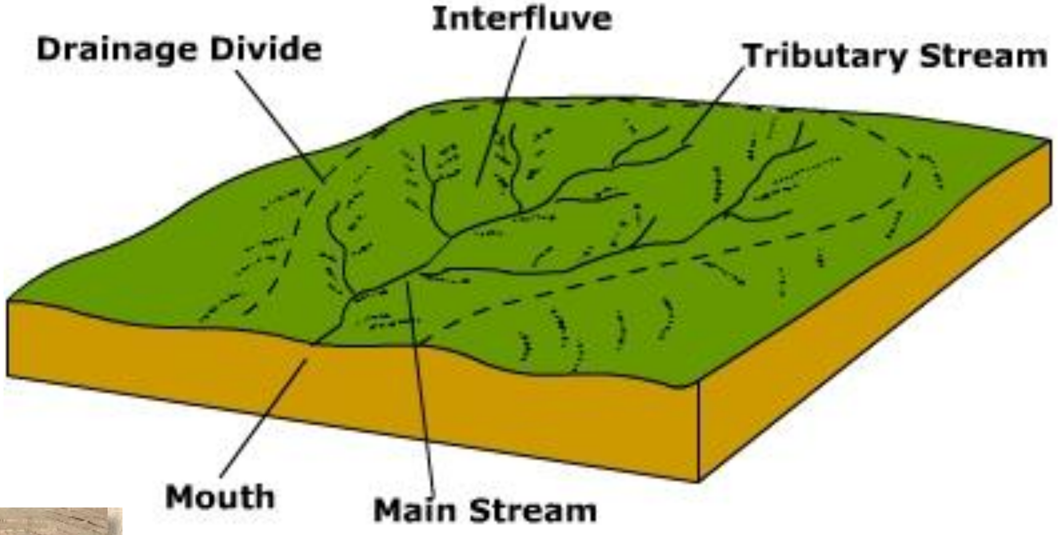


Drainage.
Culverts

LEARNING OBJECTIVES (LO)

1. Understand the definition of culverts and their characteristics
2. Understand the function of culverts
3. Identify various types of culverts
4. Identify the components of a culverts

Culverts

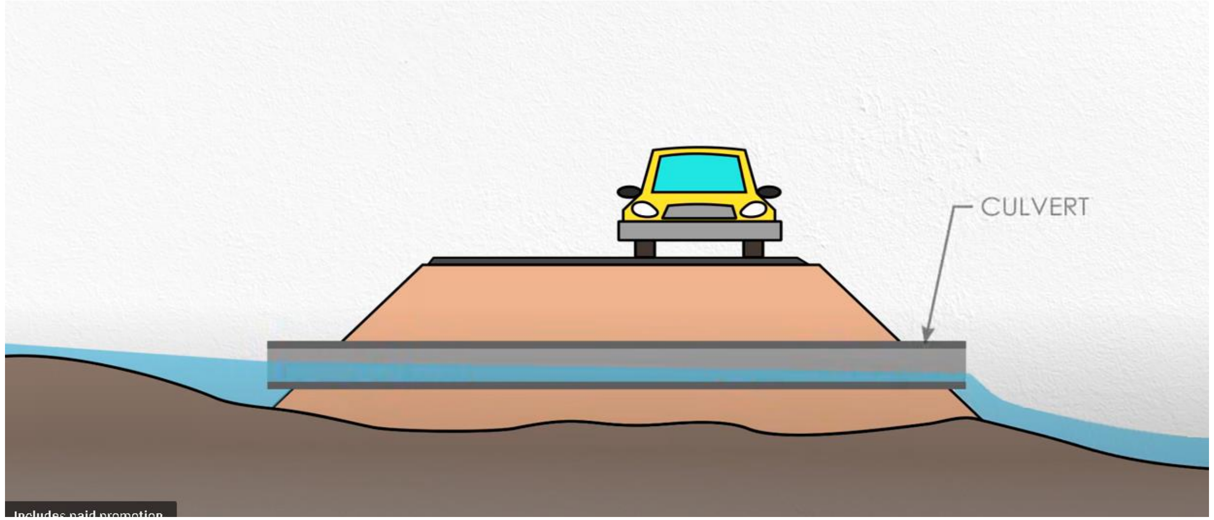
A culvert is a cross drainage structure not classified as a bridge, that provides an opening under a roadway, or other types of access or utility.

Characteristics:

- Consists of a short conduit, typically less than 250 feet long, used to transport water through (or under) an embankment.
- flow depends on entrance geometry and depth of flow at the downstream end.
- Culverts through roadway and railway embankments are designed to pass the design discharge without overtopping the embankment or causing extensive ponding or inundation at the upstream end.

