

## Section 17 – Underground Structures

### CIP Bottomless Culvert: General Configurations, Wall, Slab & Pile Detail, Foundation Details

#### XS Sheet Numbers

XS17-050-1, XS17-050-2 and XS17-050-3

#### Description of Component

The Cast-In-Place bottomless culverts are mainly used for fish and wildlife passage because they can provide a natural channel bed. These underground structures in XS sheets can have earth cover with a range from 0 feet (top exposed to ground) to 20 feet (maximum). The spans range from 12 feet to 20 feet. The wall heights range from 6 feet to 15 feet.

#### Standard Drawing Features

There are 3 plan sheets including General Configurations, Wall, Slab and Pile Details, as well as Foundation Details.

#### Design/General Notes

General Design Specifications are AASHTO LRFD Bridge Design Specifications, 6th Edition and CA Amendments. Other specific design notes are:

1. Earth Load:

Earth pressures for two conditions:

For culverts with piles or footing on rock

140 LB/CF vertical, 42 LB/CF horizontal.

140 LB/CF vertical, 140 LB/CF horizontal.

For culverts with footing on soil

140 LB/CF vertical, 42 LB/CF horizontal.

140 LB/CF vertical, 70 LB/CF horizontal.

2. Unit Stress

$f'_c = 3600$  psi (Culverts & Footings)

$f'_c = 4000$  psi (Driven Piles and CIDH Shafts)

$f'_y = 60,000$  psi (Steel Reinforcement)

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#### 3. Foundation

Geotechnical Services (GS) is responsible for providing Foundation Recommendations for the types of foundations such as shallow foundation (spread footing) or deep foundation (footing with piles) based on subgrade investigation at each job site. The types of piles (CIDH shafts or Driven piles) and pile design data should be specified by GS if deep foundation is recommended. Piles with design capacity of 200 kip is shown in the plans only as a possible alternative and needs to be approved by GS for a specific job. Structure Designer (SD) should work with GS in the process of installations of Foundation Recommendations into plans.

#### Additional Drawings Needed to Complete PS&E

District plans of highway drainage design

Either XS17-051: Piles/Footings on Soil or XS17-052: Piles/Footings on Rock

#### Contract Specifications

Standard Specification Sections 19, 49, 51, 52 and 90

#### Restrictions on Use of Standard Drawings

Potential erosion of the natural bed and potential scouring to the footings could be a major concern for this type of culvert. Geotechnical services should provide investigations and approval for the type of foundation of bottomless structure to resist erosion and scouring. Hydraulic services should provide protection measurements for erosion and scouring as needed.

#### Special Considerations

The CIP bottomless culvert can also be used for other purposes based on cost and constructability considerations or for protecting an existing utility due to load changes.

Bottomless culverts in XS sheets might not be an efficient design alternative when they are buried deeply, for example, when the earth cover is over 25 feet. Other types of bottomless culverts with curved top might be considered in this case, which would be a special design case which needs to get approval from Underground Structure Specialist in DES.