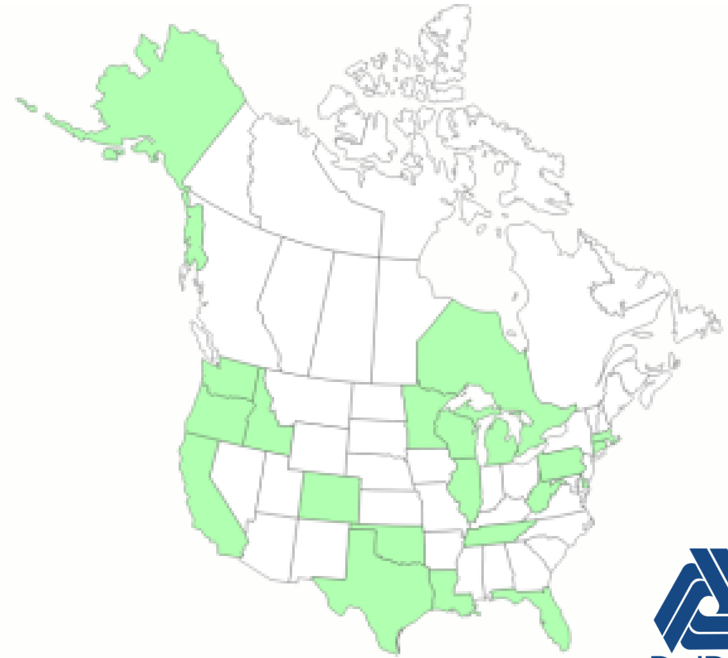
Pooled Fund Post

The Newsletter of the Roadside Safety Pooled Fund Program

http://www.roadsidepooledfund.org

DECEMBER 2017 VOLUME 4. NO.2



We had the pleasure this year of partnering with several new states including Colorado, Delaware, Oklahoma and our first international member, Ontario!

What's Inside

The objective of the Roadside Safety Pooled Fund Program is to provide a cooperative approach to conducting research on roadside safety hardware. Emphasis will be placed on assisting State DOTs with their implementation of MASH and addressing other roadside safety needs of common interest.

In November of 2017 TTI hosted a two-day annual pooled fund meeting in College Station, TX, with representatives from each of the DOTs members and FHWA. During the meeting important MASH implementation information was discussed, devices needing MASH testing were identified, and projects were prioritized for the upcoming year. The final list of projects is shown on the right.

2017 Pooled Fund Project Priorities

MASH Coordination Effort
Engineering Analysis to Support MASH Compliance
MGS with Reduced Post Spacing
Transitions to MGS with Reduced Post Spacing
MGS on Critical Flare
Transition from W-beam Median Barrier to Concrete Median Barrier
TL-4 Median Barrier Foundation
Pin-and-Loop Portable Concrete Barrier Pinned to Concrete
Treatment of Gaps in Concrete Barrier

Roadside Safety Pooled Fund

Texas A&M Transportation Institute

MASH Implementation Deadline

DECEMBER 31

As of **December 31, 2017** only safety hardware evaluated using the 2016 edition of MASH criteria will be allowed for new permanent installations and full replacements of W-Beam barriers and cast-in-place concrete barriers.

MASH Tested W-Beam Barriers

	G4(1S) W-Beam Median Barrier	Failed 27-in tall with W6x8.5 steel posts spaced at 6-ft 3-in in G4 W-Beam median barrier	Non-proprietary
	Modified G2 Weak Post Guardrail	32-in tall 12 gauge W-Beam guardrail with S3x5.7 steel posts spaced at 12-ft on center	Non-proprietary
	...sed Span Length for ...pan ...tem	31" high MGS long-span guardrail with unsupported spans greater than 25 ft	Non-proprietary

See [MASH DATABASE](#)
For a complete list of tested hardware !

