FEATURE ARTICLES

The Penalties of Non-Standardization

GILBERT E. MORRIS, JR., Armco Steel Corporation, Middletown, Ohio

More often than not the central theme in most current articles dealing with highway safety is the role of the guardrail. Among the most valuable contributions in this field are those developed through the results of full-scale dynamic tests conducted by researchers in California and New York and by the General Motors Corporation. Until these tests were made, guardrail design was seriously lacking in features that would provide safety compatible with modern high-speed traffic.

The deluge of information recently published on the design aspects of highway barrier systems is now beginning to have an economic impact. Guardrail, particularly the standard steel "W" section, is one of the biggest bargains the highway user (and taxpayer) now enjoys. In a period of dramatically rising construction costs, the installed cost of guardrails has remained relatively stable. (See Figure 1.) This stability is a result of a standardized rail section, splice bolts, post bolts and posts. Each of these are off-the-shelf, mass-produced items that in effect have become a commodity product. The low cost per unit is a result of a substantial investment in equipment to manufacture and install a large volume of identical units.

Today, however, as a result of the headlong rush to apply the recent research findings, there is near chaos. This is particularly true of accessory items that go with this standard product. There is no argument that highway safety is well worth a substantial investment. There can be no argument, either, that we are not getting the greatest return for the invested dollar. In short, we should be getting more safety per tax dollar.

As an extreme example, consider the very simple post bolt and washer. A rectangular washer that is nominally 4 inches by 2 inches fits under the head of the post bolt. A survey of standard plans of 15 states shows that there are 14 variations in dimensions of the washer alone (See Figure 2). Fortunately in this particular instance, AASHO has initiated action designed to standardize one specific size and thickness. The tooling cost of nearly $2,000 per size per manufacturer, however, already amounts to a sizable investment.

As a further illustration, requirements for the bolts vary from lengths of two inches to 26 inches in increments of one inch. Unlike its companion washer, standardization on length is not possible because of the requirements for posts which can be wood, steel or concrete in combinations of no-offset, single blocked-out and double blocked-out.

Most serious and by far the most costly to the taxpaying highway user is the effect of non-standardization of terminal accessories at bridge abutments and at ends of runs where the rail dips and twists into the ground. Functionally, the rail must change smoothly from a semirigid barrier to a rigid wall at a

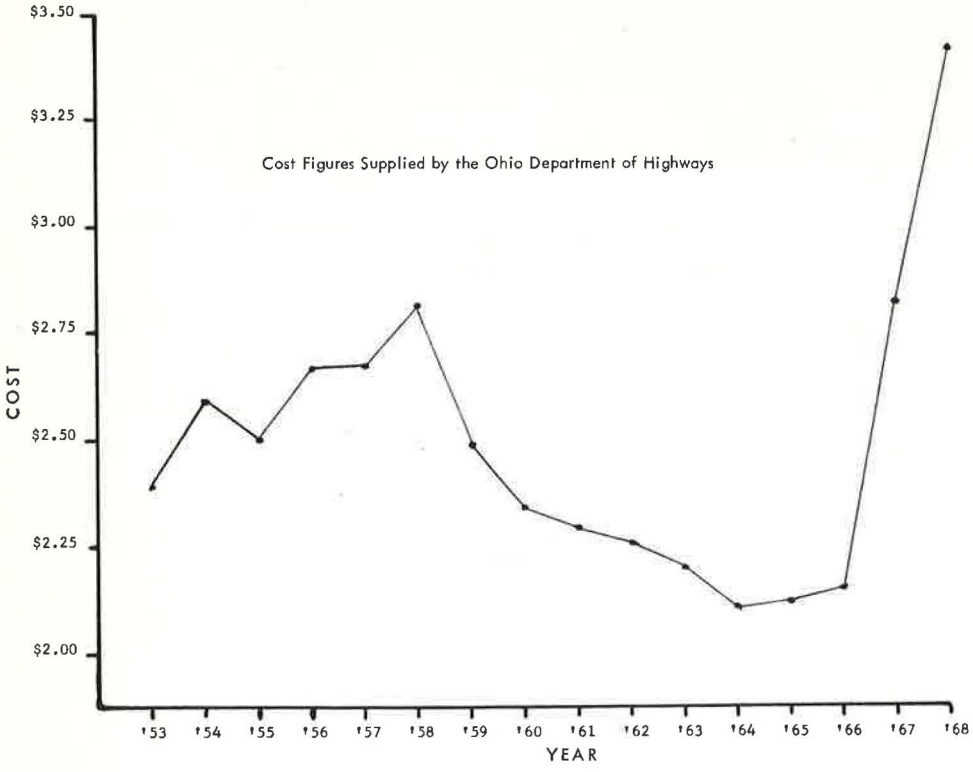

Figure 1.

Guardrail Post Bolt Washers

Width	Length	Thickness	Hole Dimensions
1¾"	3"	⅛"	11/16 x 15/16
1⅝"	3"	⅛"	11/16 x 15/16
Max. 1¾ to 1½"	Min. 2½"		To fit bolt
1¾"	3"	8 gage	11/16 x 15/16
1¾"	4½"	3/16"	11/16 x 15/16
1 9/16"	3"	⅛"	11/16 x 15/16
1¾"	1¾"	10 gage	⅜ ϕ
1 9/16"	3"	8 gage	11/16 x 15/16
			11/16 Round
2"	4"	⅛"	13/16 Round
1¾"	3"	8 gage	31/32 x 11/16
1¾"	3"	8 gage	31/32 x 11/16

Figure 2.

