



INDIANA DEPARTMENT OF TRANSPORTATION

Driving Indiana's Economic Growth

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TO: All Design, Operations, and District Personnel, and Consultants

FROM: /s/Mark Bailey
Mark Bailey
Title Hydraulic Division Director
Division Hydraulics

SUBJECT: Outlet Protection

REVISES: *Indiana Design Manual Chapter 203-2.02(15) & Figure 203-2D*

EFFECTIVE: Stage 3 submittals on or after March 24, 2023

This design memo's purpose is to update and clarify guidance concerning riprap size at the outlet of pipes. Due to the increase in small structures under 4 ft in span, some riprap sizes have stones larger than the pipe itself. Therefore, IDM Figure 203-2D was updated to adjust for the outlet velocity as well as the structure size.

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

IDM Revisions

203-2.02(15) Energy Dissipator

An energy dissipator is used to protect the culvert and downstream channel from scour. The two primary types of scour are local scour and channel degradation. Local scour is the result of high-velocity flow at the culvert outlet and extends only a limited distance downstream. Channel degradation can proceed in a fairly uniform manner over a long length or can be evident in one or more abrupt drops, or headcuts, progressing upstream with each runoff event.

The culvert should be designed independent of the dissipator design, with the exception of an internal dissipator, which may require an iterative solution. The culvert design should be completed before the outlet protection is designed and should include computation of outlet velocity. The downstream channel protection should be designed concurrently with the dissipator design.

A culvert will likely require outlet protection. The class of riprap used for outlet protection should be sized in accordance with Figure [203-2D](#). For a side ditch that does not carry a live stream, sod can be used at the outlet. Seeding should be used if the design velocity is less than 2 ft/s.

Energy dissipators should be used for structures with a proposed outlet velocity greater than 13ft/s and a span greater than 3ft. However, energy dissipators are not required for existing structures with an outlet velocity greater than 13ft/s and do not show signs of scour.

Riprap Sizing for Erosion Protection		Velocity, v (fps)			
		$v < 6.5$	$6.5 \leq v < 10$	$10 \leq v < 13$	$v > 13$
Span of Structure, x	$x \leq 2'$	Revetment	Revetment	Revetment	Revetment
	$2' < x \leq 2.5'$	Revetment	Class 1	Class 1	Class 1
	$2.5' < x \leq 3'$	Revetment	Class 1	Class 2	Class 2
	$x > 3'$	Revetment	Class 1	Class 2	Energy Dissipator
Stream Protection		Revetment	Class 1	Class 2	Class 2

Notes:

1. If clear-zone or other issues prohibit the use of the required erosion-protection method, the Office of Hydraulics should be contacted for additional instructions.
2. Substitution of partially grouted riprap of one size smaller than that recommended in the table may be used.

STREAM VELOCITY FOR EROSION PROTECTION

Figure 203-2D

[Rev. Jan. 2023]