



U.S. Department  
of Transportation  
**Federal Highway  
Administration**

1200 New Jersey Avenue, SE  
Washington, D.C. 20590

In Reply Refer to: HSSD/B-202

Dr. Ronald K. Faller  
Research Assistant Professor  
527 Nebraska Hall  
P.O. Box 880529  
Lincoln, NE 68588-0529

Dear Dr. Faller:

This letter is in response to your request for the Federal Highway Administration (FHWA) acceptance of a roadside safety system for use on the National Highway System (NHS).

Name of system: TL-2 Rough Stone Masonry Guardwall  
Type of system: Longitudinal Barriers-Aesthetic Barriers  
Test Level: TL-2  
Testing conducted by: Midwest Roadside Safety Facility  
Task Force 13 Designator: [FHWA will fill in this info]  
Date of request: August 13, 2009  
Date of completed package: January 13, 2010  
Request initially acknowledged: September 18, 2009

You requested that we find this system acceptable for use on the NHS under the provisions of the National Cooperative Highway Research Program (NCHRP) Report 350 "Recommended Procedures for the Safety Performance Evaluation of Highway Features."

### **Requirements**

Roadside safety devices should meet the guidelines contained in the NCHRP Report 350 or the American Association of State Highway and Transportation Officials' Manual for Assessing Safety Hardware (MASH). The FHWA Memorandum "Identifying Acceptable Highway Safety Features" of July 25, 1997, provides further guidance on crash testing requirements of longitudinal barriers.

### **Description**

The Rough Stone Masonry Guardwall system consists of three main subsystems: (1) the reinforced concrete foundation slab; (2) the inner reinforced concrete core wall; and (3) the rough masonry façade and attachment system.



The reinforced concrete foundation slab is 9 inches thick and is laid on top of a 6-inch thick compacted crushed aggregate base. The top of the slab is positioned 6 inches below the traveled way. In the slab both bent and straight bars are used, as shown in Enclosure 1. A reinforced concrete core wall is constructed on top of the foundation slab. The core wall is rigidly attached to the slab using the vertical steel reinforcing bars which extended out of the slab. Weep holes are placed transversely through the parapet as shown in drawing RSMG-1v15, sheet 14 of 15, of Enclosure 1.

The 7 inch thick rough stone material is attached to the inner core wall using: (1) a mortar bed on the front and top faces of the inner core wall as well as a narrow region on the surface of the slab foundation; (2) Dovetail Anchor Slots with Dovetail Anchor ties on the front surface of the core wall; (3) Dovetail Anchor Ties wedged under the steel angles that are anchored to the top surface of the core wall; (4) stainless steel, Z-clips attached to the top surface of the core wall using masonry anchors; and (5) ASTM A36 steel angles attached to the top surface of the core wall using Wedge-bolt Screw Anchors with the upper angle leg extending into kerf cut into the bottom side of the top capstone with the void space filled with mortar. The nominal top of the guardwall is 22 inches from the traveled way. Enclosure 1 illustrates the design details and general layout of the rough stone masonry guardwall.

The above description is associated with the single-face rough stone masonry guardwall. Enclosure 2 shows design details and general layout of double-face rough stone masonry guardwall. The double-face rough stone masonry guardwall is structurally similar to the single-face guardwall (which was described above) but the stones are attached to both sides of the core wall. This type of wall is used where aesthetic appearance is deemed necessary for both sides of the wall (e.g. median).

### **Crash Testing**

The single-face 22 inch rough stone masonry guardwall was crash tested by Midwest Roadside Safety Facility according to NCHRP 350 Test 2-11. The rough stone masonry guardwall was also crash tested according to Test 2-11 where the test article was buried 2 inches deeper. In the latter test the top of the wall was 20 inches above the traveled way. Enclosure 3 shows the cross section of the end section detail view associated with the second test article.

### **Findings**

According to NCHRP 350, Test 2-10 and Test 2-11 are to be conducted for longitudinal barriers for Test Level 2 approval. The 22 inch rough stone masonry guardwall was crash tested according to Test 2-11 which involves a 2000 kg pickup truck colliding with barrier at a speed of 70 km/h and at an angle of 25 degrees. The test article successfully passed the test and Enclosure 4 summarizes the results of this test.

