

Mr. SKEELS. Maybe we have telepathy.

Mr. CONSTANDY. Maybe you could say this was too much of a good thing.

Mr. SKEELS. They tried, but they did look at it. When they looked at it on paper, it did not look like this.

Mr. CLAUSEN. How would you alter the design in this specific instance?

Mr. SKEELS. How would I do it? I would bring the railing closer to those piers. I would clear them by perhaps 2 or 3 feet, bring them in. And then of course I would not use this type of post and I would use more of them.

Mr. CONSTANDY. What do you think of that, Mr. Ricker?

Mr. RICKER. I certainly agree it is flared out too much. If you come in within 2 or 3 feet of the piers, that would be adequate.

I am not quite sure of Mr. Skeels' comment about the kind of post or more posts, because I think this is 6-foot-3-inch spacing.

Mr. PRISK. It is.

Mr. SKEELS. I stand corrected. I thought it was 12. I would use 6 feet 3 inches.

Mr. PRISK. Here is a closeup of the same installation, same location.

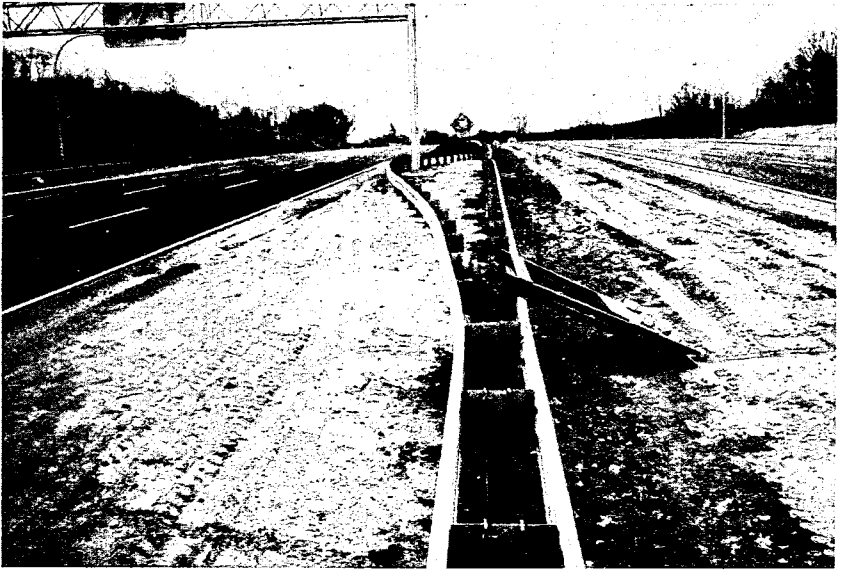
Another attraction that they have here is that the curb, which runs along outside the rail, just under the structure itself is a disturbing feature. We are going to talk about curbs later.

Mr. CONSTANDY. Is that curb serving any purpose?

Mr. PRISK. It cannot serve any useful purpose at that location.

This is the same location we looked at a moment ago.





Now, here is what you get as you continue on the project. Looking along this backed-up section here, you get to the sign support structure, and the rail is bellied out again to pick up this location of the sign support. Again, it creates somewhat as a pocket on this side; but if the sign support is there, I do not know what else you are going to do about it.

Mr. SKEELS. Move it over.

Mr. CONSTANDY. You can see you can move the entire installation over there. That is one thing you can do. There has been a hit on this side opposite the sign support, too.

Does it seem that the bridge could have been lengthened so that the footing and the supports would have been within the median barrier?

Mr. WILKES. That is the comment I was going to make; the sign bridge could have been lengthened to approach the median.

Mr. CONSTANDY. I just wonder if that would increase the size of the bridge structure, the sign bridge structure?

Mr. WILKES. It would be a nominal increase.

Mr. CONSTANDY. The kind of cost we are talking about would not make it prohibitive, would it?

Mr. WILKES. No.

