ISTEA INNOVATIVE BARRIERS WHAT IS HAPPENING?

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Section 1058 of the 1991 Intermodal Surface Transportation Efficiency Act (ISTEA) requires each State highway agency to certify annually that a minimum of 2.5 percent of the kilometers (mileage) of new or replacement permanent median barriers included in awarded contracts on Federal-aid highways consist of innovative barriers. Innovative barriers are defined in the legislation as those considered experimental by the Federal Highway Administration (FHWA) or declared operational after January 1, 1985.

When the 1991 Act became law, however, the FHWA was no longer classifying tested barriers as experimental or operational but rather leaving this decision to each highway agency. Therefore, a modified definition of innovative barrier was developed. For purposes of Section 1058, an innovative median barrier became one which (1) was considered experimental by a State; or (2) was not already in use (or was in limited use) by that State and differed significantly in material, size, shape, performance/test level or operational characteristics from median barriers in common use elsewhere. In order to allow maximum flexibility to each State, the FHWA did not publish a list of barriers considered innovative under this new definition, but responded informally to questions of eligibility posed by individual States.

The information included in the certifications received for CY 1992 are summarized in Table 1. Of the 52 State highway agencies submitting certification information (50 States, plus the District of Columbia and Puerto Rico), 42 reported the inclusion of median barrier totalling approximately 837 km (520 miles) in Federal-aid contracts on the National Highway System (NHS). Twenty-seven of these States reported almost 145 km (90 miles) (17 percent) of the total as innovative barrier. The most commonly used innovative barrier was the single-slope concrete barrier developed by Texas (12 States), followed by New Jersey barrier higher than 810 mm (32 inches) (8 States), a concrete F-shape higher than 810 mm (32 inches) (2 States), and the Ontario Tall Wall, Modified Thrie-beam, IBC Mark VII, New Jersey barrier painted white, and Quick-Change barrier (1 State each).

As noted above, eight different types of barriers were considered innovative by the certifying States. A brief description and a subjective analysis of each follows:

- Single slope concrete median barrier.

This median barrier was originally developed and tested by the Texas highway department. It is nominally 1070 mm (42 inches) high and has a front face that slopes away from traffic at an angle of 10.8 degrees from vertical. Originally intended for use at locations where planned roadway overlays would change both the effective height and shape of a standard New Jersey concrete median barrier, testing indicated that for small cars (820 kg = 1,800 pounds) redirection was smoother with significantly less roll than with the New Jersey shape. Large car redirection, however, was very much like comparable impacts with the New Jersey shape. Large car redirection, however, was very much like comparable impacts with the New Jersey shape in that the vehicle's bumper climbed to a height of 1020 mm (40 inches) before the car lost contact with the barrier, resulting in a high roll angle. The single slope concrete median barrier has not been tested with any vehicle larger than 2040 kg (4500 pounds), although tests with an 8165-kg (18,000-pound) single-unit truck are planned. While it appears unlikely that a large truck would penetrate or roll over a 1070-mm (42-inch) tall single slope barrier, the distance the top of the trailer would lean over the top of the barrier is not known. This factor becomes critical if the barrier is used immediately in front of a fixed rigid object such as a bridge pier or overhead sign support.

- Tall New Jersey concrete median barrier.

Increasing the height of the standard New Jersey barrier has little or no effect on most impacts, but does offer advantages for vehicles with higher centers of gravity. As with the single slope barrier discussed above, the degree to which a truck or bus rolls beyond the top of the wall must be considered when using the barrier to shield rigid objects. Additionally, a taller wall may act to some extent as a low-maintenance glare screen.

- Tall F-shape concrete median barrier.

Full scale crash tests with vehicles ranging from 820 kg (1,800 pounds) to 36 290 kg (80,000 pounds) have indicated that the F-shape (or a New Jersey barrier with the 75-mm (3-inch) reveal covered), with its slope break-point 250 mm (10 inches) above the roadway surface, compared to 330 mm (13 inches) for the New Jersey barrier, performs significantly better than the standard New Jersey shape. Impacting passenger-size vehicles tend not to climb as high up the F-shape as on the New Jersey shape and are redirected more smoothly. High-center-of-gravity vehicles do not lean as far over this shape as they do with either of the barriers discussed above. The extra heights used (up to 1420 mm = 56 inches) provide additional shielding from large trucks and buses for rigid objects directly behind the barrier and also serve as glare screens under some circumstances.

• Ontario tall wall.

This barrier is essentially a 1040-mm (41-inch) high F-shape with no reinforcing steel. When tested, it successfully contained and redirected a 36 290-kg (80,000-pound) tractor-trailer combination impacting at 80 km/h (50 mph) and 15 degrees. To compensate for the elimination of reinforcement, it is more massive than similar height New Jersey or F-shape barriers. The barrier used by Indiana was 1170 mm (46 inches) high to accommodate future overlays.