MASH Tested Cast-In-Place Barriers

	New Jersey Safety Shape Barrier (TL-4)	Failed TL-4 32-in New Jersey shape bridge rail	Non-proprietary
	Signs Placed on Concrete Median Barriers	Crashworthy hardware and placement guidelines for placement of signs or light poles mounted on top of barriers	Non-proprietary
	32" New Jersey Safety Shape Barrier (TL-3) (pickup truck test)	32-in New Jersey shape bridge rail	Non-proprietary

Hardware Examples:

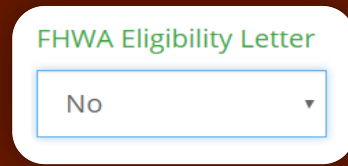
Strong-Post W-Beam Guardrail with 25" Height (TL-2)

32" New Jersey Safety Shape Barrier (TL-3)

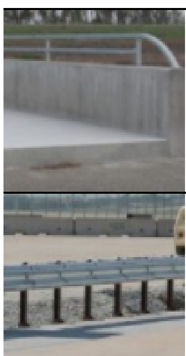
31" W-Beam Median Barrier (TL-3)

MASH Database

The MASH crash test database provides a running list of MASH testing of roadside safety hardware. The user friendly search engine allows hardware to be filtered by device types, test level, hardware with eligibility letter, and if it is proprietary or not.



Devices without Eligibility



Hardware Tested

The information provided in this database is for reference only. It is the responsibility of the ... the selected system meets current Federal eligibility and safety requirements.

To filter available hardware devices, select the type of device, test level, eligibility letter, and if the device is proprietary/non-proprietary. If there are options available for the device selected they will appear ... Results are displayed below and can be selected for more information.

Device Types: -Bridge Railing

Test Level: All

FHWA Eligibility Letter: All

Proprietary/Non-proprietary: All

Bridge Railing Options

Height: 19.75, 31, 32, 32.75, 33, 33.1, 36, 39, 46, 48, 49.25

Material: Combination, Concrete, Steel, Timber

Combo (Veh/Ped): Yes, No

	Title	Description	Proprietary/ Non proprietary
	Caltrans Type 732SW Bridge Rail	Type 732SW bridge rail is a vertical, reinforced concrete wall on a sidewalk with a pedestrian steel tubular handrail or chain link fence on top (TL-2).	Non-proprietary
	MGS Bridge Rail	31-inch Midwest Guardrail System (MGS) Bridge Rail	Non-proprietary

The MASH database contains information on MASH tested hardware collected at a National level.

FAILED TESTS

- Have questions about the MASH Crash Test Database?
- Have test information you want to share with us?

Who to Contact

Chiara S. Dobrovolny—TTI
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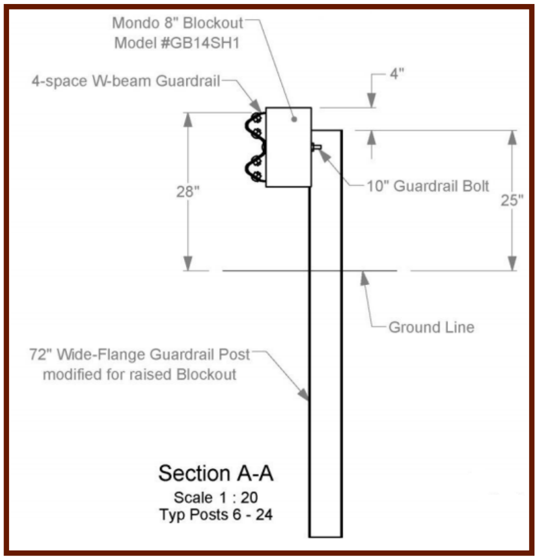
Jeff Petterson—WsDOT
Email: PetterJ@wsdot.wa.gov

VOTE

The MASH database is used to help generate the pooled fund scorecards. Each Scorecard refers to one or multiple roadside safety categories based on the MASH Implementation Plan deadlines . The DOTs review and "score" each entry based on their interest in adopting/ maintaining each device through their MASH Implementation State Plan.

PROJECTS

28-IN. W-BEAM GUARDRAIL SYSTEM WITH 8-IN. COMPOSITE BLOCKOUTS RAISED 4 IN. ON STEEL POSTS



Details for the 28-inch W-Beam Guardrail System with Raised Composite Blockouts

TTI Researcher : Chiara Silvestri Dobrovolny, Ph.D.

Technical Representative: Ali Hangul, P.E. Tennessee DOT

FINAL REPORT

The purpose of this testing study was to assess the performance of the 28-inch W-beam guardrail system with 8-inch composite blockouts raised on steel posts according to MASH test 3-11.

