



**TPF-5(114)
Roadside Safety
Research Program
Pooled Fund Study**

PARTICIPATING PARTNERS:

- Alaska Department of Transportation & Public Facilities
- California Department of Transportation
- Louisiana Department of Transportation and Development
- Minnesota Department of Transportation
- Pennsylvania Department of Transportation
- Tennessee Department of Transportation
- Texas Department of Transportation
- Washington State Department of Transportation
- Federal Highway Administration
- Texas Transportation Institute

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F-Shape Concrete Barrier with Slotted Drain Holes

INTRODUCTION

The Louisiana Department of Transportation and Development (LaDOTD) currently uses a cast-in-place concrete bridge rail on Louisiana bridges. The F-Shape bridge rail is 32 inches in height and 13.25 inches wide at the base. Presently, for bridges that use this concrete F-Shape bridge rail, drainage is provided only at the ends of the bridge since there is no opening provided through the bridge rail. LaDOTD has proposed the use of 6-inch high by 24-inch long open slots located 10 ft apart at the base of the rail to accommodate drainage through the railing.

Adequate storm water drainage is necessary for safety on vehicular bridges. For bridges utilizing continuous cast-in-place concrete bridge rails with no openings, storm water drainage is typically provided on the ends if drainage scuppers are not provided. Drainage through the bridge railing can provide more efficient drainage of storm water. LaDOTD has developed an F-Shape barrier with drainage slots to accommodate drainage through the bridge rail into scuppers or off the sides of the bridge.

RESEARCH METHODOLOGY

Openings and penetrations in roadside barriers can adversely affect the crash performance of the barrier system. These openings and/or penetrations can cause vehicular snagging, instability or other undesirable performance when impacted by an errant vehicle. Often, full-scale crash testing is warranted to evaluate the performance of a specific barrier system that utilizes openings and penetrations. A drainage opening, like the one proposed for the LaDOTD F-Shape Bridge Rail, is one such opening



TXDOT Single Slope Concrete Barrier (Wildlife Crossing) SSCB

in a barrier system that is commonly used. The purpose of this project was to evaluate the performance of the proposed LaDOTD F-Shape Barrier with drainage opening and see if a comparison(s) can be made to other acceptable barriers that have a similar drainage opening.

The proposed details showed the LaDOTD Concrete F-Shape Barrier with 6-inch high by 24-inch long drainage slot openings. The current drainage slot details have been compared with other barriers systems utilizing similar type slots. This review consisted of comparisons with the Texas Department of Transportation (TXDOT) Single Slope Concrete Barrier (Wildlife Crossing) Precast SSCB (TXDOT Wildlife Crossing Barrier) and the Washington Pin & Loop Barrier System designed and crash tested by TTI for the Washington State DOT.

The TXDOT Wildlife Crossing Barrier is 42 inches in height above the pavement surface and has openings for wildlife access through the barrier. Each unit is 30 ft in length and contains two openings that are 12 inches high and 5 ft in length. Based on the review of the geometric features of this barrier, it was determined that the TXDOT Wildlife Crossing Barrier was crashworthy with respect to *NCHRP Report 350 TL-3* performance criteria. TXDOT is currently using this barrier on approximately 10 miles of high speed

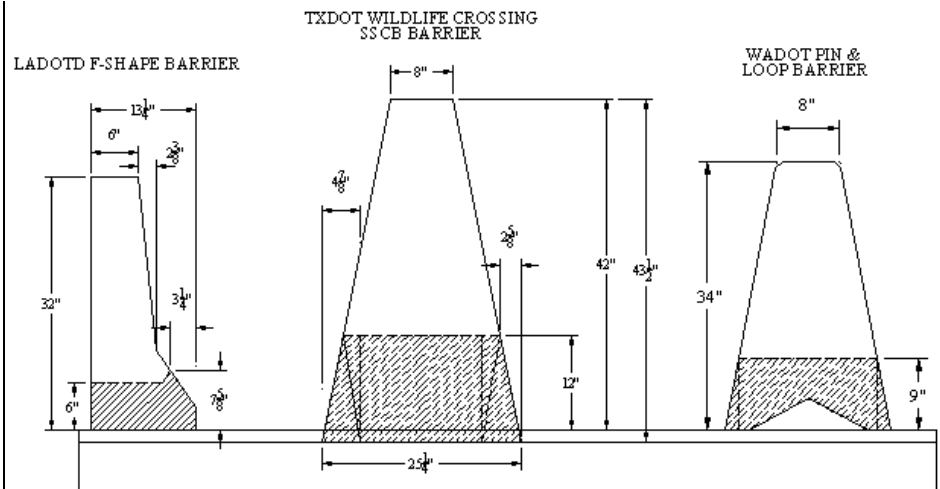
roadway in South Texas near Padre Island where wildlife crossing access is needed. At the time of this writing, several vehicular impacts have occurred on the 10-mile stretch of barrier. No fatalities or serious injuries have been reported from these vehicle impacts.

