any additional steel that may be required when depth of fill on top slab is 2'-0" or less.
5. If piles are used; bottom slab shall be increased 9" in thickness and piles shall be equally spaced in the transverse direction as well as equally spaced in the longitudinal direction.
6. If rise exceeds 10'-0", this bar may be lapped at mid height at Contractors option.

**TYPICAL SECTION**

7. If bottom slab exceeds 18" in thickness, longitudinal bars shall become #4's @ 1'-0" max.
8. Concrete cover shall be increased from the cover indicated in typical section to 4" clear for all surfaces with direct exposure to salt water.

**\* FOR OFFICE USE ONLY \***

APPROVAL
<i>C.S. Friedman</i> DIRECTOR OFFICE OF STRUCTURES
DATE: 10/09/2007
VERSION
1.0

STATE OF MARYLAND  
DEPARTMENT OF TRANSPORTATION  
STATE HIGHWAY ADMINISTRATION  
OFFICE OF STRUCTURES

**TYPICAL SECTION  
MULTI-CELLED BOX CULVERT**

DETAIL NO. BC-402

SHEET    OF   

BOX CULVERT

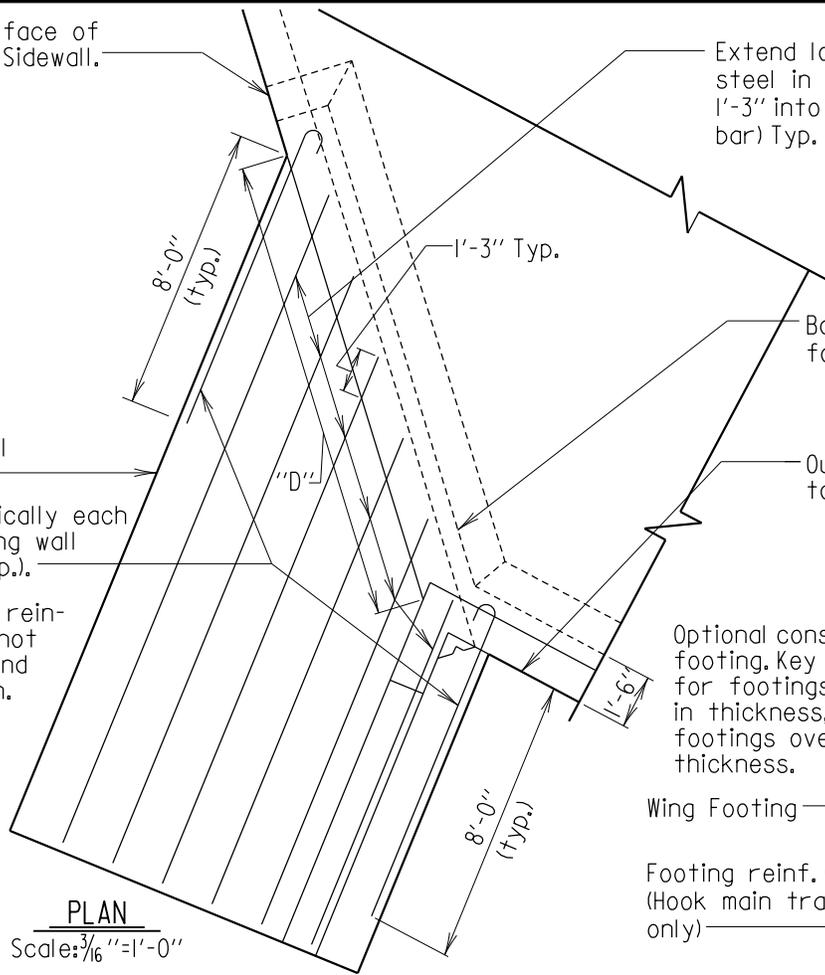
Outside face of Culvert Sidewall.

Extend longitudinal reinforcing steel in footing (top & bottom) 1'-3" into toe wall (measured along bar) Typ.

Rear face of wing wall footing.