Culvert functions

- Hold up the weight of traffic passing over without collapsing
- Hold up the weight of fill over it without collapsing
- Be able to let enough water pass through without overtopping the road

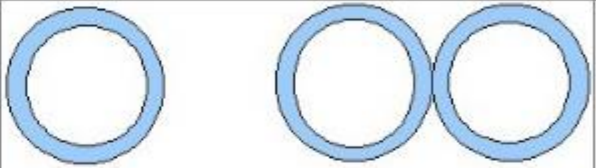
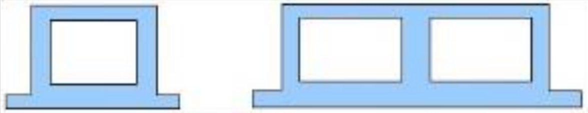
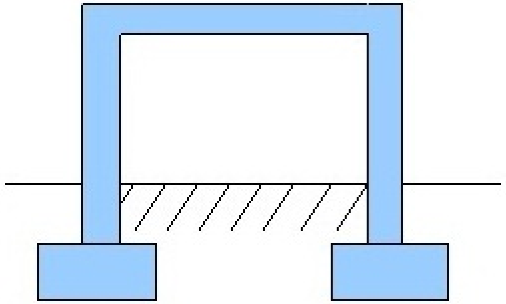


Besides culverts, drainage systems include

Underdrains
Ditches
Slopes

There are various types of culvert depending on its purpose and shape. Below are among a few types commonly used:

Types of Culverts

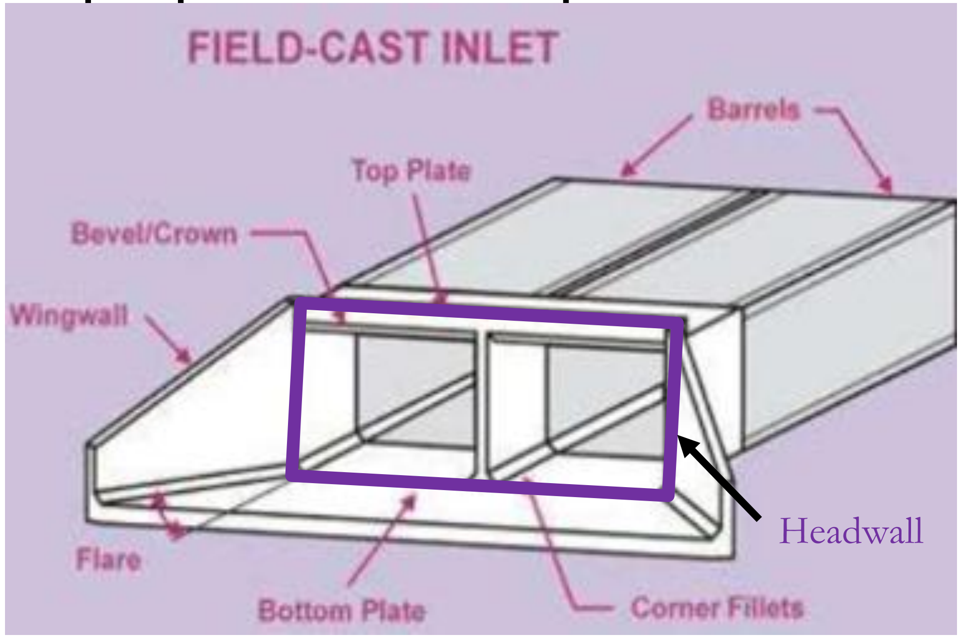
Type of culvert	Typical Cross Section of culverts	Common Material used for culverts
Pipe Single or Multiple	 Single Pipe Multiple Pipe Culvert	Corrugated Material, Plain or Reinforced Concrete, Vitrified Clay, Cast Iron.
Pipe Arch Single or Multiple		Corrugated Material
Box Culvert Single or Multiple		Reinforced Concrete
Bridge Culvert		Reinforced Concrete

