U.S. Department
of Transportation
Federal Highway
Administration

Memorandum

SENT VIA ELECTRONIC MAIL

Subject: INFORMATION: FHWA Acceptance Letter WZ-240 NCHRP Report 553 "Crashworthy Work Zone Traffic Control Devices"

Date: September 8, 2006

/original signed by George "Ed" Rice, Jr./

~for~

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Reply to
Attn. of: HSSD

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This memorandum recognizes seven generic work zone devices that were designed and crash tested by the Texas Transportation Institute (TTI) under the NCHRP Project 22-18 "Crashworthy Work Zone Traffic Control Devices." The devices and the crash tests are described in detail in the NCHRP Report 553, which may be obtained in PDF format on line at http://onlinepubs.trb.org/onlinepubs/nchrp/nchrp_rpt_553.pdf.

The objective of this research was to develop nonproprietary, crashworthy workzone traffic control devices constructed of readily available materials. A state-of-the-practice review helped identify sets of workzone devices for which additional generic designs were needed. The sets for which new devices were developed include Type III barricades with attached sign panel; low-mounting-height (i.e., 0.3 m [1 ft]), portable sign supports with rigid sign substrate; and high-mounting-height (i.e., 1.5 m and 2.1 m [5 ft and 7 ft]), portable sign supports with rigid sign substrate. In addition to crashworthiness, consideration was given to cost and functionality (e.g., durability, handling, site adaptability, etc.) The designs were reviewed and prioritized by the project panel, and the prioritization served as the basis for the full-scale crash testing.

A total of 10 full-scale crash tests were conducted under the project, of which seven were found acceptable or marginally acceptable. The square, perforated steel tubing used to fabricate the framing of the various devices tested was manufactured from ASTM A570 grade 50 steel. The use of a rigid plywood sign substrate in each application presented a distinct design challenge, but at least one design was successfully crash tested in each set of workzone devices investigated.

Introduction

The FHWA guidance on crash testing of work zone traffic control devices is contained in two memoranda. The first, dated July 25, 1997, titled "INFORMATION: Identifying Acceptable Highway Safety Features," established four categories of work zone devices: Category I devices are those lightweight devices which are to be self-certified by the vendor, Category II devices are other lightweight devices which need individual crash testing but with reduced instrumentation, Category III devices are barriers and other fixed or heavy devices also needing crash testing with normal instrumentation, and Category IV devices are trailer mounted lighted signs, arrow panels, etc. for which crash testing requirements have not yet been established. The second guidance memorandum was issued on August 28, 1998, and is titled "INFORMATION: Crash Tested Work Zone Traffic Control Devices." This later memorandum lists devices that are acceptable under Categories I, II, and III. Our new acceptance process was outlined in our memorandum "FHWA Hardware Acceptance Procedures – Category 2 Work Zone Devices" dated November 11, 2005.

A brief description of the devices that passed the crash testing follows:

9.1.1 Perforated Steel-Tube Type III Barricades

Based on successful test results for both centered (Test 1) and offset (Test 3) impact conditions, a perforated steel-tube barricade with wooden rails and plywood sign panel is considered to be an acceptable device for use in work zones. Both a 1.2-m · 1.2-m (4-ft · 4-ft) sign panel mounted at 1 ft in a diamond configuration and a 0.8-m · 1.5-m (2.5-ft · 5-ft) sign panel mounted at 0.8 m (2.5 ft) are considered acceptable for use on this barricade frame. However, the taller 1.2-m · 1.2-m (4-ft · 4-ft) sign panel produced greater windshield damage. Because a plywood sign panel tends to be more critical from a crashworthiness standpoint because of its greater weight, the successful test with a plywood substrate is considered to be sufficient for acceptance of a similar design with a comparably sized aluminum sign substrate or other lightweight substrate materials (e.g., corrugated plastic). Because the wooden rails used in the successfully tested barricades are considered more critical from an impact performance standpoint than lighter, hollow-profile plastic rails, both types of rails are considered acceptable. The use of the vertical braces in the barricade framing is optional. The braces were incorporated into the crash-tested systems because their presence represents a more critical configuration for impact performance evaluation. In absence of the vertical braces, the barricade rails and sign panel must be directly attached to the barricade uprights to prevent the sign and fractured rails from rotating into the windshield of the impacting vehicle.

9.1.2 Hollow-HDPE/Wooden Type III Barricade

A barricade fabricated from wood and hollow profile plastic lumber (HPPL) was found to have acceptable impact performance in a full-scale crash test (Test 4). The 102-mm · 102-mm (4-in · 4-in) HPPL barricade uprights and vertical braces were manufactured from high density polyethylene (HDPE). Both a 1.2-m · 1.2-m (4-ft · 4-ft) sign panel mounted at 0.3 m (1 ft) and a

0.8-m · 1.5-m (2.5-ft · 5-ft) sign panel mounted at 0.8 m (2.5 ft) are considered acceptable. However, the performance of the taller 1.2-m · 1.2-m (4-ft · 4-ft) sign panel is expected to be marginal. A plywood sign substrate was used in the crash test of the hollow-HDPE/wooden barricade with attached sign panel. Because a plywood sign panel tends to be more critical from a crashworthiness standpoint because of its greater weight, the successful test with a plywood substrate is considered to be sufficient for acceptance of a similar design with a comparably sized aluminum sign substrate or other lightweight substrate materials (e.g., corrugated plastic). Because the wooden rails used in the successfully tested barricades are considered more critical from an impact performance standpoint than lighter, hollow-profile plastic rails, both types of rails are considered acceptable.

