

should be used to provide the same double thickness strength that results where the ribbon is overlapped.

"A test conducted on a duplication of this typical signpost barrier illustrates these needs beyond question.

"The boxes in this test set-up simulate the concrete sign bases. As on the freeway, the test speed is 65 mph and the impact angle is 25 degrees. These results are graphic proof that many of our present sign barriers are inadequate for present conditions.

"Bridgerails of this or similar design should be considered wherever possible in new construction, as their smooth surface prevents snagging, and their strength with the steel upper rail will safely deflect even large trucks.

"And finally, the approach sections of W-beam guardrail should be firmly attached to a flaired abutment at the end of the bridgerail. This provides a continuity of support and prevents the possibility of impacting the bridge-end.

"Highway safety tests are a continuing program at the General Motors Proving Ground, and their results to date prove that substantial improvements in guardrail safety can be made on existing and future installations using currently available materials and knowledge.

"Details of the Proving Ground tests and guardrail installations are available. For published materials, write to the Director of the General Motors Proving Ground, Milford, Michigan."

Mr. CONSTANDY. Some of the things which you have shown here were commented on during the slide presentation last week. There was some discussion relative to the merits, or the necessity, of blocking out the guardrail from the post. I have noticed here you used a spring mount. I wonder whether you had any thoughts relative to it versus a wooden blackout section or steel blackout section.

Mr. LUNDSTROM. We have put our emphasis on the spring bracket, actually. We drive these tests now, we find that the shallow angle impacts are very easy on the occupants of the car, very little sheet metal damage. So we believe this additional cushioning is the proper benefit to be obtained from the spring bracket that you cannot get from the simple wood blackout. So we prefer it. It probably costs a little bit more.

Mr. MCCARTHY. Mr. Lundstrom, do you know of any States that have adopted the results of your research?

Mr. LUNDSTROM. Yes; we have obviously worked most closely with our own Michigan Highway Department. In the past few years they have been running their own experiments based on the suggestions we have given them. They have been to our proving ground several times to see for themselves what can be done and I know that they have done very good experiments on roadside slopes. They have been experimenting with improved guardrail, with burying the ends of the guardrail now and most recently we have conducted a series of experiments in cooperation with them on lampposts.

Now, the turnpike authorities have visited us. The median guardrail installed on the Pennsylvania Turnpike utilizes some of the findings that we have developed at the proving ground. We have had this bridge parapet installed in sample section on one of the Detroit freeways. We have had other States. Ohio has perhaps been another leader in the utilization of the clean roadsides and extended guardrail programs. And please believe me, we are not the only ones who have done research. California has done a very considerable amount of research in guardrail and in roadsides and they have applied many of these suggestions.

So while it has seemed to us to be slow in developing, we are very much encouraged by the approach of the States, in more recent years,