December 21, 2000

Refer to: HSA-1/B-75

Mr. Kaddo Kothman
President
Road Systems, Inc.
P.O. Box 2163
Big Spring, Texas 79721

Dear Mr. Kothman:

Your July 26 letter to Mr. Dwight A. Horne, former Director of the Office of Highway Safety Infrastructure, was forwarded to me for a response. Mr. Richard Powers of my staff reviewed this request for acceptance of a 14-gauge w-beam as a National Cooperative Highway Research Program (NCHRP) Report 350 test level 3 (TL-3) traffic barrier when used with a standard wood or steel strong post barrier system. The only difference in your design from the modified G4-1S guardrail (which uses 150 mm x 200 mm routed wood blockouts in place of steel blockouts) was the use of a thinner w-beam rail element. A July 2000 report prepared by the Southwest Research Institute entitled "Full-Scale Crash Evaluation of a 14-Gauge W-Beam G4-1S Guardrail System" contained information on a successful test of a 2000-kg pickup truck impacting the barrier at 100.6 km/h and at an impact angle of 24.2 degrees. All Report 350 evaluation criteria were met. Maximum dynamic rail deflection was 820 mm.

Upon request, Dr. Dean Sicking, Director of the Midwest Roadside Safety Facility in Lincoln, Nebraska, provided Mr. Powers additional information on the proposed thickness specification of the 14-gauge rail element and on its mechanical properties.

In his October 11 letter, Dr. Sicking recommended a ***minimum*** rail thickness (before galvanizing) of 1.90 mm. For comparison, the specified nominal thickness of a standard 12-gauge rail is 2.67 mm. This reduction in cross-sectional area of approximately 29 percent will lower the torsional stiffness of the rail element. Although the reduced thickness did not appear to be detrimental to barrier performance in the crash test with the 2000-kg pickup truck, it could come into play with smaller vehicles that contact the lower portion of the w-beam in an impact. However, since this office has accepted other longitudinal traffic barriers as meeting Report 350 evaluation criteria with only the pickup truck test, we will not require the small car test, but suggest you consider running it to verify acceptable performance with the 820-kg vehicle.

On December 14, Mr. Powers received via facsimile transmission from Dr. Sicking, a mill certification indicating that the yield strength of the tested rail was 63.5 ksi and its tensile strength

was 71 ksi. These values are within the range set by the American Association of State Highway and Transportation Officials M-180 standard specification for corrugated sheet steel for guardrails.

Since the strong-post w-beam installation with the 14-gauge rail element met Report 350 requirements for a TL-3 design with the pickup truck, this system may be considered acceptable for use on the National Highway System (NHS) when such use is requested by the appropriate highway authority. This acceptance applies to use of the 14-gauge rail element only for the barrier proper, and not for its use in transitions or guardrail terminals. However, I cannot recommend its use on high-speed NHS routes without serious reservations. Since the adoption of Report 350 test procedures, there have been some controlled crash tests in which a standard 12-gauge rail element ruptured completely or began tearing at a splice location or at a post. For example, one 12-gauge w-beam guardrail section ruptured during a full-scale crash test with a mid-size automobile. Some researchers believe this failure apparently occurred when the w-beam guardrail deformed around a stiff structural component on the vehicle frame. The localized deformation in the rail extended to the splice, allowing the rail to tear on the end of the down-stream rail element. The resistance of a guardrail to this type of local deformation is proportional to the square of the rail thickness. Therefore, the likelihood of this type of failure would be expected to increase as rail thickness is reduced, regardless of the rail shape. Additionally, there have been anecdotal reports from at least one State highway agency indicating rupture failures in new 12-gauge guardrail installations. Most experts in the field of barrier design believe that a 12-gauge w-beam rail on a strong post system is very near its upper performance limits in severe crashes. Thus, I believe that the reduced cost of a thinner rail element is offset by the increased level of risk associated with its use. A highway agency which elects to use any light gauge w-beam guardrail should monitor its in-service performance carefully to ensure that barrier performance is not compromised.

Sincerely yours,

(original signed by Frederick G. Wright, Jr.)

Frederick G. Wright, Jr.
Program Manager, Safety