Preliminary Investigation

Caltrans Division of Research and Innovation

Compliance Crash Testing of the Caltrans Type 26 Bridge Rail

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The Caltrans Division of Research and Innovation (DRI) receives and evaluates numerous research problem statements for funding every year. DRI conducts Preliminary Investigations on these problem statements to better scope and prioritize the proposed research in light of existing credible work on the topics nationally and internationally. Online and print sources for Preliminary Investigations include the National Cooperative Highway Research Program (NCHRP) and other Transportation Research Board (TRB) programs, the American Association of State Highway and Transportation Officials (AASHTO), the research and practices of other transportation agencies, and related academic and industry research. The views and conclusions in cited works, while generally peer reviewed or published by authoritative sources, may not be accepted without qualification by all experts in the field.

Summary

Background

The Type 26 bridge rail is an existing design that has been built on numerous bridges throughout the state, providing adequate service (current Std. Plan B11-54 located at (http://www.dot.ca.gov/hq/esc/oe/project_plans/highway_plans/stdplans_US-customary-units_10/viewable_pdf/b11-54.pdf). It is also a cost effective barrier to construct. Although it is expected to meet safety requirements, it has never been crash tested. To meet Caltrans bridge rail policy and fully determine its crashworthiness, it must be tested and evaluated to ensure that it meets crash testing guidelines in the Manual for Assessing Safety Hardware (MASH).

Photo taken from
http://www.fhwa.dot.gov/BRIDGE/bridgerail/br054201.cfm

The Highway Safety Features New Product Committee, along with Structures Design, recognized that crash testing of the Type 26 bridge rail was a high priority several years ago. This committee is responsible for recommending approval of highway safety features for use in Caltrans right of way. The bridge rail is a vertical, reinforced concrete wall on a sidewalk with a pedestrian steel tubular handrail or chain link fence on top and is usually constructed on routes with pedestrian walkways and posted speed limits of 70 km/hr (45 mph) or less. The Type 26 bridge rail was to be crash tested in 2003 but the project was modified to test the ST-20 bridge rail instead. This was due to pending construction projects requiring see-through features.

Additionally, this bridge rail is still being widely used. From 2005 to 2009, the Type 26 (not including the Type 26A, Type 26 Modified, and Type 26A Modified) was used in 10 contracts (more than 2 per year) totaling nearly 1700 m. Including all versions for the same time period, the

Type 26 has been used on 48 contracts for more than 11,300 m of bridge rail constructed. (Source Caltrans Contract Cost Database shown in Appendix). New details (see Appendix) of a slightly taller, 29 inches above the sidewalk, version of the Type 26 were provided for crash test article construction on April 5, 2011 by Structures Design.

Summary of Findings

We searched several locations for crash tests on products similar to the Type 26. No similar products were found that had been tested to MASH Test Level 2 (TL-2). FHWA will accept TL-2 testing because it is to be used only in applications with an unprotected sidewalk and a posted speed limit 45 mph or less (see e-mail from Ken Kochevar, CA FHWA, dated 5/21/2010 included in Appendix). Caltrans Structures Design wants TL-2 testing because the Type 26 meets the first three criteria below (see e-mail from Greg Kaderabek dated 5/18/2010 included in Appendix):

- Bridge rail with integral sidewalk can only be used in a TL-2 location (posted speed on bridge deck is 45 mph or less).
- Bridge rail with integral sidewalk is needed where pedestrian traffic is expected, and the bridge deck posted speed is 45 mph or less (and bike traffic is expected to ride on bridge deck rather than on sidewalk with pedestrians).
- Bridge rail with sidewalk must be at least the minimum height above the sidewalk as required for pedestrian traffic (currently 42").
- If posted speed on the bridge deck is over 45 mph (TL-4 location), then the pedestrian walkway must be separated from vehicular traffic by a vehicular rail (minimum height 32" above bridge deck), and have a pedestrian rail of at least a minimum height 42" along the outside edge of the ped walkway (typically along the edge of deck). In this case, a raised sidewalk [above the bridge deck] is not needed.