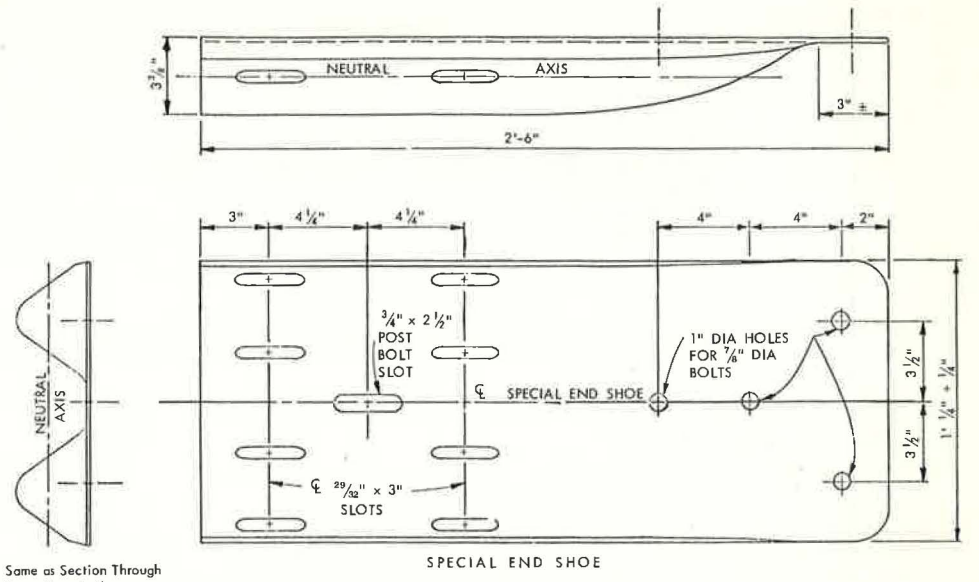

Figure 3.

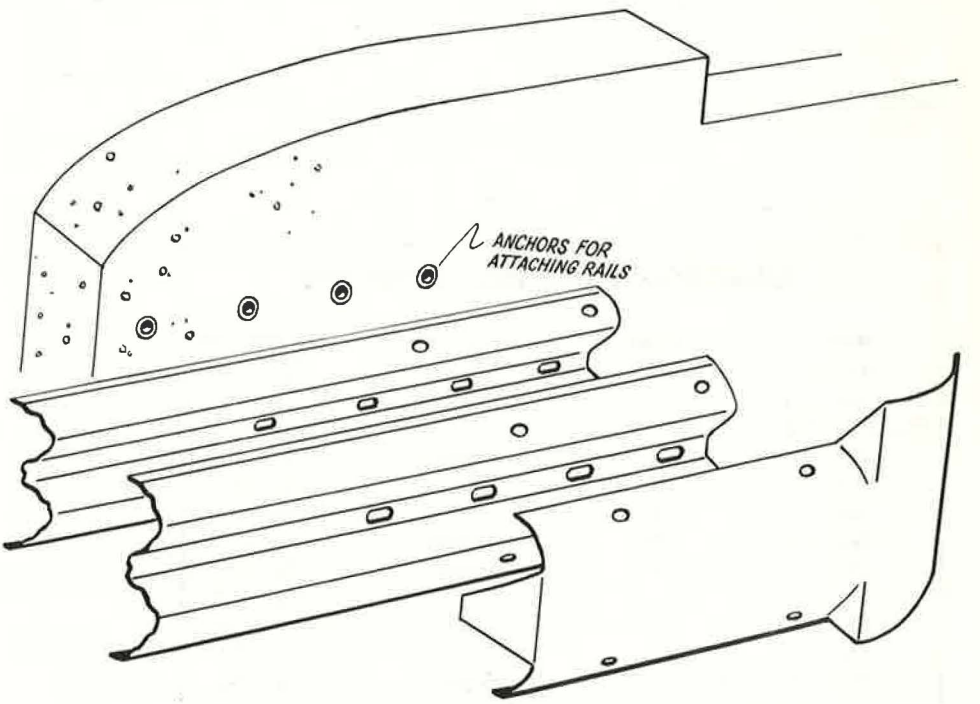

Figure 4.

bridge abutment with the capability of transmitting 80,000 lbs. of tension to the abutment or wing wall. Since the transfer of the 80,000 lbs. involves the last section of a standard rail which is normally 12 gage, the problem is not simple. Even though two 1¼-inch diameter bolts are strong enough to transfer 80,000 lbs. in shear and appear to offer an optimum number for field drilling into concrete, it takes at least eight ⅝-inch diameter bolts to stay within the allowable metal bearing on the 12-gage rail.

The result has been as many as 40 different solutions to the same problem. Each has its own bolt and hole size, slots, brackets, etc., and each is subject to change on future contracts. The costly result is that the last section of rail is three to four times the normal price of rail plus the cost of brackets, plates and bolts. In some instances tooling can run as high as $20,000. The price of such tooling must be written off on the first contract for fear that future modifications may make it obsolete.

A recent design by the Michigan Department of State Highways seems to offer a practical solution. The "end shoe" shown in Figure 3 can be attached to any standard piece of rail through the conventional eight splice bolts. The shoe in turn transfers the load to the abutment through a minimum of larger bolts. Figure 4 shows other ideas along the same line.

To realize the savings of standardization the Michigan design should be adopted nationally for both downstream and upstream ends of guardrail installations. Furthermore, it would be in the overall interests of the highway user for AASHO and industry to attempt jointly a standardization program for all guardrail accessories.