3-#8's vertically each face of wing wall footing (typ.).

Transverse reinforcement not shown. Extend as in Option.



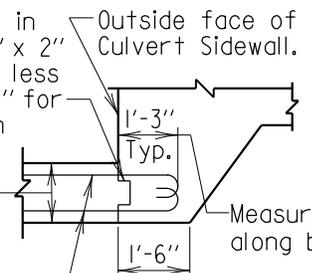
**PLAN**  
Scale: 3/16" = 1'-0"

Bottom of wing wall footing/toe wall.

Outside face of Culvert toe/head wall.

Optional const. joint in footing. Key size: 4" x 2" for footings 18" or less in thickness, 6" x 3" for footings over 18" in thickness.

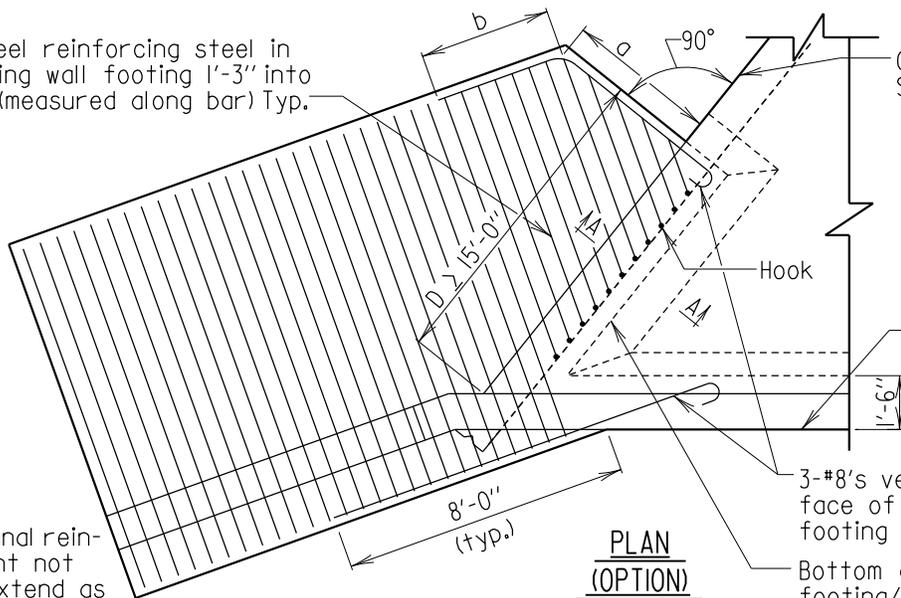
Wing Footing  
Footing reinf. steel. (Hook main transverse only)



**SECTION A-A**  
Scale: None

Note:  
 $a + b = 8'-0''$

Extend heel reinforcing steel in top of wing wall footing 1'-3" into toe wall (measured along bar) Typ.



**PLAN (OPTION)**  
Scale: 3/16" = 1'-0"

Outside face of Culvert Sidewall.

Outside face of Culvert toe/head wall.

3-#8's vertically each face of wing wall footing (typ.).

Bottom of wing wall footing/toe wall.

Longitudinal reinforcement not shown. Extend as shown in Plan.

Note:

1. When the distance measured along the outside face of culvert, between the back of headwall/wing wall and the rear face of wing wall footing, (shown as D), exceeds 15 ft. the Contractor has the option of installing the footing as shown in Option.
2. Culvert and toe wall reinforcing steel not shown.

APPROVAL
<i>E.S. Freedom</i> DIRECTOR OFFICE OF STRUCTURES
DATE: 10/09/2007
VERSION
1.0

STATE OF MARYLAND DEPARTMENT OF TRANSPORTATION STATE HIGHWAY ADMINISTRATION OFFICE OF STRUCTURES
<b>TIE-IN DETAIL FOR BOX CULVERT BOTTOM SLAB AND WING WALL FOOTING</b>
DETAIL NO. BC-501
SHEET <u>1</u> OF <u>1</u>

BOX CULVERT