9.2.1 Adjustable Tripod Sign Stand

The adjustable tripod system (Test 5) produced the least amount of damage to the vehicle of the low mounting height sign stands tested. Damage to the windshield was limited to a small crack, and the driver's view was not obstructed by the sign panel or windshield damage. Based on the successful test with a heavy plywood sign substrate, a comparably sized aluminum sign substrate or other lightweight substrate materials (e.g., corrugated plastic) are also considered acceptable.

9.2.2 Pivoting Dual Upright Low Mounted Sign Stand

The sign support system with pivoting dual uprights (Test 6) deformed the windshield sufficiently to classify its performance as marginally acceptable. Side-to-side adjustment of the sign support system to accommodate placement on roadside slopes is achieved by extending the upright on the downhill side of the slope the desired distance out of its sleeve or adjusting the attachment of one of the uprights to the sign panel. To tilt the sign panel to the front or back to accommodate placement on vertical grades, the upper bolt used to connect the sleeve to the pivot plate is removed and reinserted after aligning the sleeve with one of the other holes in the plate. Based on the successful test with a heavy plywood sign substrate, a comparably sized aluminum sign substrate or other light-weight substrate materials (e.g., corrugated plastic) are also considered acceptable.

9.2.3 Independent Dual Upright Low Mounted Sign Stand

The sign support system with independent dual uprights (Test 7) is the simplest and least expensive of the low mounting-height sign support systems designed or tested under this project. The system comprises two identical, independent uprights that, when bolted to their respective skids, form inverted, T-shaped legs. The sign panel is bolted to the uprights and serves as the cross bracing for the system. The impact performance of the system is considered acceptable and the system is deemed suitable for use in work zones. Although the sign panel briefly covered the windshield during the test, the 0.06-s interval during which the driver's vision would have been obscured is not considered to be of long enough duration to adversely influence the driver's ability to control the vehicle. Side-to-side adjustability to accommodate placement of the sign support on a roadside slope is achieved by extending the downhill upright out of its sleeve. Transportation is facilitated by the removal of the bolts or pins connecting the uprights inside the sleeves. In the opinion of the researchers, the addition of a horizontal cross brace for added stability should not adversely affect the impact performance of this low-mounting-height sign support system if the cross brace is placed across the sleeves at or near the skids. Based on the successful test with a heavy plywood sign substrate, a comparably sized aluminum sign substrate or other lightweight substrate materials (e.g., corrugated plastic) are also considered acceptable.

9.3.3 Strong Dual Uprights with Slip Connection High Mounted Sign Stand

The high-mounting-height sign support system with strong, dual uprights incorporates 57-mm (2-1⁄4-in) square, perforated steel tube uprights inserted into 64-mm (2-1⁄2-in) square, perforated steel sleeves. The strong, dual-upright perforated steel-tube sign support with 1.2-m · 1.2-m · 13-mm (4-ft · 4-ft · 1⁄2-in) plywood sign panel mounted at a height of 1.5 m (5 ft) met all required evaluation criteria for both the head-on and end-on impact scenarios. The incorporation of larger, stronger uprights into the design limited the deformation of the uprights and prevented them from wrapping around the front of the vehicle. The 1.5 m (5 ft) mounting height is generally believed to be more critical than a 2.1 m (7 ft) mounting height from an impact performance standpoint, because the lower center of mass decreases the point of rotation of the supports and increases rotational velocity. Since the strong, dual upright sign support system met all required evaluation criteria with the sign panel mounted at 1.5 m (5 ft), the researchers consider the same sign support system to be acceptable for a 2.1 m (7 ft) mounting height as well. The rigidity and mass of a plywood sign panel makes it more critical than most other substrate materials from a crashworthiness standpoint. Based on the successful test of the strong, dual upright sign support system with a plywood substrate, this sign support system is also considered to be acceptable when used in conjunction with a comparably sized aluminum sign substrate or lighter weight corrugated plastic sign substrate.

For drawings and additional details, including crash performance, please see Report 553 referenced at the beginning of this memorandum.

Findings

Damage was varied among the devices, from minor cosmetic deformation to substantial windshield cracking. However, all the devices described above received an “acceptable” or “marginally acceptable” rating from the researchers.

The results of the testing met the FHWA requirements and, therefore, the devices described above are acceptable or marginally acceptable, as noted above, for use on the NHS under the range of conditions tested, when proposed by a State.

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

- Our acceptance is limited to the crashworthiness characteristics of the devices 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 device 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 device being marketed is significantly different from the version that was crash tested, it reserves the right to modify or revoke its acceptance.
- Potential users should refer to the NCHRP Report 553 which includes sufficient information on design and installation requirements to ensure proper performance.

- Suppliers 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 they will meet the crashworthiness requirements of the FHWA and the NCHRP Report 350.
- To prevent misunderstanding by others, this letter of acceptance, designated as number WZ-240 shall not be reproduced except in full. This letter, and the test documentation upon which this letter is based, is 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 device for which the applicant is not the patent holder. The acceptance letter is limited to the crashworthiness characteristics of the candidate device, 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.

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