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

August 21, 2009

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

In Reply Refer To:
HSSD/B-194

Mr. Robert Meline
Roadside Safety Research Group
California Department of Transportation
5900 Folsom Blvd
Sacramento, CA 95819

Dear Mr. Meline:

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

Name of system: California Type 90 Concrete Bridge Rail
Type of system: Steel Post and Beam mounted on Concrete Curb
Test Level: Test Level 4 (TL-4)
Testing conducted by: Roadside Safety Research Group, California Department of Transportation
Date of request: January 20, 2009

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

Requirements
Roadside safety systems should meet the guidelines contained in the NCHRP Report 350, "Recommended Procedures for the Safety Performance Evaluation of Highway Features". FHWA Memorandum "ACTION: Identifying Acceptable Highway Safety Features" of July 25, 1997, provides further guidance on crash testing requirements of longitudinal barriers.

Description
The bridge rail is a steel post and beam system atop a concrete curb that has a reverse-slope of 5.2 degrees. This design raises the reaction point of impacting vehicles which reduces roll. The concrete curb is 550 mm (21 1/2 inches) high, 500 mm (19 1/2 inches) wide at the top, and

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450 mm (17 3/4 inches) wide at the base. The top of the steel rail is 925 mm (36 1/2 inches) above the travel way. The steel rail consists of 254 x 102 x 6.4 mm (10 inch x 4 inch x 1/4 inch thick) tube steel welded to 178 x 127 x 7.9 mm (7 inch x 5 inch x 5/16 inch) tube steel posts spaced 3 m (10 feet) apart. Two 6-mm (1/4 inch) thick steel plates are welded to the backside of the rail and the back of each post to add stiffness to the post-rail connection. The posts are welded to a base plate that is rigidly attached to the concrete curb with anchor rods cast into the curb. See attached design drawings.

Crash Testing

The California Type 90 Concrete Bridge Rail was crash tested by Roadside Safety Research Group, California Department of Transportation. The barrier had some permanent damage. The vehicle lug nuts and rims caused gouging and spalling of the top of the concrete curb from just upstream of the initial impact point to where the rear tire lost contact with the rail, about 4.5 m downstream of the impact point. At posts 3 and 4 the spalling extended to the front edge of the post base plate. The gouging and spalling were superficial and not structural as evidenced by the lack of exposed reinforcement bars. In addition, there was minor weld cracking at Post 3 (the post nearest the impact location) where the post was attached to the base plate. The welds were cracked approximately 6 mm on each side of all four corners, with a 0.05-mm gap at the crack locations. The center of the base plate was also bent upwards on the traffic and upstream sides, with the maximum deformation of 5 mm (1/5 inch) occurring on the traffic side. Additionally, the steel rail had a permanent lateral deflection of less than 15 mm (3/5 inches).

Findings

We concur that the California Type 90 Concrete Bridge Rail meets all barrier structural adequacy and vehicle trajectory criteria as outlined in NCHRP Report 350 and is acceptable for use on the NHS as a TL-4 barrier when allowed by the 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 system and does not cover their structural features, nor conformity with the Manual on Uniform Traffic Control Devices.
- 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-171 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 documentation may be reviewed at our office upon request.
- 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,

