Summary of Final Report, BC353-27
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EXPERIMENTAL INVESTIGATION AND ANALYSIS OF FLOW UNDER BARRIER WALLS

PROBLEM STATEMENT

Temporary concrete barriers (inertial attenuators) are often installed at highway construction sites, on the edge of driving lanes, for traffic safety. To permit pavement drainage, cutouts are included at the bottoms of the barriers to form a small rectangular drainage inlet when the barrier is placed on the pavement. Because these barriers rest directly on the pavement or shoulder, a hydraulic configuration much like a curb and gutter is created. While runoff from the pavement is usually a continuous distribution, these inlets are located at regular, closely spaced intervals, due to the positioning of the barriers. In this regard, the arrangement of inlets is much like a manifold problem. Safety considerations make removal of stormwater from pavement a critical requirement. Since the barriers are often located very close to the driving lane and no flexibility in size or spacing of the inlets is afforded, it is essential to be able to assess the capacity of the system to ensure that water does not spread onto the pavement.

OBJECTIVES

The purpose of this study was to establish the hydraulic performance of barrier wall inlets, as a first step to evaluating the capacity of the barrier wall drainage system. To accomplish this goal, several tasks were undertaken:

- perform experimental measurements of the discharge characteristics of various aperture configurations, both under sump and transverse flow conditions
- test various full-scale configurations for drainage apertures at a tilting flume experimental facility
- vary both the cross and longitudinal slope of the flume, with zero longitudinal slope corresponding to sump conditions (no channel velocity)
- measure discharge rates of individual inlets as a function of approach flow rate and pavement slope parameters for supercritical conditions

FINDINGS AND CONCLUSIONS

The final report for this project is divided into two components. The first part consists of a description of experiments and analysis of results regarding measurements of flow capacities for barrier inlets. This portion of the investigation follows closely upon previous work done by the Principal Investigator. In addition, a previous study of barrier wall inlets was conducted by the PI for FDOT. This earlier study yielded considerable information, but further experimental work was needed (as was the development of a practical design aid for applications as discussed below). In these experiments, the capacities of isolated, single inlets were measured under conditions of long approach distances and no runoff. Longitudinal and cross slopes were varied over ranges covering most field conditions, including sump flow. The principal result of this portion of the study was the development of several empirical correlations describing capacity. Several other conditions of interest were also studied, including some measurements of the transition from supercritical to subcritical flow and possible methods for enhancing capacity (this latter investigation was not found to be productive, however).

The second part of this investigation discusses the development of a design and planning model intended to aid in the estimation of spread for practical application of inertial attenuators. As part of this effort, a more advanced computational program was first constructed as a preliminary step to understanding how the flow along a wall of attenuators actually develops. Subsequently, this information was used to build a simplified spreadsheet program suitable for general usage. This program computes flow past barrier walls set on grade and includes the possibility of a sag curve. The program (in spreadsheet format) has the following three components, each occupying a single sheet: a variable slope section with flow from left to right, a variable slope section with flow from right to left, and a section representing the ponded region that will form near a minimum elevation section. An example problem is analyzed using the spreadsheet program. This program can also be utilized to estimate flow on simple slope conditions.

BENEFITS

The principal benefit of this research is expected to be improved safety at construction sites, obtained by application of the hydraulic capacity relationships developed during this investigation. This application will likely be facilitated by the availability of predictive modeling methods for systems of barrier installations. Reduced accident events are anticipated to result in cost savings on construction projects. This study was eventually expanded to permit the further development of a second generation predictive modeling program with several advanced features.

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