The 20 inch rough stone masonry guardwall was also crash tested according to Test 2-11 and the test article successfully passed the test as can be seen in the summary sheet shown in Enclosure 5. However, black contact marks and scratches on the vertical face of the guardwall found in the post-crash investigation of the second test revealed that the guardwall was overridden by the test vehicle. Consequently, the rough stone masonry guardwall system is to be implemented with a nominal top mounting height of 22 inch relative to the traveled way. This configuration allows for a construction/operational height reduction tolerance of 2 inches.

The second test shows that the rough stone masonry guardwall system described in this letter cannot be used where the nominal height of the parapet relative to the traveled way is less than 20 inches.

Test 2-10 involves an 820 kg small passenger car impacting the barrier at a speed of 70 km/h and at an angle of 25 degrees. Based on previous crash tests successfully conducted on similar barriers with a small car, we concur with the University of Nebraska Researchers that Test 2-10 is not critical and the completion of the test is not necessary if the wall is constructed vertically according to the enclosed design drawings.

Regarding the texture of the rough stone masonry surface, the masonry wall can have the maximum projections up to 38 mm beyond the neat line, 50 mm deep raked joints, and beds 50 -75 mm thick. These constraints are imposed according to Stone Masonry Guardwall-Design and Construction Notes for Aesthetic Barriers dated May 15, 2002, ([http://www.efl.fhwa.dot.gov/files/technology/abs/StoneMasonry/design-notes/stone\\_descon.pdf](http://www.efl.fhwa.dot.gov/files/technology/abs/StoneMasonry/design-notes/stone_descon.pdf)) in order to prevent snagging of vehicles and/or excessive occupant compartment intrusion.

In your letter you also requested acceptance for the double-face rough stone masonry guardwall. Your request is acceptable on the grounds that a layer of rock attached to the other side of the core wall does not degrade the performance of the system.

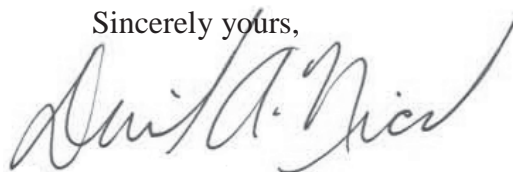
Therefore, the system described above and detailed in the enclosed drawings is acceptable for use on the NHS under the range of conditions tested, when such use is acceptable to a highway agency.

Please note the following standard provisions that apply to FHWA letters of acceptance:

- This acceptance is limited to the crashworthiness characteristics of the systems.
- Any changes that may adversely influence the crashworthiness of the system will require a new acceptance letter.
- Should the FHWA discover that the qualification testing was flawed, that in-service performance reveals unacceptable safety problems, or that the system being marketed is significantly different from the version that was crash tested, we reserve the right to modify or revoke our acceptance.
- You will be expected to supply potential users with sufficient information on design and installation requirements to ensure proper performance.
- You will be expected to certify to potential users that the hardware furnished has essentially the same chemistry, mechanical properties, and geometry as that submitted for acceptance, and that it will meet the crashworthiness requirements of the FHWA and the NCHRP Report 350.
- To prevent misunderstanding by others, this letter of acceptance is designated as number B-202 and shall not be reproduced except in full. This letter and the test documentation upon which it is based are public information. All such letters and this acceptance letter shall not be construed as authorization or consent by the FHWA to use, manufacture, or sell any

patented system for which the applicant is not the patent holder. The acceptance letter is limited to the crashworthiness characteristics of the candidate system, and the FHWA is neither prepared nor required to become involved in issues concerning patent law. Patent issues, if any, are to be resolved by the applicant.

Sincerely yours,

A handwritten signature in black ink, appearing to read "David A. Nicol". The signature is fluid and cursive, with a large, sweeping flourish at the end.

David A. Nicol  
Director, Office of Safety Design  
Office of Safety

5 Enclosures