Chapter 06

BOX CULVERTS
(BC)
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.

**Notes:**

**SKEW ANGLE**

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

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

<table>
<thead>
<tr>
<th>S or T</th>
<th>Key Size</th>
</tr>
</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>
</tr>
</tbody>
</table>

5. Design is valid for live load surcharge.
PLAN
Scale; 1/2" = 1'-0"

V-Groove all around top and sides of Headwall at 1/4" of all supporting walls.
CONTRACTION JOINT FOR BOX CULVERT BARREL

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)

<table>
<thead>
<tr>
<th>M,N,S,T</th>
<th>Key Size</th>
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</thead>
<tbody>
<tr>
<td>a</td>
<td>a/2</td>
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<tr>
<td>Less than 12''</td>
<td>3'' 1/2''</td>
</tr>
<tr>
<td>12'' to 18''</td>
<td>4'' 2''</td>
</tr>
<tr>
<td>18'' or over</td>
<td>6'' 3''</td>
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</tbody>
</table>

FLOOR OF JOINT

SECTION A-A

VERTICAL LOCATION OF KEY WHEN PILES ARE USED

PLAN

HORIZONTAL LOCATION OF KEY WHEN PILES ARE USED

Scale: None

Scale: None
* 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.

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

Outside face of sidewall.

Inside face of sidewall.

*2'-6" min.

*5'-0" min.

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.
--- EXPANSION JOINT FOR BOX CULVERT BARREL ---

### 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.

### Table: Key Size

<table>
<thead>
<tr>
<th>M, N, S, T</th>
<th>Key Size</th>
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<tr>
<td>less than 12&quot;</td>
<td>3&quot; a/2</td>
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<tr>
<td>12&quot; to 18&quot;</td>
<td>4&quot; 2&quot;</td>
</tr>
<tr>
<td>18&quot; or over</td>
<td>6&quot; 3&quot;</td>
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</table>

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**ELEVATION**

- Scale: None

**SECTION A-A**

- Scales None

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

<table>
<thead>
<tr>
<th>M, N, S, T</th>
<th>c/2</th>
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<tbody>
<tr>
<td>less than 12&quot;</td>
<td>3&quot; a/2</td>
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<tr>
<td>12&quot; to 18&quot;</td>
<td>4&quot; 2&quot;</td>
</tr>
<tr>
<td>18&quot; or over</td>
<td>6&quot; 3&quot;</td>
</tr>
</tbody>
</table>

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**PLAN**

- Scale: None

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

- Scale: None

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**Typical Section of Walls and Slabs**

- Scale: None

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**Expansion Joint**

- Fasten to concrete with asphaltic cement.
- 1" Sponge type expansion joint filler material, full length of key. Fasten to one face with copper nails.
Notes:
1. Reinforcing steel not to pass through joint.
2. All keys are nominal size.
3. This joint detail is to be used for all walls greater than 15' in length.
4. This joint detail to be used for all walls greater than 15' in length.

<table>
<thead>
<tr>
<th>Key Size</th>
<th>M or P</th>
<th>Wing Wall Reinforcing</th>
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<tbody>
<tr>
<td>a</td>
<td>3/4</td>
<td></td>
</tr>
<tr>
<td>b</td>
<td>1/2</td>
<td></td>
</tr>
<tr>
<td>c</td>
<td>5/8</td>
<td></td>
</tr>
</tbody>
</table>

Normal Wall Reinforcing

Normal Headwall

Alternate: #6 @ 1'-6'' + #6 @ 1'-6'' + #6 @ 1'-6''

Joint filler, material full height of key. Fasten to one face with copper nails.

1" Sponge type expansion joint to extend from top of footing to top of wall.

Expansion joint to extend from top of footing to top of wall.

All keys are nominal size.

Reinforcing steel not to pass through joint.

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

NORMAL WING WALL EXPANSION JOINT

STATE OF MARYLAND
DEPARTMENT OF TRANSPORTATION
OFFICE OF STRUCTURES

STATE HIGHWAY ADMINISTRATION

DEPARTMENT OF TRANSPORTATION
STATE OF MARYLAND
OFFICE OF STRUCTURES

10/09/2007

PLAN

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

1.0

DETAIL NO. BC-302

BOX CULVERT WING WALL EXPANSION JOINT
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.

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

Splice at mid height and epoxy coat these bars.

2 1/2" min. cl.

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 6" c/c.
- All other longitudinal bars to be 4" @ 1'-6" c/c.

Slope to follow crown and grade of roadway.

Epoxy coat these bars.

Slope to follow invert grade.

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

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

See appropriate bar lap chart.

See Note 'A'.

- c/c straight bars.

Top of bottom slab to be set 1'-0" below proposed Invert.

Ultimate Invert Elevation after siltation,

Design Invert Elevation

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

Note:
- Reinforcing in bottom slab shall be the same as in top slab.
- All longitudinal bars to be 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.
- 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.
- If piles are used, the 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.
- If rise exceeds 10'-0", this bar may be spliced at mid height at Contractors option.

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

---

** See appropriate bar lap chart.

1. Box Culvert shall be designed as a rigid frame.
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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 spliced at mid height at Contractors option.

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

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**PLAN**

Scale: \( \frac{1}{8} = 1'-0'' \)

**SECTION A-A**

Scale: None

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**PLAN (OPTION)**

Scale: \( \frac{1}{8} = 1'-0'' \)

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**STATE OF MARYLAND**

DEPARTMENT OF TRANSPORTATION

STATE HIGHWAY ADMINISTRATION

OFFICE OF STRUCTURES

APPROVAL

DIRECTOR

OFFICE OF STRUCTURES

DATE: 10/09/2007

VERSION

1.0

DETAIL NO. BC-501

SHEET ___ OF ___