MARYLAND DEPARTMENT OF TRANSPORTATION — STATE HIGHWAY ADMINISTRATION	Office of Structures ***Guidelines and Procedures Memorandum***	DESIGN Number: D-78-15(4) Date: 03-16-2018
Length and Treatment of Culverts		Approval: DRAFT

Each culvert shall be evaluated as to the type of end treatment to be used.

All box culverts hall be built with wing walls or have the barrel extended. Non-hydraulic pipes shall have the ends of the pipes beveled to conform to the fill slope with slope protection and cut-off walls unless there are overriding aesthetic concerns. The end treatment for hydraulic pipes shall be determined during design.

For all hydraulic culverts the bottom of the toe wall, wing walls and headwall or slope protection cut-off wall shall be placed 3'-0" minimum below the invert elevation of the culvert. Each site must be evaluated for scour potential and the footings or cut-off walls adjusted accordingly. All of these evaluations are to be made during the preliminary development stages of the structure (i.e. Hydrologic/Hydraulic stage, T.S.&L. stage and Foundation Review stage).

Headwalls for Culverts Carrying 5'-0" or Less Fills (measured at the hinge point):

The length of the culvert shall be determined by placing the concrete headwall so that the traffic barrier on the headwall lines up with the approach traffic barrier. This wil1 necessitate the concrete headwall being placed parallel to the adjacent highway.

Headwalls for Culverts Carrying More Than 5'-0" Fills (measured at the hinge point):

The highway typical section, between hinge points, shall be carried across the culvert. The length of the culvert shall be determined utilizing 2:1 side slopes regardless of approach roadway slope. Refer to Chapters 3 and 7 of the Highway Development Manual.

1) For Culverts Less Than 20 Feet wide (Measured along the center line of the highway)

   The headwall shall be placed normal to the center line of the culvert at a point where the fill over the entire culvert is 9 inches minimum. When setting the length of pipe or pipe arch culverts, the total length should be set in even feet for economy.

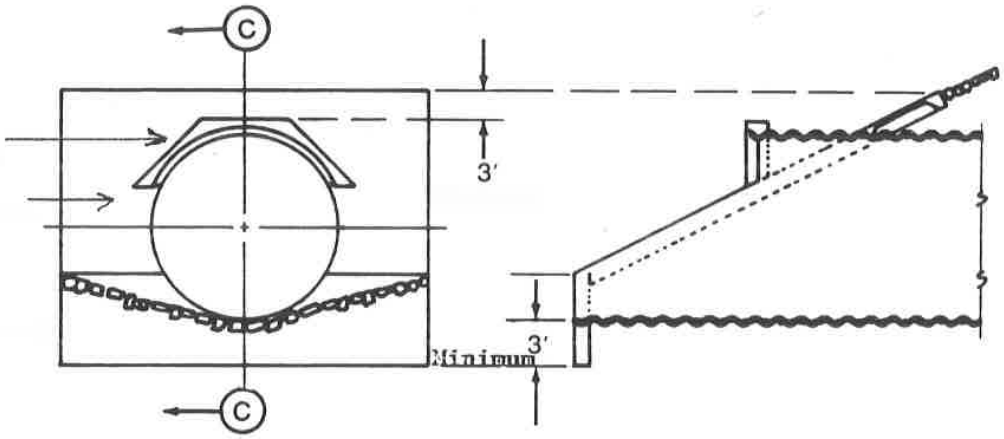
2) For Culverts Greater Than or Equal to 20 Feet Wide (measured along the center line of highway)

   The headwall shall be placed parallel to the adjacent highway. For skew angles between 80 and 90 degrees consideration can be given to placing the headwall normal to the culvert's center line. The location of the headwall shall be determined by economic analysis comparing increased headwall height costs to increased culvert length and earthwork costs.

Length and Treatment of Culverts

Beveled Ends for Culverts

The diagram below shows the typical treatment with slope protection, cut-off walls and a slope collar for one end of a beveled culvert.



Cutting the ends of a culvert to a skew or bevel, which matches the embankment slope, destroys the ability of the end portion to resist the earth pressures.

Designers shall evaluate the skewed end of pipes to ensure proper support is provided. In larger pipes it will be necessary to ensure that the structural plates can carry the unbalanced loads created in the skewed end section and if they can't a headwall must be placed normal to the pipe. On multiple cell pipe culverts this will cause a wall between the pipes to connect the headwall.

In general, when the skew angle between road and the pipe is less than 70 degrees some type of additional end reinforcement should be considered. During backfill and construction of culverts, ends may require temporary bracing to prevent distortions.