• Quick-Change median barrier.

This moveable concrete barrier is described in Chapter 9 of the AASHTO's 1989 *Roadside Design Guide* as a temporary work zone barrier. When used for this purpose, it does not qualify as a Section 1058 innovative barrier. However, when this barrier is used for a permanent lane change operation to balance peak traffic flows, it does meet the intent of the law. The barrier itself has exhibited good redirectional capability for passenger-sized vehicles. It has not been tested with trucks.

• International Barrier Corporation (IBC) Mark VII barrier.

This proprietary, sand filled, metal-bin barrier stands 1070 mm (42 inches) high, has a good performance record, although its use has been limited. Based on available information, however, the IBC barrier is not currently available and States that presently have some IBC installations are having difficulty obtaining replacement parts to repair damaged sections.

• Modified Thrie-beam median barrier.

This barrier is described in Chapter 6 of the AASHTO's 1989 *Roadside Design Guide*. When tested, this double-faced metal railing contained and redirected an 18 140-kg (40,000-pound) bus at 80 km/h (50 mph) and 15 degrees. However, the bus rolled onto its side after impact. Since this type of barrier usually needs repair after a hit, it is generally not recommended in locations subjects to frequent impacts or where repair work would necessitate closing one or more median lanes.

• Painted concrete median barrier.

Although painting a standard concrete barrier white (or using white cement and light-colored aggregate) can increase its visibility and theoretically reduce accidents. The FHWA's initial reaction was that, while probably advantageous, such treatment does not meet the intent of Section 1058. However, a more liberal view of the law would encourage use of any treatment that reduces accidents as well as ones that limit their severities. This interpretation is discussed in the final section of this Report.

Of the 15 States that did not include any innovative barrier in their total median barrier, five installed less than 0.4 km (1/4 mile) of total median barrier and did not believe it cost-effective to include any innovative barrier in such limited quantities. Most of the remaining States indicated there was insufficient time to add innovative barrier to projects that were ready for bid or that planned CY 1992 projects that included innovative barrier were not awarded in CY 1992. One State proposed that the 2.5 percent requirement be applied over the entire six-year period covered by the 1991 ISTEA rather than on an annual basis. Ten States reported no median barrier installations at all. A few agencies suggested that the certification requirement be rescinded.

While Section 1058 of the ISTEA indicates a minimum annual usage of innovative barriers, the FHWA believes the intent of Section 1058 will be met if a State can show a good faith effort in each calendar year to select projects for the installation of innovative barriers and the percentage of such barriers over a multi-year period meets or exceeds the minimum amount specified by law. A State that is not in compliance in any calendar year should, however, indicate in its annual certification the reasons why it was not able to install the required amount and its plans for future compliance. We can conclude, however, judging by the high percentage of median barrier considered innovative by the States in their 1992 certifications, that the 2.5 percent requirement is relatively easy to attain.

Since the 2.5 percent is a minimum annual goal, the installation of only a small total amount of barrier is not necessarily a valid reason to install no innovative barrier. Under some conditions, it could very well be appropriate to install 100 percent innovative barrier. Also, short sections of innovative barrier within a run of median barrier might be appropriate. Annually, several accidents occur when large vehicles, usually tractor semi-trailer combinations, strike bridge piers that are shielded with conventional traffic barriers. Taller and stronger barriers can be used to good advantage at many such locations. For example, the State of Louisiana uses a 1370-mm (54-inch) tall concrete safety shape in advance of and through bridge piers on its Interstate system, an innovative practice other States might wish to consider.

Twenty-seven of the 42 States that installed median barriers on the NHS reported installing barrier that they considered innovative. This resulted in a total of 17 percent innovative barrier out of the 520 miles of median barrier installed nationally. However, over a third of the 42 agencies installing median barrier installed no innovative barrier in 1992. Since lead time on major highway projects is often over two years, several States installing no innovative barrier in 1992 reported that some would be included in contracts advertised in 1993 and subsequent years. The FHWA has taken this factor into consideration in its review and acceptance of the first year certifications.

Some confusion exists regarding the specific types of barriers that can qualify as innovative. Since the assumed intent of Section 1058 is the improvement of

