Florida Department of Transportation Research

Closed Flume Inlet Efficiency
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The storm drain is an inconspicuous but critical part of the roadway, especially in Florida. Drains look deceptively simple, but they must capture water as efficiently as possible. To help assure the performance of storm drains, the Florida Department of Transportation (FDOT) developed standards for their design, construction, and maintenance. The standard for the closed flume inlets (CFI) was introduced in the 1990s, but their efficiency has never been formally evaluated.

In this project, Florida International University researchers investigated the efficiency, or hydraulic capacity, of the current CFI design and how changes to its geometry would alter its performance. Currently, hydraulic capacity of CFIs is obtained from empirical equations based on studies of CFIs with slightly different geometries from the FDOT standard. Perhaps surprisingly, the flow through a CFI is highly complex.

The closed flume inlet storm drain is an inconspicuous but important safety feature of the roadway.

The researchers conducted experiments at IIHR—Hydroscience & Engineering at the University of Iowa. Models of CFIs were built of marine plywood at a large scale, one-fifth actual size, which permits accurate modeling. Several variations of the basic CFI design were attached to a model roadway for testing. The model made it possible to adjust the downward slope of the roadway (longitudinal slope). Longitudinal slope was varied from 0.3 to 5%.

Interior slope (cross slope) of the CFI was set at any of three slopes from 2 to 6%; CFIs were built so that the inlet side and the outlet side had the same width (unconstricted flow) or sides of the CFI were angled so that the outlet side was narrower than the inlet (constricted flow); the inlet could be standard or extended length. Preliminary results were reviewed with FDOT to select final design parameters for the model. FDOT was consulted frequently during subsequent testing to determine how to proceed.

For each experimental trial, the model was set to the desired geometry. Flows into the model were varied, and the flow into the model and the flow out of the CFI were measured. Inlet flow was varied from zero to 12 cubic feet per second of water. Cross-sectional velocity of the outflow was measured by combining outflow rate determined in the receiving weir box and the cross-sectional flow, measured by using an imaging system, image analysis, and direct depth measurements.

This project established relationships among design elements of the closed flume inlet, providing more definitive guidelines for manufacturers, especially the relationship between longitudinal slope and cross slope. CFIs are an important safety feature of roadways, and improved designs help ensure that Florida's highways are passable and safe in even the wettest conditions.

Project Manager: Rick Renna, FDOT Roadway Design Office
Principal Investigator: Mehmet Bayraktar, Florida International University
For more information, visit http://www.dot.state.fl.us/research-center