

driver leaving on the median side might otherwise drop to a roadway below through the opening in the median. On most projects studied, long sections of approach guardrail were flared into the median center line or even beyond to divert vehicles from the opening between the bridges. The solution of decking the median area was not frequently practiced. This has the advantage of eliminating the hazard just referred to and also removes the additional hazard posed by the left edge parapet walls.

Among the States, Rhode Island has concluded that 20 feet is about the widest median that can be economically paved between twin bridges. Some States that have studied this item believe that median widths up to 30 feet can be economically justified for paving. On the nine Interstate sections inspected, there were many twin bridges with medians below ten feet that were not paved over. The separate structures were often less than 25 feet apart, and eliminating the two parapet walls on the left sides of approaching traffic would have saved their cost, plus that of the extensive length of guardrail used on the approaches to the structures. This could frequently support the incremental cost of paving the median area.

Noteworthy among the bridge safety design problems that still await solution is the development of a satisfactory transition structure between approach guardrail and bridge railing or other elements of a grade separation structure. In two States, Oklahoma and Utah, some attempt was made to obtain an anchorage but the design was not altogether successful. In the other seven States, there was no physical connection or evidence of any attempt to make the approach guardrail integral with the bridge railing, a pier, or any other structural component. The need for an answer to this transition problem ranks as high as any on the list of immediate safety priorities. Discussions and information obtained during the survey indicated that most States plan some remedy of this deficiency. It was interesting to notice the varying nature of the concern. In one State, there was almost no guardrail on the approach to structures, whereas in another, the approach guardrail had been built to a bridge location even before the bridge deck had been completed.

Bridge Railing

The effectiveness of rails on bridge structures is related to their height as well as to their design composition. Measurements were taken on many of the structures observed in the nine States. Bridge rail height, adjoining and measured from the roadway surface, was as low as 27 inches in some cases and as high as 44 inches in other cases. The most common height of bridge rail was 40 inches above the roadway surface. Only a few of the States had lower or higher bridge railing than 40 inches, which suggests that this dimension, as well as the functional design requirements of bridge railing, needs to be studied and specified more exactly for application to bridges of the Interstate System.

Aluminum was a common alternate for steel for bridge railing. Many different configurations were noted. Combinations with various heights of concrete bridge parapets make this element extremely elusive for evaluation. Bridge designers appear to exercise a great deal of individual expression in developing the configuration of bridge rails. Aesthetics and the desire to have a bridge rail that you can "see through" should not exceed the concern for a railing that is able to withstand the impact of a colliding vehicle without failure and unnecessary hazard to highway users.

Shoulders

Some attention was given during the study to the use of shoulders on the main roadway and on ramps. In Utah and in Oklahoma, the normal width of the shoulder was frequently obstructed by curbs placed at the entrance ramp terminal.

In addition to obstructions of the main roadway shoulders, which should in all cases be available for disabled vehicles, a great inconsistency existed in the design of shoulders for ramp roadways. In a few cases it was difficult to tell whether the ramp shoulder was paved. On one project the ramp had a paved shoulder six feet wide on the right and no shoulder paving on the left. In still another State, the shoulder of the ramp was paved three feet wide both right and left. Elsewhere, the ramps were outlined with curbs. The practice of paving shoulders on connecting ramps at interchanges obviously has not been sufficiently determined, and there is doubt that the need for adequate shoulders at all locations has yet been fully appreciated.