U.S. Department of Transportation
Federal Highway Administration

Memorandum

SENT VIA ELECTRONIC MAIL

Subject: ACTION: Supplementary Guidance for the Selection of W-Beam Barrier Terminals

Date: NOV 17 2005

From: George E. Rice Jr. for John R. Baxter, P.E.
Director, Office of Safety Design

Reply to Attn. of: HSA-10

To: Safety Field

My October 26, 2004, memorandum, "Guidance for the Selection of W-beam Terminals", transmitted detailed information intended for use by roadway designers as an aid in selecting the most appropriate W-beam terminal for a specific site. The guidelines presented therein are currently being reviewed by members of the AASHTO Technical Committee for Roadside Safety for inclusion in the next edition of the AASHTO Roadside Design Guide (RDG). In the meantime, some have expressed a concern that the federal guidelines are misleading in regard to the runout areas needed behind and beyond gating terminals. This memorandum provides additional information to assist designers in making appropriate barrier terminal selections.

Current terminal selection recommendations, both in the FHWA Guidelines and in the 2002 RDG, call for a minimum distance of 75' x 20' adjacent to the backside of the W-beam immediately downstream from the terminal end. This distance is clearly noted as being a minimum distance based on the final resting position of the 1800-lb small car in several W-beam terminal end-on tests (NCHRP Report 350 test 3-30). Given the greater weight and resultant impact severity of the 4400-lb pickup truck, it is obvious that a greater runout area would be needed for the truck impact at the same speed and angle (test 3-31). Several individual acceptance letters have specifically noted the distance traveled by the pickup truck in the certification tests and have recommended a minimum length of barrier to accommodate the observed post-crash trajectory.

To assist the designer in selecting an appropriate terminal at a specific site, I am attaching both a tabular and a graphic summary showing the distances traveled and the reported resting positions of both types of test vehicles in selected certification tests. These test data show the reported resting positions of both the small car and the pickup truck after impacts into energy-absorbing designs (BEST, ET-series, SKT, and FLEAT) and non-energy absorbing designs (REGENT, SRT). As would be expected, in the end-on tests (3-30 and 3-31) the impacting vehicles traveled

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a greater distance behind the barrier after striking non-energy absorbing terminals. Also as expected, terminal type has little affect on a vehicle's post-crash travel distance when impacted at an angle (tests 3-32 and 3-33) because energy-absorbing terminals are most effective in limiting penetration behind the barrier in head-on crashes. Finally, as noted above, higher weight vehicles traveled further distances after impact.

The selection of an appropriate W-beam terminal must be a deliberate choice based on specific site conditions. At locations where:

- flat angle impacts are possible and the terrain behind and adjacent to the barrier could allow a vehicle to reach the shielded hazard, or
- where the terrain behind and adjacent to the barrier in advance of the primary (shielded) area of concern is itself likely to cause serious occupant injuries in a crash,

either the barrier itself should be lengthened to lessen the likelihood that a vehicle behind the rail will reach the primary (or any secondary) fixed object or non-traversable terrain, or ***an energy-absorbing terminal should be considered***. Even in the latter instance, the recommended minimum runout area should be provided wherever practical.

Please discuss barrier terminal selection procedures with those in the State DOT responsible for this activity to ensure they are aware of current guidelines and are taking them into consideration in their terminal selection and installation decisions. States not already doing so should also be asked to investigate all fatal crashes involving barrier terminals to determine if the barrier length or terminal type/location may have contributed to the crash severity. In-service performance evaluation of all safety appurtenances is the only means available to verify the assumed crashworthiness of safety hardware based on limited certification tests and to identify unforeseen problems with hardware that need to be addressed.

Attachment

Full Scale Crash Test Results for W-Beam Terminals

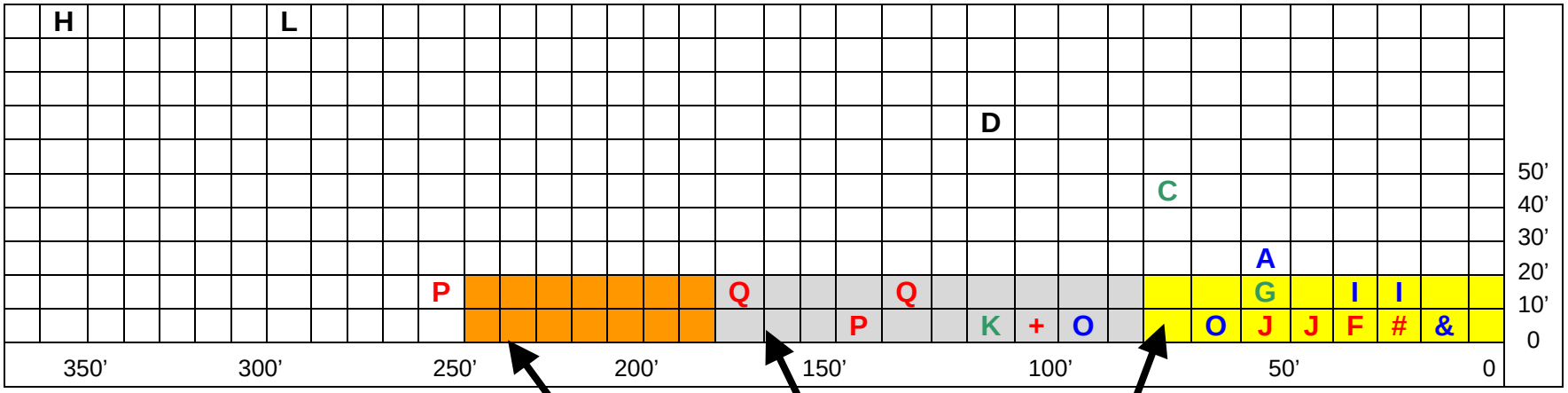
(Final Resting Position of Vehicle Shown for TL-3 Impact Condition)