The 28-inch system performed acceptably for MASH Test 3-11, with a maximum vehicle roll and pitch angles of 32 degrees and 12 degrees, respectively.

28" W-Beam System with Raised Composite Blockouts prior to Testing

For the test conducted in this study, a guardrail height of 28 inches was chosen, and rail splices were positioned on posts. These selections represent the worst case condition for testing. Taller rail heights, offset rail splices, and raising of the blockout less than 4 inches are considered acceptable based on the results of this more critical test. The practice can be used to raise the height of a deficient guardrail to an acceptable height (i.e., 28 inches or greater), or could be used to raise the height of existing guardrail to improve performance (e.g., 31-inch rail height).

Ongoing Project:
Single Slope Concrete Barrier in 1-inch Asphalt

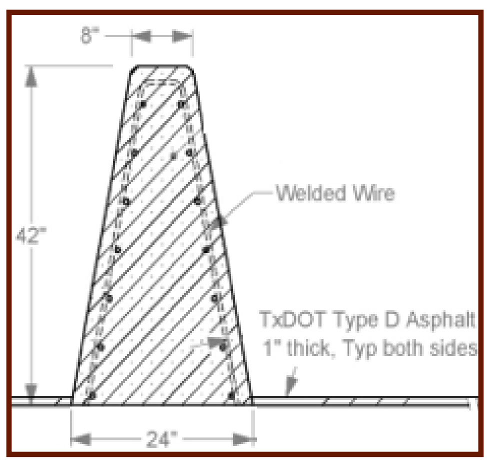
TTI Researcher : Roger Bligh, Ph.D., P.E.

Technical Representative: Wade Odell, P.E.; Ken More, P.E., Chris Lindsey, P.E., TxDOT

The purpose of this test study was to assess the performance of the TxDOT 42-inch tall SSCB with 1-inch ACP lateral support according to AASHTO *MASH* TL-4. The system contained and redirected the vehicle which remained upright during and after the collision event . The 42" SSCB with 1-inch ACP lateral support performed acceptably for MASH Test 4-12.

TxDOT 42" SSCB with 1" ACP prior to testing

As part of the testing program, it was necessary to establish a minimum segment length for the evaluation of the 1-inch ACP overlay. A minimum segment length of 75 ft was selected in consultation with TxDOT and is the length that was successfully tested. Cast-in-place segment lengths greater than or equal to 75 ft will provide more resistance to sliding and rotation and are, therefore, considered acceptable. Shorter segments lengths will require additional lateral resistance (e.g., dowels across the joint to the longer segment length) unless further testing and evaluation is performed.



Details of TxDOT 42" SSCB with a 1" ACP

MASH EQUIVELENCY OF NCHRP REPORT 350 - APPROVED BRIDGE RAILS



NCHRP funded research study NCHRP 20-07/Task 395 “MASH Equivalency of NCHRP 350-Approved Bridge Railings” to determine which rail systems need to be retested to MASH criteria and which, if any, can be "grandfathered" based on evaluation under previous criteria.

The objectives of this research were to: (1) prioritize bridge railings including concrete barrier, (2) determine MASH equivalent test levels, and (3) determine whether individual types of bridge railing can be considered MASH compliant or if additional testing is needed.

Global Test Equivalency

The researchers developed global test equivalencies for NCHRP 350 bridge rail systems, which are summarized in the table below.

NCHRP 350 Rail System Type	MASH Test Level			
	TL-2	TL-3	TL-4	TL-5
Solid Concrete Parapet	TL-2	TL-3 TL-4		TL-5
Concrete Beam-and-Post	TL-2 TL-3 TL-4			TL-5
Metal Beam-and-Post Deck Mounted	TL-2 TL-3 TL-4			TL-5
Metal Beam-and-Post on Curb	TL-2 TL-3 TL-4			TL-5
Metal Beam-and-Post on Concrete Parapet*	TL-2	TL-3 TL-4		TL-5

Summary of Global Test Equivalency for NCHRP 350 Bridge Rail Systems

Rail Specific Analysis

In addition, the researchers developed a “rail specific” analysis methodology for different bridge rail categories and used it to analyze the highest ranked rail systems in these categories. As part of this effort, three key criteria were explored: **stability**, **strength**, and **geometrics**.

