INDIANA DEPARTMENT OF TRANSPORTATION

Driving Indiana's Economic Growth

Design Memorandum No. 22-24

December 19, 2022
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TO: **All Design, Operations, and District Personnel, and Consultants**

FROM: ***/s/Mark Bailey***
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Director, Hydraulics Engineering Division

SUBJECT: **Cutoff Walls for Box Culverts**

REVISES: ***Indiana Design Manual*** **Chapter 203-2.03(04)**

EFFECTIVE: **Immediately**

This design memo's purpose is to update and clarify guidance and dimensions of cutoff walls for box culverts in the *Indiana Design Manual*.

Cutoff walls were required for any reinforced concrete box without headwalls. It was noted that some box structures may have headwalls that do not include the cutoff wall section, and hence a clarification is added to require cutoff walls for all box structures with a concrete bottom.

For questions related to this design memo please contact the Hydraulics Engineering Division at Hydraulics@indot.in.gov.

IDM Revisions

203-2.03(04) Inlet or Outlet End Treatment [Rev. Dec. 2022, Feb. 2023]

The culvert end-treatment type should be selected from the list shown below based on the given considerations and the entrance loss coefficient, K_E. See Figures 203-2H and 203-2 I for the recommended values of K_E. Roadside safety should be considered in the selection and design. See Chapter 49 for a discussion of practices for the safety treatment of a drainage structure.

The following discusses the types of culvert end treatments and their advantages and disadvantages.

1. Projecting Inlet or Outlet.

    a. Extends beyond the roadway embankment.
    b. Susceptible to damage during roadway maintenance or an errant vehicle.
    c. Has a low construction cost.
    d. Has poor hydraulic efficiency for thin material.
    e. Should include anchoring the end treatment to strengthen the weak leading edge for a culvert of diameter of 42 in. or larger.
    f. Can be strengthened by use of a concrete collar, if necessary.

2. Mitered End Treatment.

    a. Hydraulically more efficient than a thin edge projecting.
    b. Should be mitered to match the fill slope.
    c. Should include anchoring the end treatment to strengthen the weak leading edge for a culvert of diameter of 42 in. or larger.

3. Improved End Treatment.

    a. Should be considered for a culvert which will operate in inlet control.
    b. Can increase the hydraulic performance of the culvert, but can also add to the total culvert cost. Therefore, it should be used only if economically justified.

4. Pipe End Section.

   a. Used to retain the roadway embankment to avoid a projecting culvert barrel.
   b. Used where the side slopes of the channel are unstable.
   c. Used where the culvert is skewed to the normal channel flow.
   d. Provides the best hydraulic efficiency if the flare angle is between 30 and 60 deg.
   e. Should be provided for a precast-concrete drainage structure.

5. Wingwall.

   a. Available for either corrugated metal or concrete pipe.
   b. Retards embankment erosion and incurs less damage from maintenance.
   c. Can improve a projecting metal pipe entrance by increasing hydraulic efficiency, reducing accident hazard, and improving the pipe entrance's appearance.
   d. Is hydraulically equivalent to a headwall, but can be equivalent to a beveled or side-tapered entrance if a flared, enclosed transition occurs before the barrel.

6. Apron.

   a. Used to reduce scour from a high headwater depth or from approach velocity in the channel.
   b. Should extend at least one pipe diameter upstream.
   c. Should not protrude above the normal streambed elevation.
   d. May be constructed of riprap and an appropriate geotextile or concrete.
   e. Should be set at the structure invert elevation.

7. Cutoff Wall.

   a. Used to prevent piping along the culvert barrel and undermining at the culvert end.

   b. Should be used for all box structures with a concrete bottom.

      - If bedding material (i.e. crushed stone, b borrow, etc.) is present, the cutoff wall should extend 6 inches below the bedding material.
      - If bedding material is not present, the depth of the cutoff wall should be a minimum of 20 inches below the bottom of the culvert.

8. Weep Hole. A weep hole should not be used.