TABLE 1 SUMMARY DATA FROM REPORTING AGENCIES IN CALENDAR YEAR 1992

	Total Median Barrier (miles)	Total Innovation Barrier (miles)	% Innovative Barrier
Region 1			
ME	0.21	0	0
NH	0	n/a	n/a
VT	0	n/a	n/a
MA	11.82	0.10(a)	0.8
CT	15.91	0	0
RI	3.37	0	0
NY	15.04	0.90(b)	6.0
NJ	14.02	0	0
PR	0.19	0	0
	60.56	1.00	1.65
Region 3			
PA	12.70	1.43(b)	11.2
MD	7.20	0	0
VA	22.70	0.71(b)	3.1
DE	3.59	0.53(b)	14.8
WV	1.89	1.89(b)	100.1
DC	0	n/a	n/a
	48.08	4.56	9.48
Region 4			
NC	23.25	17.11(c)	73.6
SC	8.71	1.78(d)	20.4
TN	19.35	0	0
KY	22.47	0.66(b)	2.9
GA	37.64	0	0
FL	24.94	13.97(f)	56.0
AL	11.88	0.40(c)	3.4
MS	4.32	2.21(c)	51.2
	151.56	36.13	23.84
Region 5			
OH	16.69	0.56(b)	3.3
IN	31.06	1.28(e)	4.1
IL	27.75	17.37(c)	62.6
MI	10.00	4.40(b)	44.0
WI	17.70	3.30(c)	18.6
MN	3.27	0.89(g)	27.2
	106.47	27.80	26.61

TABLE 1 SUMMARY DATA FROM REPORTING AGENCIES IN CALENDAR YEAR 1992 (continued)

	Total Median Barrier (miles)	Total Innovation Barrier (miles)	% Innovative Barrier
Region 6			
AR	1.62	0.54(b)	33.3
LA	6.20	0	0
OK	0	n/a	n/a
TX	29.90	12.30(b)	41.1
NM	3.09	0	0
	40.81	12.84	31.46
Region 7			
MO	9.66	1.10(b)	11.4
NE	0.90	0.90(c)	100.0
IA	0.18	0	0
KS	3.81	0.20(g)	5.3
	14.55	2.20	15.12
Region 8			
ND	1.48	0.22(c)	14.9
SD	0	n/a	n/a
MT	0.19	0	0
WY	0.11	0	0
CO	2.00	0.29(c)	14.5
UT	0	n/a	n/a
	3.78	0.51	13.49
Region 9			
CA	40.00	2.30(h)	5.8
AZ	0	n/a	n/a
NV	0	0	n/a
HI	0	n/a	n/a
	40.00	2.30	5.75
Region 10			
WA	15.80	0.97(b)	6.1
AK	9.0	0	0
OR	28.90	0	0
ID	0	n/a	n/a
	53.70	0.97	1.81
TOTALS	519.51	88.31	17.0

highway safety, the FHWA will continue to place emphasis on barriers that are more effective in one or more ways than the current national "standard", the 810-mm (32-inch) high New Jersey concrete median barrier. To assist and encourage each State to use such barriers, the FHWA will accept as innovative for 1993 and subsequent years any crashworthy median barrier that: 1) was considered experimental by the FHWA on or after January 1, 1985, or 2) has been declared crashworthy by the FHWA since that date, or 3) a State chooses to call experimental.

An appropriate in-service evaluation to assess performance and other aspects of the innovative barrier is strongly recommended for any median barrier considered innovative under Section 1058 of the ISTEA. An evaluation will be required of any barrier that does not qualify as innovative under categories 1 or 2 in the last sentence of the preceding paragraph and achieves innovative status only on the basis of a State declaring it to be experimental. Construction costs, accident frequencies and severities, barrier performance, and maintenance requirements are the most common factors for analysis and comparison. Chapter 7 of National Cooperative Highway Research (NCHRP) *Report 350, Recommended Procedures for the Safety Performance Evaluation of Highway Features*, provides general guidelines for in-service evaluations. This approach should afford each State highway agency maximum flexibility in designing its median barriers and will permit the use of barriers such as the 810-mm (32-inch) high F-shape concrete barrier or enhanced visibility barriers that would not otherwise qualify as innovative.

All State highway agencies planning to install median barriers are encouraged to examine the actual performance of their standard barriers and to review the specific site conditions where the barrier will be used to see if an innovative barrier is more appropriate. States using even limited quantities of median barrier may find that an innovative barrier may be the best choice for a particular location.

With the publication and FHWA acceptance of *NCHRP Report 350* with its six test levels for longitudinal barriers, both existing and new barriers are likely to be classified or tested for classification under the new test matrices. Although at present there are no definitive warrants for the use of higher or lower performance barriers, subjective selection factors such as highway speeds, roadway geometrics, percent trucks, consequences of penetration, and past accident histories can be used, as they have been for many years. Some efforts are underway to develop more objective selection procedures to match barriers to site conditions. Designers should remain abreast of future developments in this area.

INNOVATIVE BARRIER TYPES

a. International Barrier Corporation (IBC) Mark VII sand-filled metal bin barrier;

b. Single slope concrete barrier;

c. Tall New Jersey barrier (variable heights from 42 to 56 inches);

d. New Jersey barrier painted white.

e. Ontario tall wall (46-inch high un-reinforced concrete);

f. Modified thrie-beam median barrier;

g. F-shape concrete barrier (51-inches and 56-inches high); and

h. Quick-Change concrete barrier (permanent lane-change operation);

(1 inch = 25.4 mm)