



## SECTION 6 - CULVERTS

### 6.1 CULVERT LOCATION, LENGTH, AND WATERWAY OPENINGS

Recommendations on culvert location, length, and waterway openings are given in the AASHTO *Guide on Hydraulic Design of Culverts*.

### 6.2 DEAD LOADS

For unique and site specific culverts, where a geotechnical investigation is made, vertical and horizontal earth pressures may be computed by recognized or appropriately documented analytical techniques based on the principles of soil mechanics and soil structure interaction, or design pressures shall be calculated as being the result of an equivalent fluid weight as shown in Article 6.2.1. For all other culverts, loads shall be applied as shown in Article 6.2.1.

#### 6.2.1 Culvert in Trench, or Culvert Untrenched on Yielding Foundation.

- A. Rigid Culverts except reinforced concrete boxes:
  - (1) For vertical earth pressure ..... 140 pcf  
For lateral earth pressure ..... 42 pcf
  - (2) For vertical earth pressure ..... 140 pcf  
For lateral earth pressure ..... 140 pcf
- B. Reinforced Concrete Boxes:
  - (1) For vertical earth pressure ..... 140 pcf  
For lateral earth pressure ..... 100 pcf
  - (2) For vertical earth pressure ..... 140 pcf  
For lateral earth pressure ..... 35 pcf
- C. Flexible Culverts:
  - (1) For vertical earth pressure ..... 140 pcf  
For lateral earth pressure ..... 140 pcf

#### 6.2.2 Culvert Untrenched on Unyielding Foundation.

A special analysis is required.

### 6.3 LIVE LOADS

Culverts shall be designed for HS-20 loads only.

### 6.4 FOOTINGS

Footings for culverts shall be carried to an elevation sufficient to secure a firm foundation, or a heavy reinforced floor shall be used to distribute the pressure over the entire horizontal area of the structure. In any location subject to erosion, aprons or cut-off walls shall be used at both ends of the culvert and, where necessary, the entire floor area between the wing walls shall be paved. Baffle walls or struts across the unpaved bottom of a culvert barrel shall not be used where the stream bed is subject to erosion. When conditions require, culvert footings shall be reinforced longitudinally.

### 6.5 DISTRIBUTION OF WHEEL LOADS THROUGH EARTH FILLS

6.5.1 Culverts shall be designed for all combinations of dead load, earth load and live load for two feet less than and two feet more than the initial and final design conditions. The culvert need not be designed for less than the minimum fill as specified in these specifications.

6.5.2 For all culverts other than reinforced concrete boxes, concentrated live loads shall be considered as acting over an area as specified in Article 3.30 and distributed through the fill at a slope of 7:8. For reinforced concrete pipes and all flexible culverts, when this distribution width is less than the span or diameter, the applied pressure for design purposes, shall be the total load divided by the span or diameter.

For reinforced concrete boxes, when the depth of fill is two feet or less, the wheel load shall be distributed as in slabs with concentrated loads. When the depth of fill is greater than two feet, concentrated loads shall be considered as uniformly distributed over a square, the sides of which shall equal  $1\frac{3}{4}$  times the height of fill.



**6.5.3** When such areas from several concentrations overlap, the total load shall be uniformly distributed over the area defined by the outside limits of the individual areas. For single spans, the effect of live load may be neglected when the depth of fill is more than 8 feet and exceeds the span length; for multiple spans it may be neglected when the depth of fill exceeds the distance between faces of end supports or abutments.

**6.5.4** For RCB's, when the depth of fill exceeds 2 feet, reinforcement to provide for the lateral distribution of concentrated loads is not required.

**6.5.5** Impact shall be as follows:

0 feet - Fill - 1 foot	30%
1 foot < Fill - 2 feet	20%
2 feet < Fill - 3 feet	10%
3 feet < Fill	0%

## 6.6 DESIGN

**6.6.1** The design service life for drainage facilities for all projects with overfills greater than 10 feet, or with roadway widths greater than 28 feet, shall be fifty years. Roadway widths 28 feet or less with less than 10 feet of overfill shall have a minimum service life of twenty five years.

**6.6.2** The culvert design guideline for corrugated metal, reinforced concrete, and thermoplastic pipe culverts are in Sections 12, 17 and 18 respectively.