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

Enclosures

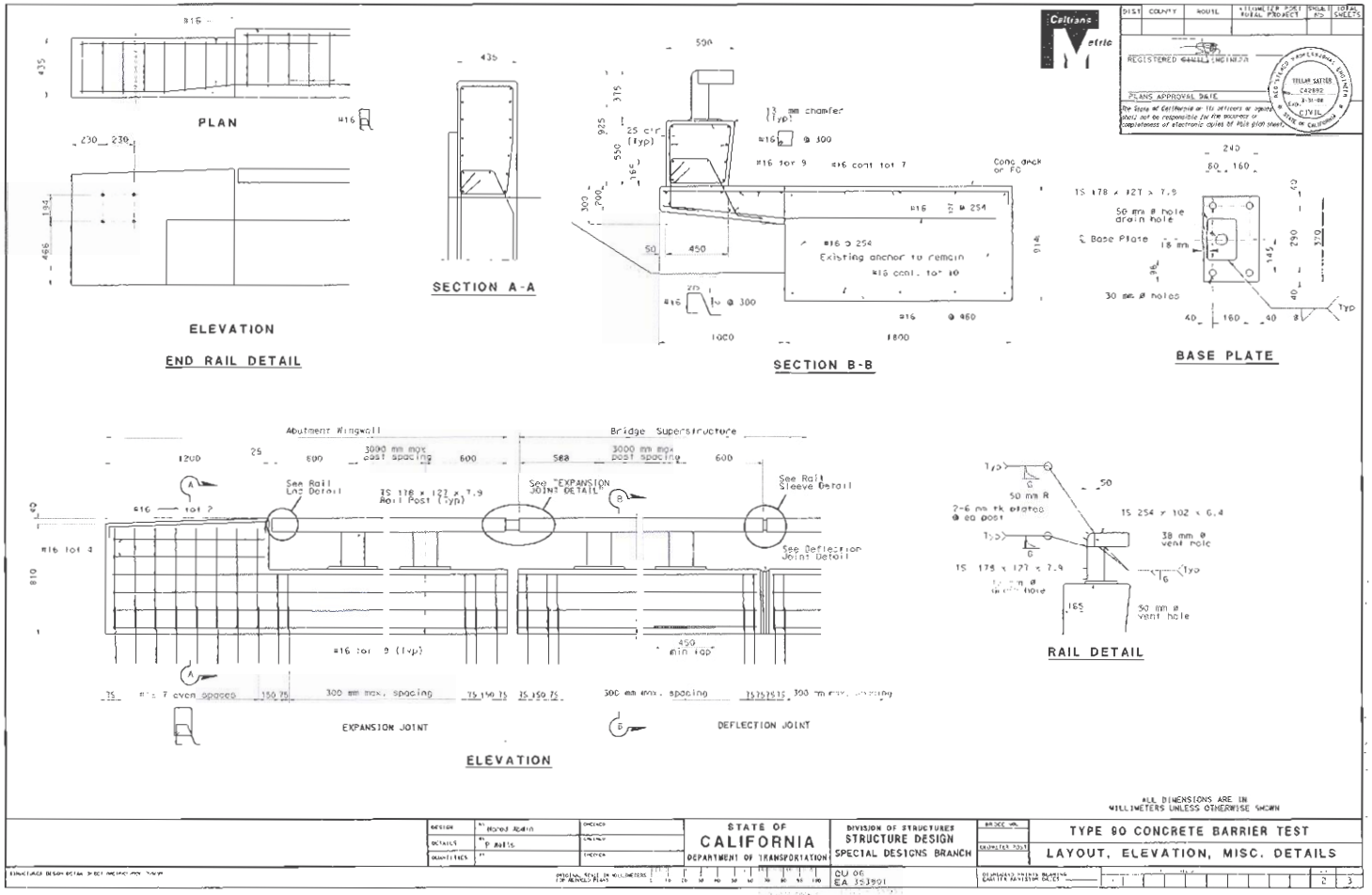


Figure 7-20 – Type 90 Details

