

Section 17 – Underground Structures

XS Sheet Numbers	XS17-050-1, XS17-050-2 and XS17-050-3
Description of Component	The Cast-In-Place bottomless culverts can provide a natural channel bed for special projects such as for fish and wildlife passage. These underground structures in XS sheets can have earth cover ranged from 0.0 ft (exposed top) to 20 ft (Max). The spans range from 12 ft to 20 ft while the wall heights range from 6 ft to 15 ft.
Standard Drawing Features	These three plan sheets form a group, including General Configurations, Wall, Slab and Pile Details, as well as Foundation Details.
Design/General Notes	<p>Design Specifications: AASHTO LRFD Bridge Design Specifications, 6th Edition and CA Amendments.</p> <p>Plans are not to be used for bottomless culverts in a corrosive environment or where there is a severe scour condition or in freeze-thaw areas. Where culverts are exposed to marine environment, thickness of concrete shall be increased to provide 4” coverage.</p> <p>Foundation</p> <ol style="list-style-type: none"> a. 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. Foundation design must comply with recommendations in Geotechnical Report based on soil investigation of the job site. b. The types of 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 an alternative and needs to be approved by GS for a specific job. c. Before design refer to hydraulic and hydrology study for scour recommendations. d. Maximum hydraulic design discharge not to exceed 1'-0" below soffit of the top slab of the culvert.
Additional Drawings Needed to Complete PS&E	District plans of highway drainage design, and Either XS17-051 “Pile Foundation/Footings on Rock” or XS17-052 “Footings on Soil”
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	The CIP bottomless culvert can also be used for other purposes based on cost.

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Considerations	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 20 ft. Modifications or 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.

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XS Sheet Numbers	XS17-051
Description of Component	The details of the Cast-In-Place bottomless culvert frames with Pile Foundation or with Footings on Rock are shown in the plan. The plan applies to two types of foundations: footings on piles and footings on rock. These underground structures with rock foundation or pile-footing can have earth cover ranged from 0.0 ft (exposed top) to 20 ft (Max). The spans range from 12 ft to 20 ft. The wall heights range from 6 ft to 15 ft.
Standard Drawing Features	This plan provide reinforcement details in walls and top slab with foundation of Pile-Footing or Footings on Rock. It also provide dimensions for the thicknesses of walls and top slab.
Design/General Notes	See User Guide for XS17-050 for details.
Additional Drawings Needed to Complete PS&E	District plans of highway drainage design, and XS17-050-1 “General Configurations”, XS17-050-2 “Walls, Slab and Pile Details” and XS17-050-3 “Foundation Details”
Contract Specifications	Standard Specification Sections 19, 49, 51, 52, 90
Restrictions on Use of Standard Drawings	See User Guide for XS17-050-1, XS17-050-2 and XS17-050-3 for details.
Special Considerations	See User Guide for XS17-050-1, XS17-050-2 and XS17-050-3 for details.

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XS Sheet Numbers	XS17-052
Description of Component	The details of the Cast-In-Place bottomless culverts with Footings on Soil are shown in the plan. These underground structures with footing on soil can have earth cover ranged from 0.0 ft (exposed top) to 20 ft (Max). The spans range from 12 ft to 20 ft while the wall heights range from 6 ft to 15 ft.
Standard Drawing Features	This plan provide reinforcement details in walls and top slab with foundation of Footings on Soil. It also provide dimensions for the thicknesses of walls and top slab.
Design/General Notes	See User Guide for XS17-050-1 XS17-050-2 and XS17-050-3 for details.
Additional Drawings Needed to Complete PS&E	District plans of highway drainage design, and XS17-050-1 “General Configurations”, XS17-050-2 “Walls, Slab and Pile Details” and XS17-050-3 “Foundation Details”
Contract Specifications	Standard Specification Sections 19, 49, 51, 52, 90
Restrictions on Use of Standard Drawings	See User Guide for XS17-050-1 XS17-050-2 and XS17-050-3 for details.
Special Considerations	See User Guide for XS17-050-1 XS17-050-2 and XS17-050-3 for details.

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XS Sheet Numbers	XS17-060
Description of Component	The plan is used to Repair Corrugated Metal Pipe (Arch Pipes) and Structural Steel Plate culverts by paving the damaged invert due to corrosion and abrasion.
Standard Drawing Features	The single sheet of standard plan shows the details of the invert pavement and construction procedures.
Design/General Notes	Design Specifications: AASHTO LRFD Bridge Design Specifications, 6 th Edition and CA Amendments
Additional Drawings Needed to Complete PS&E	District plans of highway drainage design
Contract Specifications	Standard Specifications Sections 15, 51, 66, 67
Restrictions on Use of Standard Drawings	The plan is used for metal pipe invert repair damaged mainly around the invert of the CMP, CMPA, CSSPP and CSSPPA with a minimum central angle of 120 degrees (to the 4 o'clock and 8 o'clock positions of the circular culvert), as a standard case.
Special Considerations	<p>Some special considerations for the procedures and calculations are given below:</p> <ol style="list-style-type: none"> 1. Obtain applicable Culvert Investigation Corrosion Report through Corrosion Technology Branch (METS) and Soils Report from Geotechnical Engineer. Determine wall thickness and corrugation size of the metal or structural steel plate pipe and the soil backfill density. 2. From Shear Stud Selection Chart, select number of studs required to support the compression ring in the pipe wall. 3. Based on soil and water PH, and abrasion level obtained from District Hydraulics Engineer based on HDM Table 855.2A, determine required concrete patch thickness from HDM Table 855.2F, a minimum of 3" above the pipe crest. 4. Fill voids underneath culvert with slurry cement backfill or grout. 5. The selected number of Welded Headed Studs attached to the corrugated culvert crest will provide a safety factor of 2.0.