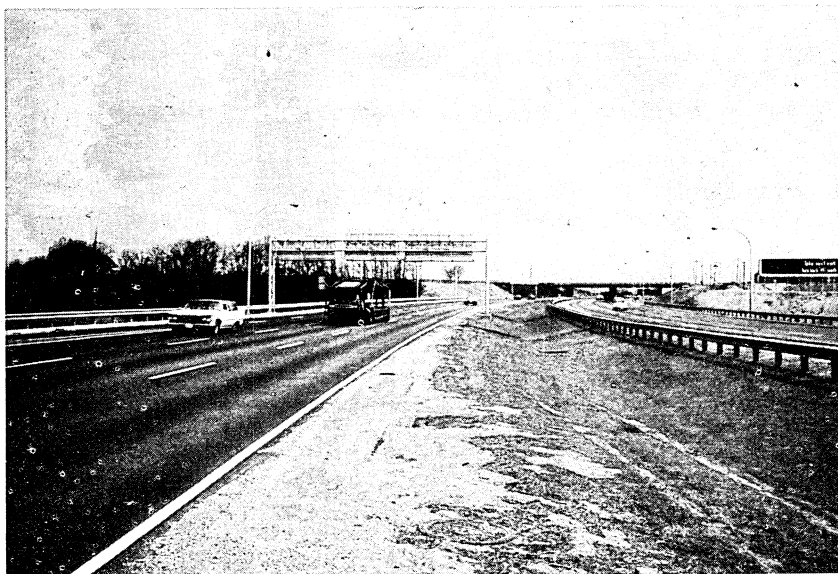
Mr. CONSTANDY. You would save something on guardrail installation?

Mr. WILKES. It would help out.

Mr. CONSTANDY. If you want to add the cost of the accidents you anticipated here, you would probably extend the bridge?

Mr. WILKES. I would agree.

Mr. PRISK. Here is a case where they did not go out and pick up the signpost. This is right in the same vicinity. And there is a sign bridge, the same type we just looked at. Here is a double beam, blocked-out rail, median barrier installed along one edge of the median instead of down the middle, so this is too far away to go.



Mr. CONSTANDY. Does anyone on the panel have any suggestion?

Mr. WILKES. This looks like an exercise of judgment here. They wanted to protect the outside of the curve so they located the beam closer to the right-hand lane, the lane that is going away farthest.

Mr. CONSTANDY. How about extending this bridge, does it begin to reach a point where it is no longer feasible, or could that have been extended so the support could have gone within the guardrail, the median barrier?

Mr. WILKES. That would require an extension of, it looks like 15 or 20 feet, so that would be a substantial increase in the size of that structure.

Mr. CONSTANDY. We do not have to let this remain this way? This is not desirable, is it? The legs of the sign bridge are just a few feet off the traveled way and they are unprotected. Do you care to comment, Mr. Skeels?

Mr. SKEELS. I would cross the median barrier, pick up the sign on the other side, and then cross back again. If you could drift the barrier across the median, pick up the sign leg, without lengthening the sign. Another solution, and one that has been used on I-94 in Michigan, is to bring a barrier in from the other direction, just past the sign. In other words, bring in especially a guardrail that ties into the barrier, into the median barrier, and bring it toward the sign in the direction of travel, and just past the sign. In other words, put a third leg in there, if I make myself clear.

Mr. CONSTANDY. Yes.

Mr. PRISK. It can be done.

Mr. CONSTANDY. Mr. Ricker.

Mr. RICKER. You are speaking about the location of the median barrier as the outside of the curve. I think there is another reason. There seems to be longitudinal drainage in the bottom of that median, so you cannot put the barrier right over the pipe.

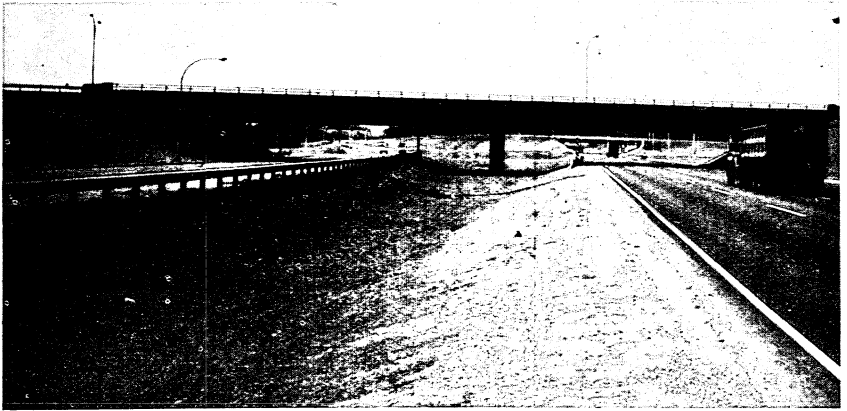
Mr. PRISK. That is true.