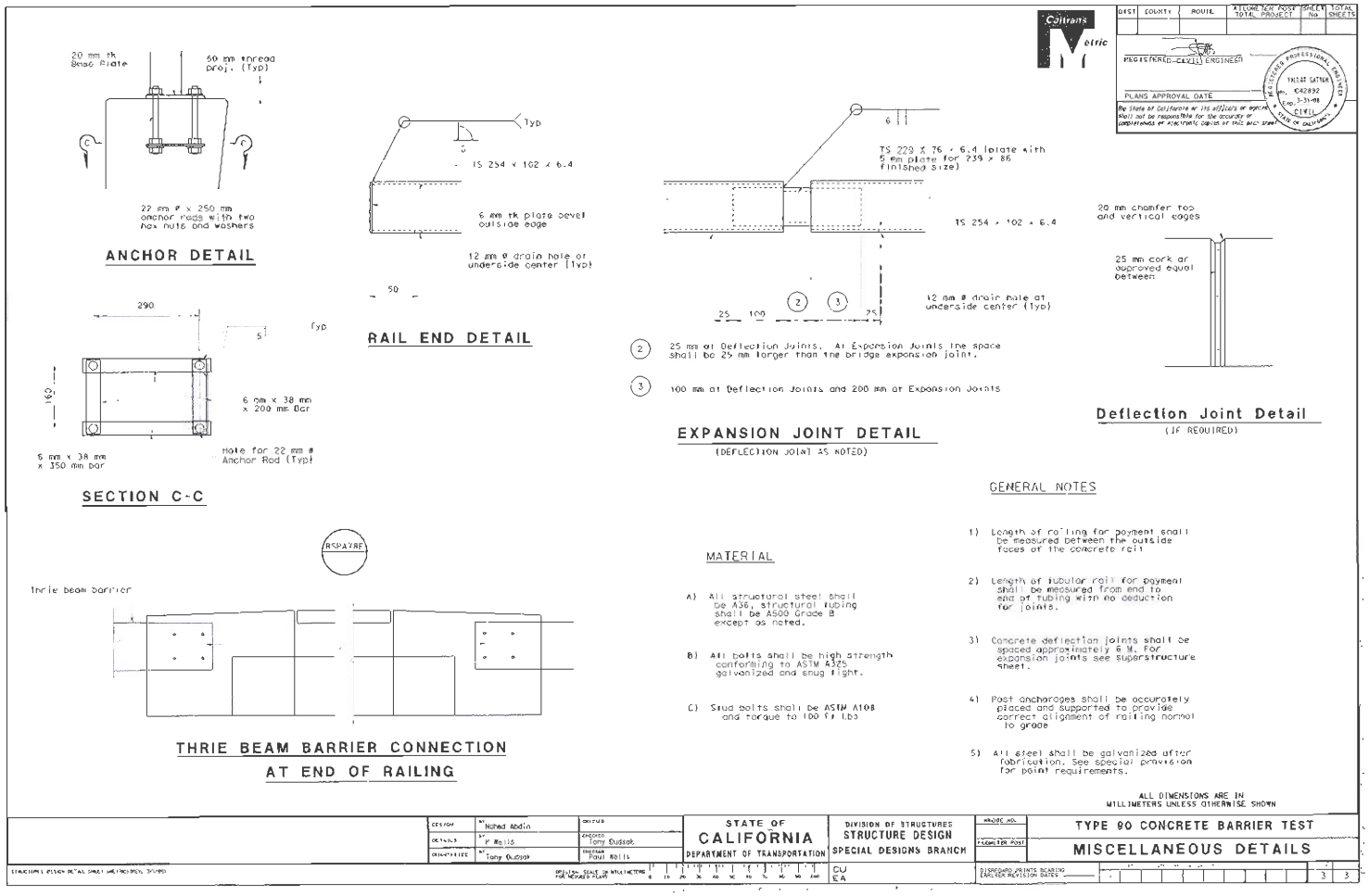
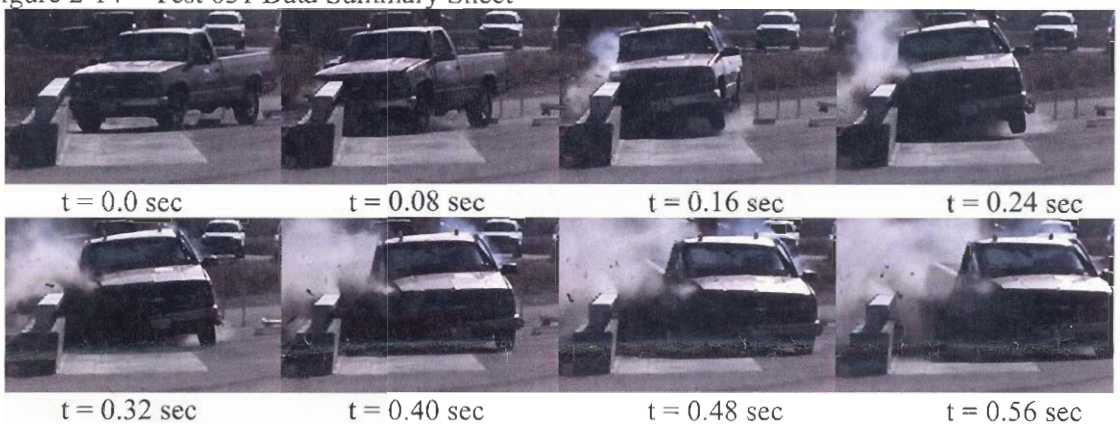
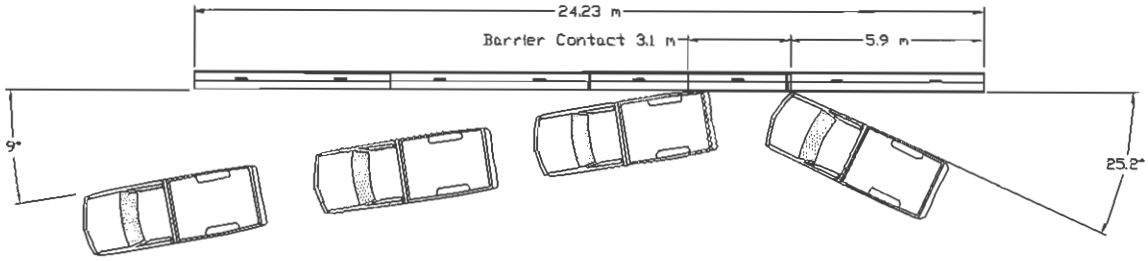


