RESEARCH NOTES
THE ROADSIDE SAFETY RESEARCH GROUP
January 2011

Development of Weed Control Barrier Beneath Metal Beam Guardrail

***RESULTS:* A new, cementitious weed barrier for use around metal beam guardrail was developed and crash tested in an effort to meet National Highway Safety Research Program (NCHRP) Report 350 Test Level 3 criteria for longitudinal barriers. This cementitious weed barrier, known within Caltrans as CRMCrete, was successfully crash tested and has been recommended for operational use.**

Why We Pursued This Research

Weed growth beneath metal beam guardrail systems is a problem because it is unsightly and the dry weeds can provide enough fuel to become the starting point of a larger brush or wild land fire. Various techniques for controlling weeds have been tried and range from physical barriers, such as weed mats and asphalt concrete, to the use of herbicides to kill weeds.

Caltrans currently uses either herbicides, mechanical methods or miscellaneous asphalt concrete (AC) to control weeds beneath metal beam guardrail. The use of herbicides is being reduced due to environmental concerns. Worker exposure and cost are also significant issues for both herbicide and mechanical weed control. Placement of miscellaneous AC beneath guardrail works well until the AC cracks and the weeds grow through it. A more effective, less costly, crashworthy method of weed control beneath guardrail is needed. A non-proprietary cementitious product that is more durable than miscellaneous AC has been introduced and can be placed under guardrail to physically block weed growth but it was unknown how this material would affect the performance of guardrail posts.

Figure 1 – CRMCrete Beneath Metal Beam Guardrail (Test 659)

Sal Torres of Caltrans District 2 developed this material and dubbed it CRMCrete because it is comprised of ordinary concrete mixed with recycled scrap tire crumb rubber. If successful, this product will serve as a weed barrier and as an additional use for scrap tire rubber.

The objective of this project was to determine whether this cementitious material can be placed beneath metal beam guardrail to prevent weed growth yet still allow the guardrail posts to move as necessary for the system to comply with National Cooperative Highway Research Program Report 350 (NCHRP Report 350) Test Level 3 criteria for longitudinal barriers.

What We Did

To minimize the chance of the CRMCrete inhibiting post rotation, “leave-out” areas were created around the posts. The “Leave-out” is a weakened section in the immediate vicinity of the posts to allow the posts to rotate and dissipate energy during an impact. A series of dynamic tests were conducted in which a bogie (surrogate test vehicle) was run head-on into various posts at 32 km/h for comparative purposes. Two tests were performed first on two posts without weed control barrier to establish a baseline for post performance. Four bogie tests were then performed on two different configurations of weed control barrier. Finally, a full-scale crash test with a ¾-ton pick-up truck (2000P) impacting steel-post metal beam guardrail with the best-performing CRMCrete configuration was conducted to ensure compliance with NCHRP Report 350 but it resulted in vehicle rollover. The bogie tests and first full-scale test utilized rubber “boots” in the leave-out areas. A second full-scale test (Test 659) was then conducted on a modified test article, this time utilizing Expanded Polystyrene Foam in the leave-outs (see Figure 1). This second test was successful and met the requirements of Report 350. The impact with the test article did not produce excessive pitch, roll, yaw, deceleration, or occupant compartment deformation of the vehicle. All full-scale testing was done in accordance with NCHRP Report 350, Test Level 3, for longitudinal barriers. With the exception of the CRMCrete installed around the post bases, the steel-post metal beam guardrail test articles were installed according to Caltrans 2006 Standard Plan A77A2.

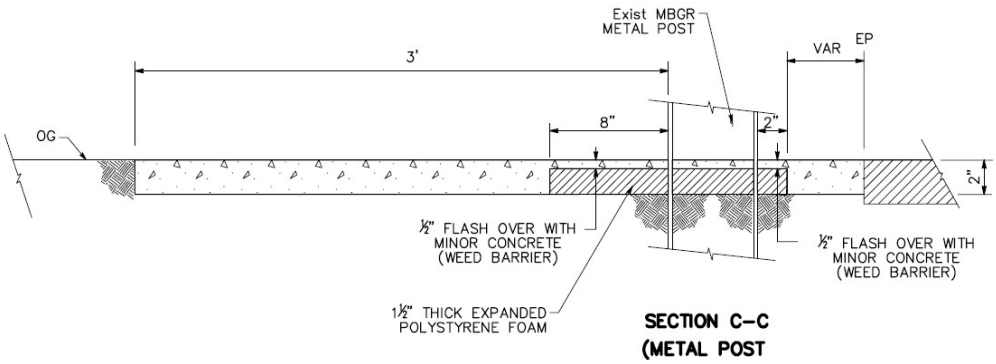

Figure 1 – Test 659 Test Article CRMCrete Configuration

Figure 2 – Test 659 Vehicle Pre-Impact

The pickup (2000 kg) was self-powered and a speed control device limited acceleration once the impact speed was reached. Steering was accomplished by means of a guidance rail anchored to the ground. A short distance before the point of impact, the pickup was released from the guidance rail. Remote braking was possible at any time during the test by means of radio control.

Figure 3 – Test 659 Vehicle Post-Impact

Figure 4 – Test 659 W-Beam Guardrail Post-Impact

In order to improve control and safety of test vehicles, additional modifications were implemented. The first modification was substituting a safety fuel tank for the stock fuel tank. Also, gaseous carbon dioxide was added to the stock fuel tank in order to purge the gas vapors and eliminate oxygen.

Other equipment added to the test vehicles included one pair of 12 V, wet cell batteries to run the additional equipment, accelerator switch to actuate the pneumatic ram attached to the gas pedal, ignition cut-out module to regulate the speed of the vehicle, microswitch to control the ignition circuit, and a 4800-kPa carbon dioxide system to control brake and gas pedals, as needed.

What Can Be Concluded

NCHRP Report 350 stipulates that crash test performance is assessed according to three evaluation criteria: 1) Structural Adequacy, 2) Occupant Risk, and 3) Vehicle Trajectory. The Test 659 Test Article rated acceptable in all these categories. For Structural Adequacy, there was damage to the leave-out areas, the posts, and to the W-beam element. The damage was as expected. For Occupant Risk, there was only minor wheel-snagging on the posts which resulted in the front left tire becoming detached from the vehicle. However, this did not result in any significant occupant risk. Occupant compartment deformation was also within the maximum allowed by FHWA. The Occupant Impact Velocities and Ridedown Accelerations were well within the limits of NCHRP Report 350. Finally for Vehicle Trajectory, the test vehicle remained relatively straight after impact, despite losing a tire. Therefore, Test 659 Test Article meets the requirements of NCHRP Report 350 Test Level 3 for longitudinal barriers.

What the Researchers Recommend

CRMCrete Weed Barrier with Expanded Polystyrene Foam used around guardrail posts is recommended for use on high-speed highways at Test Level 3. Please refer to the project final report for conditions and details of use. FHWA has provided a letter of acceptance for the CRMCrete weed barrier for use on the National Highway System (HSSI/B-205, 12/7/2010).

For more information about this research and other Roadside Safety Research Projects contact:

David Whitesel, P.E.
(916) 227-5849
david.whitesel@dot.ca.gov

John Jewell, P.E.
(916) 227-5824
john.jewell@dot.ca.gov

Bob Meline, P.E.
(916) 227-7031
bob.meline@dot.ca.gov