

D. Rationale for Existing U.S. Sign and Luminaire Support Testing Procedures and Suggested Bridge Rail Testing Procedures

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Appendix B contains the breakaway requirements from the 1985 *AASHTO Standard Specifications for Structural Supports for Highway Signs, Luminaires, and Traffic Signals*. Because the 1985 requirements are approximately the same as those in the 1975 specifications, we've had about 15 years of experience with these requirements. The changes that were made between the 1975 and 1985 requirements were as follows:

1. The design vehicle weight was reduced from 2,250 lb (1020 kg) to 1,800 lb (816 kg).
2. The description of the principal breakaway criterion was changed from being specified in terms of a change of momentum to being specified in terms of a change in velocity. The old criterion for breakaway was a momentum change of 1,100 lb-sec (4893 N-sec), which implied a change in velocity of 15.7 ft/sec (4.8 m/sec). The new criterion for breakaway is 15 ft/sec (4.6 m/sec). (FHWA accepts 16 ft/sec (4.9 m/sec).)
3. A limit was set on the height of the substantial remains following breakaway (the stub height) of 4 in. (0.1 m).
4. The test requirements and acceptance criteria vary only slightly from requirements in NCHRP Report 230, e.g., center-on crash testing is accepted where NCHRP Report 230 recommends off-center testing.

Some philosophy behind both editions of the AASHTO specification included the following points:

1. Design for the low end of the vehicle fleet weight range, but not the absolute bottom.
2. Expect breakaway hardware to break away when impacted at 20 mph (32 km/hr) by those vehicles in the fleet that weigh less than the design vehicle, motorcycles excluded.
3. Set the acceptance level at a point where injuries are expected to start to occur.
4. Expect practice to prevent life-threatening injuries for all impacts except those, primarily side-on impacts, in which an occupant might strike the breakaway structure. The objective is to account for fragile and out-of-position occupants.
5. Believe resulting impulse associated with a design vehicle striking a breakaway structure off-center will not cause the vehicle to yaw enough that it is likely to roll over.

6. Design to the state of the practicable.
7. There remains some hope that required breakaway structures can be retrofitted for side-on impact safety.

Appendix C contains the basic sections of the 1989 AASHTO Guide Specifications for Bridge Railings. The principal features of the specifications are as follows:

1. Designs are to be confirmed through crash testing.
2. Three levels of railing performance are recognized.
3. Railing performance levels are defined by crash tests.
4. Performance level selection procedures are included.

The philosophy behind the guide specifications includes the following points:

1. All bridge sites do not require the same level of railing capability.
2. Railing performance capability (performance level), and thus cost, should match the site requirements.
3. Crash testing is likely to reveal flaws in railing designs that might otherwise go undetected before placing a railing in service.
4. A performance level continuum or many closely spaced performance levels would be unmanageable.
5. Performance levels and selection procedures should be based partially on a rational analysis, but influenced extensively by AASHTO Subcommittee on Bridges and Structures perception of adequate design, with considerable weight given to current practice.
6. Test vehicles and test conditions should be selected to ensure good railing performance over a wide range of service impacts. (The 18,000-lb (8165 kg) single-unit truck is a surrogate for many vehicles but was not selected because it was a particularly bad actor in our accident experience.)
7. Test requirements and acceptance criteria vary considerably from requirements in NCHRP Report 230. Nevertheless, there is strong reliance on NCHRP Report 230 for guidance in conducting and reporting crash tests.