The Washington Pin & Loop Barrier system consisted of precast concrete barrier segments that were 12 ft-6 inches in length and 34 inches in height. The barrier segment was 8 inches wide at the top and 21 inches wide at the base with a uniform single slope surface on each side face of the barrier. A 4-inch high by 15-inch wide "V" shaped drainage slot was constructed in the base of the barrier. In addition to this longitudinal drainage slot, a transverse drainage scupper opening was constructed at the mid-length of the barrier segment. The drainage scupper opening was 9 inches high by 28 inches in length. Three ¾-inch diameter steel loops were constructed at the ends of the barrier segments. Mating loops on each end of the segment permitted the segments to be connected together using a 1-inch diameter rod at each barrier joint connection. The ¾-inch steel loops were fabricated using A36 material. The 1-inch diameter steel rods were fabricated from AISI 4142 material and were 31 inches in length.

A full-scale crash test was performed in accordance with *MASH* specifications for TL-3. Based on the results from the crash test, the barrier did not perform acceptably in accordance with the *MASH* Specifications. Upon review of the test installation, crash data, and video, it was concluded that the 9-inch high by 28-inch wide drainage slots did not contribute to the vehicle instability. The rollover of the vehicle was attributed to the barrier joint connection and not by the drainage slots in the barrier.

Strength Analysis and Design

The potential for vehicular interaction with the LaDOT F-Shape Barrier was evaluated with respect to the criteria in the AASHTO *LRFD Bridge Design Specifications*. Two figures are presented in the AASHTO



LaDOT F-Shape Barrier, TXDOT Wildlife C Crossing Barrier and WSDOT Pin & Loop Barrier Cross-Sections

LRFD Bridge Design Specifications that provide general guidelines for the crash performance of barrier that contain openings or penetrations. These figures provide guidelines for the preferred post set-back from the face of the railing elements and the preferred ratio of the rail contact widths to the overall height of the bridge rail system (see Figure A13.1.1-2-Potential for Wheel, Bumper, or Hood Impact with a Post and Figure A13.1.1-3-Post Setback Criteria, AASHTO *LRFD Bridge Design Specifications*). The potential for wheel interaction with the opening in the barrier was investigated for the LaDOT F-Shape Barrier design. For the proposed design, the post setback from the face of the rail elements was considered to be zero inches. The maximum vertical clear opening distance between the bridge top of the bridge deck and the top of the opening is 7-5/8 inches. Based on this information and the information provided in Figure A13.1.1-2, the clear opening height of 7-5/8 inches presents a low potential for vehicular interaction with the opening in the barrier during a vehicular crash.

The ratio of rail contact width to height is 0.762 (ratio of the height of the contact length of the F-Shape Barrier to the total height of rail 32 inches). Based on the proposed railing geometry and the information provided in Figure A13.1.1-3, the LaDOT F-Shape Barrier with slotted drain hole is considered marginal.

For the proposed design, the post setback from the face of the rail was considered to be zero inches. TTI researchers have reviewed the current details of the LaDOT Cast-in-Place Barrier Railing (F-Shape Barrier with Drainage Slots). Based on TTI researchers' review, the F-Shape barrier with drainage slots (LaDOTD Drawing Cast-in-Place Barrier & Transition (Transition on Wingwall)) is considered acceptable with respect to *NCHRP Report 350* TL-4 performance criteria. TTI researchers have reviewed the current details of the LaDOTD Cast-in-Place Barrier Railing (F-Shape Barrier with Drainage Slots). Based on TTI researchers' review, the F-Shape barrier with drainage slots (LaDOTD Drawing Cast-in-Place Barrier & Transition (Transition on Wingwall)) is considered acceptable with respect to *NCHRP Report 350* TL-4 performance criteria.

FOR MORE INFORMATION:

[Technical Memo for F-Shape Concrete Barrier with Drainage Slots](#)

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