System Type / Name	Test 3-30 820kg / 0 deg / offset W/4	Test 3-31 2000kg / 0 deg / centered	Test 3-32 820kg / 15 deg / centered	Test 3-33 2000kg / 15 deg / centered
Tangent **BEST** Energy Absorbing	Lat. 8.8 m (28.9 ft) Long. 17.1 m (56.1 ft)	Lat. 0.9 m (3.0 ft) Long. 8.9 m (29.2 ft)	Lat. 13.2 m (43.3 ft) Long. 21.7 m (71.2 ft)	Lat. 21.3 m (69.9 ft) Long. 36.6m (120 ft)
Tangent **ET 2000** Energy Absorbing	Lat. 1.7 m (5.6 ft) Long. 6.3 m (20.7 ft)	Lat. 2.0 m (6.6 ft) Long. 7.62 m (25.0 ft) Lat. 0.0 m (0.0 ft) Long. 12.0 m (39.4 ft)	Lat. 4.6 m (15.1 ft) Long. 17.1 m (56.1 ft)	Lat. 36.6 m (120 ft) Long. 107.9 m (354 ft)
Tangent **SKT** Energy Absorbing	Lat. 5.0 m (16.4 ft) Long. 10 m (32.8 ft) Lat. 5.7 m (18.7 ft) Long. 8.5 m (27.9 ft)	Lat. 0.0 m (0.0 ft) Long. 15.2 m (49.9 ft) Lat. 0.0 m (0.0 ft) Long. 17.5 m (57.4 ft)	Lat. 2.0 m (6.6 ft) Long. 37.0 m (121 ft)	Lat. 35 m (115 ft) Long. 90 m (295 ft)
Flared **FLEAT** Energy Absorbing	Lat. 0.0 m (0.0 ft) Long. 5.5 m (18.0 ft)	Lat. 1.7 m (5.6 ft) **Long. 32.0 m (105 ft) Lat. 1.6 m (5.3 ft) Long. 9.7 m (31.8 ft)	Did Not Conduct	Did Not Conduct
Flared **REGENT** Non-Energy Absorbing	Lat. 3.0 m (9.8 ft) Long. 19.0 m (62.3 ft) Lat. 1.5 m (4.9 ft) Long. 29.5 m (96.8 ft)	Lat. 1.0 m (3.3 ft) Long. 44.0 m (144 ft) Lat. 4.6 m (15.1 ft) Long. 77.2 m (253 ft)	Did Not Conduct	Did Not Conduct
Flared **SRT** Non-Energy Absorbing	Numbers Were Not Reported	Lat. 5.2 m (17.1 ft) Long. 41.8 m (137 ft) Lat. Not Reported Long. Past the 53.3 m (175 ft) test installation	Did Not Conduct	Did Not Conduct

** The FLEAT 3-31 Long. 32.0 m (105 ft) value is from a test involving the impact head deforming sufficiently to block the rail outlet. The rail kinking stopped after only about 1.5 m (5 ft). When the impact head was further reinforced to prevent this behavior the vehicle stopped about 1/3 the distance.

Post Impact Vehicle Trajectories

(Shown are Final Resting Positions for Various NCHRP 350 Roadside Terminals)



A – BEST Terminal Test **3-30**
B – BEST Terminal Test **3-31**
C – BEST Terminal Test **3-32**
D – BEST Terminal Test **3-33**

E – ET Terminal Test **3-30**
F – ET Terminal Test **3-31**
G – ET Terminal Test **3-32**
H – ET Terminal Test **3-33**

I – SKT Terminal Test **3-30**
J – SKT Terminal Test **3-31**
K – SKT Terminal Test **3-32**
L – SKT Terminal Test **3-33**

M – FLEAT Terminal Test **3-30**
N – FLEAT Terminal Test **3-31**

O – REGENT Terminal Test **3-30**
P – REGENT Terminal Test **3-31**

Q – SRT Terminal Test **3-31**

Vehicles May Travel Over 75 m (250 ft) With Non-Energy Absorbing Terminals

 # B + F+ N
& E + M
+ N (early design, see note)

23 m (75 ft) x 6 m (20 ft) Area as Described in the AASHTO RDG Section 8.2

Non-Energy Absorbing Terminals:

Recommended Minimum 175 ft. Clear Area Where the Vehicle Can Travel. Refer to FHWA Acceptance Letters:

- **CC-56A – MNDOT – Eccentric Loader Terminal**
- **CC-72 – Trinity Industries – Slotted Rail Terminal**
- **CC-80 – Energy Absorption Systems – REGENT**
- **CC-84 – CTDOT – TL-2 MELT Terminal**
- **CC-86 – BRIFEN – BRIFEN Cable Terminal**