The following locations were searched:

- *Federal Highway Administration Website*
- *National Transportation Library*
- *Caltrans Research*
- *A search of TRIS RIP to find research in progress yielded no relevant results.*
- *General Internet Search*

National Research

- Federal Highway Administration Website: Three separate searches of FHWA acceptance letters using keywords “Aesthetic Barriers”, “Bridge Railings”, and “Permanent Concrete Barriers” yielded no products that were vertical, tested to MASH or NCHRP Report 350 TL-2, had a sidewalk, and were approximately the height of the Type 26 (29 inches). The bridge rails that were the most similar were:

    i. Nebraska Department of Roads Open Concrete Bridge Rail (post and beam) @ TL-4 (FHWA Acceptance Letter and Diagrams are included in the Appendix). Note the suggestion for increased post set back from rail face in the acceptance letter.
    ii. Midwest Roadside Safety Facility Low Profile Concrete Bridge Rail at TL-2 (FHWA Acceptance Letter and Diagrams are included in the Appendix)
    iii. Caltrans Type 80 SW Bridge Rail (FHWA Acceptance Letter and Diagrams are included in the Appendix)

- National Transportation Library: Three separate searches using keywords “Aesthetic Barriers”, “Bridge Railings”, and “Permanent Concrete Barriers” yielded no products that were vertical, tested to MASH or NCHRP Report 350 TL-2, had a sidewalk, and were approximately the height of the Type 26 (29 inches).

- Two other crash test research groups were contacted (Midwest Roadside Safety Facility and Texas Transportation Institute) to find out about similar research projects currently being conducted. Midwest did not respond. William Williams of TTI responded that he was not aware of any research but thought the barrier would suffice at TL-2 as long as the chain link railing did not pose any problems (this e-mail is included in the Appendix).

Caltrans Research

- Three separate searches of the Caltrans Division of Research and Innovation's Research Report Website yielded no products that were vertical, tested to MASH or NCHRP Report 350 TL-2, had a sidewalk, and were approximately the height of the Type 26 (29 inches).

- Caltrans Bridge Rail XS Sheets, See SECTION 16 - Barriers and Railings: http://www.dot.ca.gov/hq/esc/techpubs/manual/bridgemanuals/bridge-standard-detail-sheets

General Internet Search

Links:

Unofficial table of bridge rails:

- http://guides.roadsafellc.com/bridgeRailGuide/index.php?action=browse&all=1

Vertical face bridge rails listed in above table without acceptance letters:

- http://guides.roadsafellc.com/bridgeRailGuide/index.php?action=view&railing=91
- http://guides.roadsafellc.com/bridgeRailGuide/index.php?action=view&railing=83
- http://guides.roadsafellc.com/bridgeRailGuide/index.php?action=view&railing=79
- http://guides.roadsafellc.com/bridgeRailGuide/index.php?action=view&railing=70
- http://guides.roadsafellc.com/bridgeRailGuide/index.php?action=view&railing=24
- http://guides.roadsafellc.com/bridgeRailGuide/index.php?action=view&railing=25

BR27C Bridge Rail (tested PL-2):

- http://safety.fhwa.dot.gov/roadway_dept/policy_guide/road_hardware/barriers/bridgerailings/docs/appendixb7c.pdf
- http://www.efl.fhwa.dot.gov/files/technology/abs/Kansas_corral/acceptance-letter/Acceptance-letter.pdf
- http://tti.tamu.edu/publications/catalog/record/?id=18639

NCHRP Report 471 "Evaluation of Roadside Features to Accommodate Vans, Minivans, Pickup Trucks, and 4-Wheel Drive Vehicles":

- http://onlinepubs.trb.org/onlinepubs/nchrp/nchrp_rpt_471.pdf

NY Vertical Faced Barriers:

- https://www.nysdot.gov/main/business-center/engineering/cadd-info/bridge-details-sheets-repostitory-usc/BD-RC2E.pdf

NY Report (see table page 4):

- https://www.nysdot.gov/divisions/engineering/structures/repository/manuals/brman-usc/Section_6_US_2011.pdf