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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

Washington State Department of Transportation

West Virginia Department of Transportation

Federal Highway Administration

Texas A&M Transportation Institute

CONTACT INFORMATION:

Dave Olson, Chair
Washington DOT
Policy, Standards and Safety Res.
P.O. Box 47372
Olympia, WA 98504-7372
(360) 705-7952
Olsonda@wsdot.wa.gov

D. Lance, Bullard, Jr., P.E.
Roadside Safety & Physical Security Division
Texas A&M Transportation Institute
TAMU 3135
College Station, TX 77843-3135
(979) 845-6153
l-bullard@tamu.edu

Roadside Safety Pooled Fund

www.roadsidepooledfund.org

Anchored Concrete Barrier on Asphalt

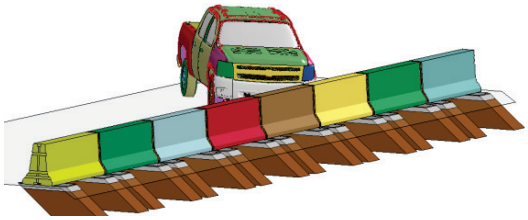
INTRODUCTION

In this project Texas A&M Transportation Institute (TTI) developed a design for anchoring F-shape temporary concrete barrier on asphalt pavement surface using steel pins. This new pinning design is an extension of a recently developed anchoring system (405160-3) that TTI designed specifically for anchoring barriers on concrete pavement or thin bridge decks. Since many situations require pinning the barrier on asphalt, this project focused on making modifications to the pinning scheme of the existing anchoring system and extending its use to placement on asphalt.

RESEARCH APPROACH

To determine the appropriate pinning scheme, the researchers evaluated the response of a single anchoring pin when installed in soil and asphalt. A series of dynamic pull tests were performed to determine the lateral resistance and deflection response of a single anchoring pin when installed in soil and in different thicknesses of asphalt pad laid over soil base. These tests revealed that pinning the barrier directly on soil is not likely to yield enough lateral restraint to sufficiently anchor the barrier with two to three pins per barrier segment. However, installing the anchoring pin in a 4-inch thick asphalt pad can yield the required lateral restraint needed. Based on the findings of the dynamic pull tests, the pinned down anchored barrier design was developed for placement on a 4-inch thick asphalt pad.

The researchers performed finite element analyses to determine the performance of the pinned barrier system under *MASH* test 3-11 conditions. Analyses were performed with a 5000-lb pickup truck model impacting the barrier system restrained by two and three anchoring pins per barrier segment. Results of the FE analyses showed slightly better performance when three pins per segment were used to anchor the barrier. Furthermore, using three anchoring pins per barrier segment provided greater factor of safety against failure or cracking of asphalt, as well as variability in soil and asphalt properties in the field. The anchorage design with three pins per barrier segment was thus selected for further evaluation by full-scale crash testing.



Finite Element Model

A 151-ft test installation comprising of 12 barrier segments, connected using pin-and-loop connections, was built for *MASH* test level 3 testing. The barrier was placed adjacent to a 1.5H:1V slope at a lateral offset of 1 ft from the slope break point. The barrier was anchored using three 1.5-inch diameter, 48-inch long steel pins per barrier segment.

CMB pinned to asphalt

MASH test 3-11 was performed with a 2005 Dodge Ram 1500 pickup impacting the barrier at an impact speed and angle of 62.2 mi/h and 24.8 degrees, respectively. The test vehicle was successfully contained and redirected by the pinned down anchored barrier system. The pinned down anchored barrier design meets *MASH* test level 3 criteria. The maximum dynamic and static deflections of the barrier system were 17.8 inches and 17 inches, respectively.

Vehicle exiting pinned barrier

Pinned barrier and vehicle after test

Pinned barrier after test

Vehicle after test

SUMMARY AND CONCLUSIONS

As described in this report, the test installation was comprised of a 12-inch thick Type-A Grade-1 crushed limestone road base, over which a 4-inch thick asphalt pavement was constructed. This road base was primarily used to meet *MASH* requirements for the type of soil that should be used for testing, and to be able to compact the 4-inch thick asphalt pavement on top. In a field installation, it may not always be feasible to have a 12-inch thick road base. Furthermore, native soil conditions may vary from one site to another. It should be noted that the primary resistance to the deflection of the barrier comes from the asphalt pavement. While differences in soil properties underneath the asphalt layer can have some influence on the lateral deflection of the barrier, their effect is expected to be minimal as long as the sub-base is stable enough to roll and compact the asphalt pavement on top of it. Thus, smaller thickness of road base may also be used in combination with native soil if the sub-base can be stabilized to achieve proper compaction of the 4-inch thick asphalt pavement on top.

The barrier in this research was placed adjacent to a 1.5H:1V slope with a 12-inch offset from the slope break point. These design conditions were agreed by the Pooled Fund states at the start of the project. The slope should not be increased without additional testing and/or modifications to the anchoring design. Similarly, the 12-inch lateral offset from the slope break point should not be decreased without further evaluation through crash testing.

The length of the barrier segments used in the test installation was 12.5 ft. This is the minimum segment length of the portable concrete barriers used among the participating Pooled Fund states. While the design was developed using the smallest barrier segment length, it can also be extended for use with longer barrier segments by adding additional anchoring pins if needed. Based on an estimate of the number of pins needed per unit length of the barrier, a 15-ft barrier segment should not need an additional anchoring pin. A 20-ft segment length however will require a fourth anchoring pin (i.e. two pins equally spaced in the mid-span of the segment) to attain nearly the same level of anchorage.

FOR MORE INFORMATION:

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Research Supervisor:
Nauman M. Sheikh
Texas A&M Transportation Institute
Nauman@ttimail.tamu.edu

Pooled Fund Technical Rep.:
Dave Olson
Washington State Department of Transportation
Washington State
Department of Transportation
Olsonda@wsdot.wa.gov

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