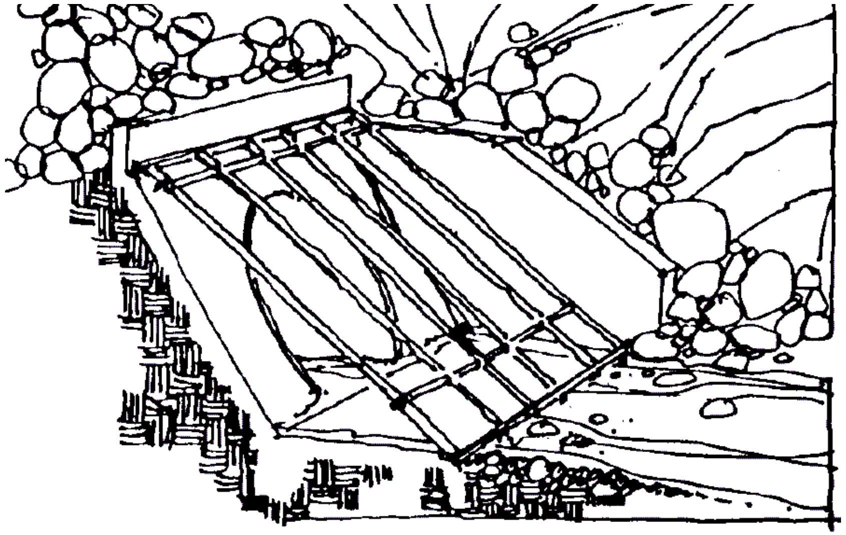
1. Box culvert
2. Pipe culvert
3. RCC solid slab culvert
4. Arch culvert



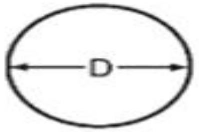
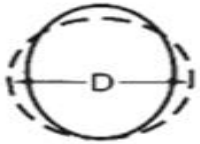
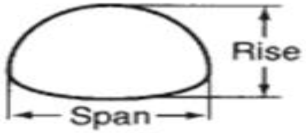
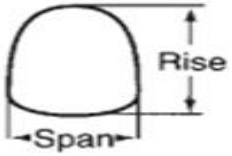
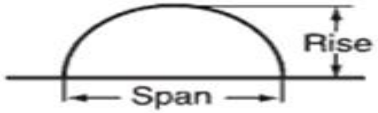

There are various types of culvert depending on its purpose and shape. Below are among a few types commonly used:

Components	Descriptions	
Barrels	Size and Shape	Selection depends on construction limitation, embankment height, environmental issues, hydraulic performance, and cost
	Material	• Commonly used materials are corrugated steel, corrugated aluminum, and recast or cast-in-place concrete. • Selection depends on corrosion, abrasion, and structural strength. • On high visibility areas, selection may be based on aesthetics and functional aspects.
End treatment (headwall and wing wall)	Purpose: Protect embankment from erosion, serve as retaining walls to stabilize the bank, and add weight to counter any buoyancy effects.	
Debris barrier	Sometimes constructed on the upstream end to prevent material from entering and clogging the culvert. The barriers are placed far enough away from the entrance so that accumulated debris does not clog the entrance.	

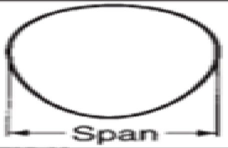




Below are some of the shapes of corrugated conduits/barrels for culverts:

Shape	Range of Sizes	Common Uses
Round 	6" – 26'	Culverts, subdrains, sewers, service tunnels, etc. All plates same radius. For medium and high fills (or trenches).
Vertically-elongated (ellipse) 5% is common 	4' – 21' nominal; before elongating	Culverts, sewers, service tunnels, recovery tunnels. Plates of varying radii; shop fabrication. For appearance and where backfill compaction is only moderate.
Pipe-arch 	Span x Rise 18" x 11" to 20' 7" x 13' 2"	Where headroom is limited. Has hydraulic advantages at low flows. Corner plate radius, 18 inches or 31 inches for structural plate.
Underpass* 	Span x Rise 5' 8" x 5' 9" to 20' 4" x 17' 9"	For pedestrians, livestock or vehicles (structural plate).
Arch 	Span x Rise 6' x 1' 9½" to 25' x 12' 6"	For low clearance large waterway opening, and aesthetics (structural plate).

Below are some of the shapes of corrugated conduits/barrels for culverts:

Shape		Range of Sizes	Common Uses
Horizontal Ellipse		Span 20' – 40'	Culverts, grade separations, storm sewers, tunnels.
Pear		Span 25' – 30'	Grade separations, culverts, storm sewers, tunnels.
High Profile Arch		Span 20' – 45'	Culverts, grade separations, storm sewers, tunnels, Ammo ammunition magazines, earth covered storage.
Low Profile Arch		Span 20' – 50'	Low-Wide waterway enclosures, culverts, storm sewers.
Box Culverts		Span 3' – 20'	Low-Wide waterway enclosures, culverts, storm sewers.
Specials		Various	For lining old structures or other special purposes. Special fabrication.

* For equal area or clearance, the round shape is generally more economical and simpler to assemble.