First of all, these barriers must prevent penetration by the vehicle. They serve no purpose, if they do not prevent penetration, at least in some degree. They redirect the vehicle along the rail. In other words, they do not deflect the vehicle off the rail back into the course of traffic out of control, but redirect the vehicle along the course of the rail.

No. 3, they decelerate the vehicle within human tolerance limits.

Mr. CONSTANDY. It is the sudden stop that kills people, is it not?

Mr. PRISK. It is that. And we certainly strive for each of these objectives in construction and design of guardrail.

The applications where guardrail is appropriate to use—I might say with respect to these, all of these are carried out with appropriate consideration for economy and for esthetics.

As to applications, there are applications obvious at grade separations and bridges, where guardrail is used. Also on steep, high embankments guardrail has obvious application, and at other roadside hazards where fixed objects are at place.

Mr. CONSTANDY. I think it is advisable for the committee to keep the initial three items of the design demands in mind as we review this series of slides.

Most important, the three Mr. Prisk has mentioned here.

Mr. PRISK. Now as we proceed, I think that I would like to move to our consideration of the history, briefly, of guardrail development.

I can recall in early highway department experience when 2 by 4's were used or 2 by 6's were used for guardrails, causing rather sad experience with splintering wooden rail coming through the car or through a windshield. So types of rails are quite important and we shall be looking for various types of rails as we review these nine projects.

Also the rail must be sufficiently strong to absorb energy without undue deflection and be suitably anchored. And we should be looking at different types, different characteristics, of the rail in this respect.

One very significant thing that has been found in recent research is that it is important to have washers to hold the rail to the post, so that the rail will not, in effect, peel off, lose its tensile quality as a system.

Mr. CONSTANDY. Do you have one of those you might show the committee?

Mr. PRISK. Yes. This washer is a rather obscure item, in many people's judgment, but that is the washer. This is the standard bolt that is used to hold the washer on the face of the rail. This is the traffic side.

Mr. CONSTANDY. The purpose of that is to keep the head of the bolt from going through the guardrail; is that right?

Mr. PRISK. Exactly so. This is the rail, the section of a common-type rail that is used.

Mr. CONSTANDY. Is that called a W-beam?

Mr. PRISK. W-beam rail. And the washer goes in in this position as it is bolted to the post.

Mr. CONSTANDY. Do you have any idea what the washer costs?

Mr. PRISK. Well, these washers, of course, are bid like other items, but 15 to 25 cents would cover the range. Perhaps that is a little bit high. The full strength of the rail cannot be realized in a crash without a washer; that is correct.