Chapter 06

BOX CULVERTS (BC)
See Bar Lap Chart
Constr. Jt. with nominal 4"x2" Key (Typ.)

Triangular Key for future extension. (See Table)

**HEADWALL SECTION**
Scaled 1/2" = 1'-0"

**TOE WALL SECTION**
Scaled 1/2" = 1'-0"

**Triangular Key**
Detail

**SKEW ANGLE**

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.

<table>
<thead>
<tr>
<th>S or T</th>
<th>Key Size</th>
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</thead>
<tbody>
<tr>
<td>Less than 12&quot;</td>
<td>3&quot;</td>
</tr>
<tr>
<td>12&quot; to 18&quot;</td>
<td>4&quot;</td>
</tr>
<tr>
<td>18&quot; and over</td>
<td>6&quot;</td>
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</tbody>
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STATE OF MARYLAND
DEPARTMENT OF TRANSPORTATION
OFFICE OF STRUCTURES

BOX CULVERT
HEADWALL AND TOE WALL DETAILS

DETAIL NO. BC-101 SHEET OF 1
Headwall of Headwall V-Groove all around top and sides of Headwall at 4 of all supporting walls.

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

V-Groove all around top and sides of Headwall at 4 of all supporting walls.
Notes:
1. Reinforcing steel not to pass through contraction joint.
2. Full face of contraction joint to be dampproofed.
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)
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.

**Box Culvert Wing Wall Construction Joint**

**Wing Wall Construction Joint**

- 2 Ply membrane waterproofing, 16" min. width centered on joint.
- #6 @ 1'-6" ± c/c to alternate with normal longitudinal steel.
- #4 @ 1'-6" ± c/c, lap with normal longitudinal steel.
- Inside face of sidewall.
- Headwall
- 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).

<table>
<thead>
<tr>
<th>M or P</th>
<th>Triangular Key Size</th>
<th>Wing Wall Key Size</th>
</tr>
</thead>
<tbody>
<tr>
<td>a</td>
<td>b</td>
<td>#6 @ 1'-6&quot; ± c/c</td>
</tr>
<tr>
<td>Less than 12&quot;</td>
<td>3&quot;</td>
<td>1/2&quot;</td>
</tr>
<tr>
<td>12&quot; to 18&quot;</td>
<td>4&quot;</td>
<td>2&quot;</td>
</tr>
<tr>
<td>18&quot; or over</td>
<td>6&quot;</td>
<td>3&quot;</td>
</tr>
</tbody>
</table>

**Plan**

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

** directors Office of Structures**

**State of Maryland**

**Department of Transportation**

**State Highway Administration**

**Office of Structures**

**Approval**

**Date:** 10/09/2007

**Version:** 1.0

**Detail No.: BC-202**

**Sheet:** 1 of 1
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.
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.

<table>
<thead>
<tr>
<th>Key Size</th>
<th>Triangular Key Size</th>
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<tbody>
<tr>
<td>M or P</td>
<td>a</td>
</tr>
<tr>
<td>Less than 12''</td>
<td>3''</td>
</tr>
<tr>
<td>12'' to 18''</td>
<td>4''</td>
</tr>
<tr>
<td>18'' or over</td>
<td>6''</td>
</tr>
</tbody>
</table>

2 layers of tarpaper full length of key. Fasten to concrete with asphaltic cement.

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

Normal Wing Wall Reinforcing

Normal Sidewall Reinforcing

Inside face of sidewall.

Alternate 6 @ 1'-6" ±
with 6 @ 1'-6" ±
which laps with normal long sidewall steel.

Normal Headwall Reinforcing.

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

Normal Wing Wall Reinforcing

Normal Sidewall Reinforcing

Inside face of sidewall.

Alternate 6 @ 1'-6" ±
with 6 @ 1'-6" ±
which laps with normal long sidewall steel.

Normal Headwall Reinforcing.

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

Normal Wing Wall Reinforcing

Normal Sidewall Reinforcing

Inside face of sidewall.

Alternate 6 @ 1'-6" ±
with 6 @ 1'-6" ±
which laps with normal long sidewall steel.

Normal Headwall Reinforcing.

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

Normal Wing Wall Reinforcing

Normal Sidewall Reinforcing

Inside face of sidewall.

Alternate 6 @ 1'-6" ±
with 6 @ 1'-6" ±
which laps with normal long sidewall steel.

Normal Headwall Reinforcing.

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

Normal Wing Wall Reinforcing

Normal Sidewall Reinforcing

Inside face of sidewalk.

Alternate 6 @ 1'-6" ±
with 6 @ 1'-6" ±
which laps with normal long sidewall steel.

Normal Headwall Reinforcing.

1" Sponge type expansion joint filler, material full height of key. Fasten to one face with copper nails.
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
4" c/c. All other longitudinal bars to be #4 @ 1'-6'' c/c.

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.

* Culvert to be built to grade when
minimum depth of fill at headwall
is less than 9 in.

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 *
Note:
Box Culvert shall be designed as a rigid frame.

1. 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.
2. Minimum thickness of sidewalls to be 36 in.
3. 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.
4. 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.
5. If rise exceeds 10'-0", this bar may be lapped at mid height at Contractors option.
6. 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
* e c/c . All other longitudinal bars to be #4's 1'-6" c/c .

Slope to follow crown and grade of roadway.

Epoxy coat these bars.

Slope to follow invert grade.

2-Ply Membrane Waterproofing
16 in., min. width centered on joint.

Splice at mid height and epoxy coat these bars.

Optional Construction Joint with x key.
* Truss e c/c and * straight e c/c to be spliced at the optional construction joint with a appropriate lap length.

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 *
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.