Stability relates to all of the characteristics of the barrier that effect vehicle stability, such as barrier height, barrier shape, and barrier stiffness. Researchers developed a guideline for minimum height requirements for MASH TL-3 through 5, as reported in the Table to the right.

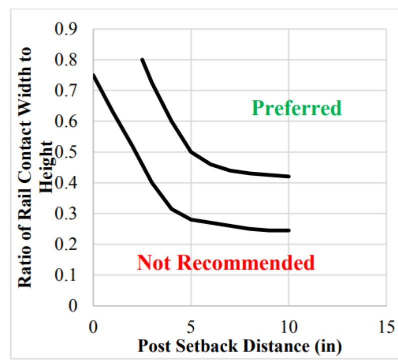
MASH Test Level	Minimum Height (in.)
TL-3	29
TL-4	36
TL-5	42

Minimum Height Requirements for MASH TL-3, TL-4 and TL-5

The **strength** category relates to the barrier’s ability to effectively contain and redirect the vehicle as well as preventing the vehicle from penetrating through the barrier.

Section 13 of the AASHTO LRFD Bridge Design Specifications contains procedures for analyzing the structural capacity of different types of bridge railings (e.g., steel, concrete). Using these procedures, an analysis of the strength of the rail system was performed.

The **geometric relationships** for bridge railings contained in Section 13 AASHTO LRFD Bridge Design Specifications were applied to evaluate the rail geometry. These relationships pertain to the potential for wheel, bumper or hood snagging on elements of the bridge rail system. For each bridge rail system, post setback distance, ratio of contact width to height, and vertical clear opening were determined or calculated and plotted against the current AASHTO LRFD Section 13 geometric criteria (above). MASH crash tests performed to date were used to determine the applicability of the geometric criteria to different bridge rail categories.



Recommendations: Researchers analyzed various prioritized bridge rail systems and assessed their compliance with MASH based on the adopted methodology.

As part of this study, the researchers developed supporting material and engineering justification for MASH compliance of MASH bridge railings for use by state DOTs.

Criteria	Assessment
Stability	Satisfactory
Rail Geometrics	Satisfactory
Strength	Satisfactory

TTI Researcher : Roger Bligh, Ph.D., P.E.

NCHRP Project Manager: Waseem Dekelbab, PhD, PE, PMP, NCHRP Senior Program Officer.

Participating Partners

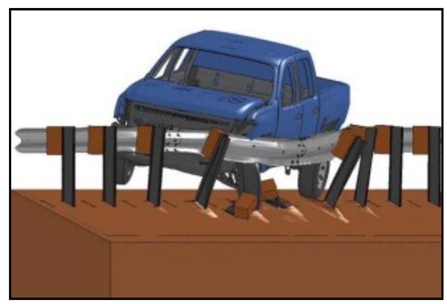
ALASKA DOT
CALIFORNIA DOT
COLORADO DOT
CONNECTICUT DOT
DELAWARE DOT
FLORIDA DOT
IDAHO DOT
ILLINOIS DOT
LOUISIANA DOT
MASSACHUSETTS DOT
MICHIGAN DOT
MINNESOTA DOT
OKLAHOMA DOT
OREGON DOT
ONTARIO Ministry of Transportation
PENNSYLVANIA DOT
TENNESSEE DOT
TEXAS DOT
WASHINGTON STATE DOT
WISCONSIN DOT
WEST VIRGINIA DOT
FEDERAL HIGHWAY ADMINISTRATION
TEXAS A&M TRANSPORTATION INSTITUTE

- Roadside Safety Pooled Fund

TTI Proving Grounds Research Facility

Crash Testing

Bogie Test Vehicle



Finite Element Analysis Simulation

The Proving Grounds Research Facility, a 2,000 acre complex, enables researchers to conduct experiments and testing with the ultimate goal of improving transportation safety. This site has large expanses of concrete runways and parking aprons well suited for experimental research and testing in the areas of vehicle performance and handling, vehicle-roadway interaction, durability and efficacy of highway pavements, evaluation of roadside safety hardware, and connected and automated vehicles.

ISO 17025

TTI Proving Ground is an International Standards Organization (ISO) 17025 accredited laboratory with American Association for Laboratory Accreditation (A2LA) Mechanical Testing Certificate 2821.01.

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Roadside Safety Pooled Fund

TPF

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