Figure 7-21 – Cross section and attachment detail for the Type 90

Figure 2-14 – Test 631 Data Summary Sheet





Test Barrier

Type: Type 90 bridge rail

Length: 24.23 m, total length consisting of 4 segments of about 6 m each.

Test Date: November 1, 2006

Test Vehicle:

Model: 1997 Chevrolet 2500

Inertial Mass: 2029 kg

Test Dummy:

Type: None used

Weight/ Position: N/A

Impact/ Exit Conditions:

Impact / Exit Velocity: 100.5 km/h / 78.3 km/h

Impact / Exit Angle: 25.2° / 9°

Impact Severity: 141.9 kJ

Test Data:

Occ. Impact Velocity (Long / Lat): 6.20 m/s / 8.17 m/s

Ridedown Acceleration (Long / Lat): -7.39 g / -10.54 g

ASI 1.77

Exterior: VDS[6]/CDC[7] FR-5, RD-6/02RFEW9

Interior: OCDI[3] RF0210001

Max. Roll/Pitch/Yaw Angles: -7.41° / 7.01° / 39.71°

Barrier Damage: Maximum dynamic deflection in steel rail of 38 mm, superficial concrete spalling, and no permanent lateral deflection.

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Flex your power!
Be energy efficient!

December 28, 2009

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Re: Type 90 Bridge Rail

Mr. Artimovich,

This letter is to recap our e-mail correspondence regarding a minor issue with the data collected during NCHRP Report 350 Test 4-11 (Test No. 631 in the report) that was noticed after the final report was completed and Federal Highway Administration (FHWA) acceptance was obtained.

First, a small portion of the roll angle rate data collected exceeded the linear range of the rate gyro sensor, which is +/-500°/s. Approximately 60 data points exceeded -500°/s. The roll rate peaked at approximately -830°/s and was capped by our data recorder, not the rate gyro sensor. This was only a small portion of the data collected and there was no indication of such a high roll rate in the video footage. Furthermore, there is no Report 350 criteria for maximum roll rate. The maximum reported roll angle was affected since it was determined by integrating the roll rate data. However, the maximum reported roll angle was very small (only -7.41°) and was probably overestimated by this data collection issue. In fact, the maximum roll angle determined by video analysis was -5.2°.

Second, one data point in the lateral acceleration data exceeded the linear range of the accelerometer sensor. The accelerometers are rated for 100 g but one data point was recorded at about 105 g. In my opinion, this had a negligible effect on the ridedown acceleration and occupant impact velocity, which were well below NCHRP Report 350 preferred limits.

Both of these issues with recorded data were probably due to a ripple in the floorboard where the sensors were mounted as there was some floorboard deformation in that location. Again, this was only a small portion of the data collected, there was no indication of such a high roll rate in the video footage, and the maximum roll angle from the video analysis was less than that determined through electronic data analysis.

Should you require any additional information or have any questions, please do not hesitate to contact me at the above phone number or via e-mail at david_whitesel@dot.ca.gov.

Sincerely,

DAVID A. WHITESEL
Transportation Engineer, Office of Roadside Safety and Cooperative Research
Division of Research and Innovation

c: file
DAW/daw