Mr. RICKER. It has to be off that one way or the other.

Mr. PRISK. That is true.

Here is another view of the same thing. In this case your pier remains exposed and it is the hazard, again, with the double beam rail on this side [indicating]. So you have a chance of coming on down in here, into this swell, and ending up passing the pier on either side, or perhaps striking it.

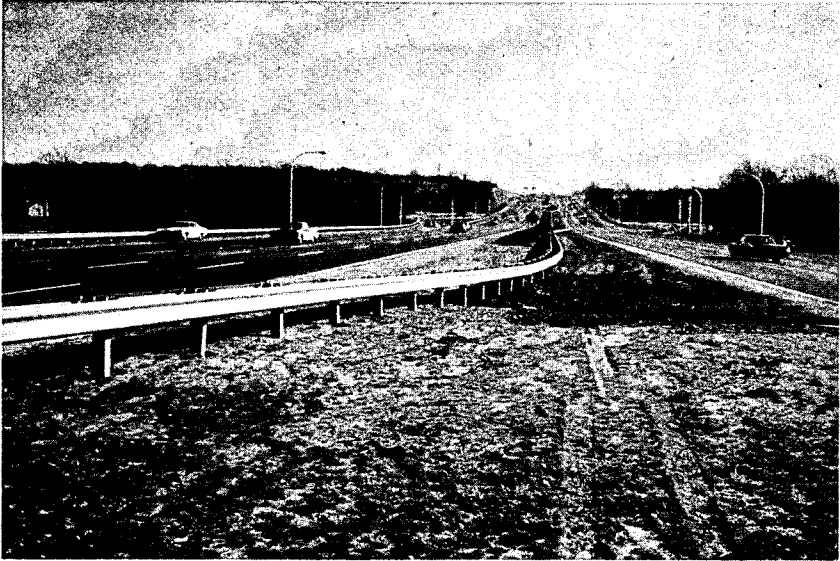
There is a little bit of rail here. Let's take a look at that.



This has been hit, obviously. Whether it did the job or not, we were not there long enough to find out; but nobody could go home too healthy after that.



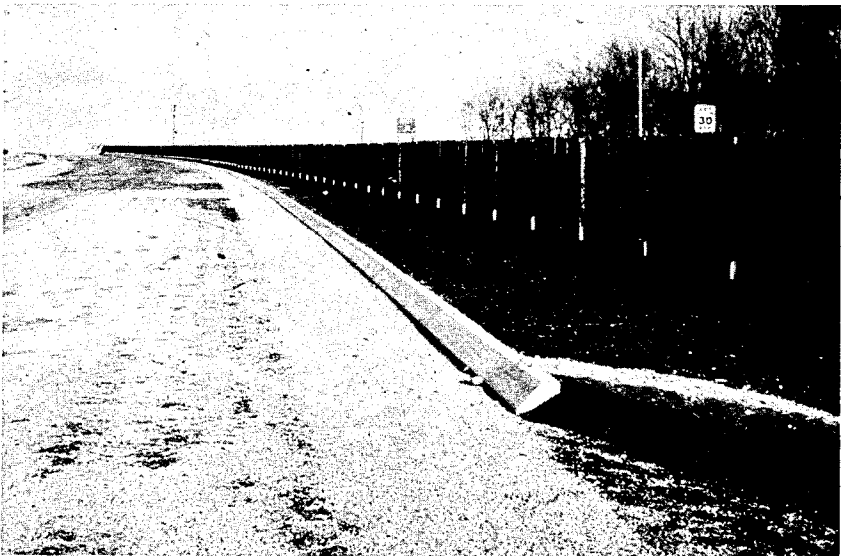
Here is another case where the rail continues on down. When you have a series of structures here with these lateral throws back toward the roadway, all of them I think could be lengthened to advantage, a little more gradual transition.

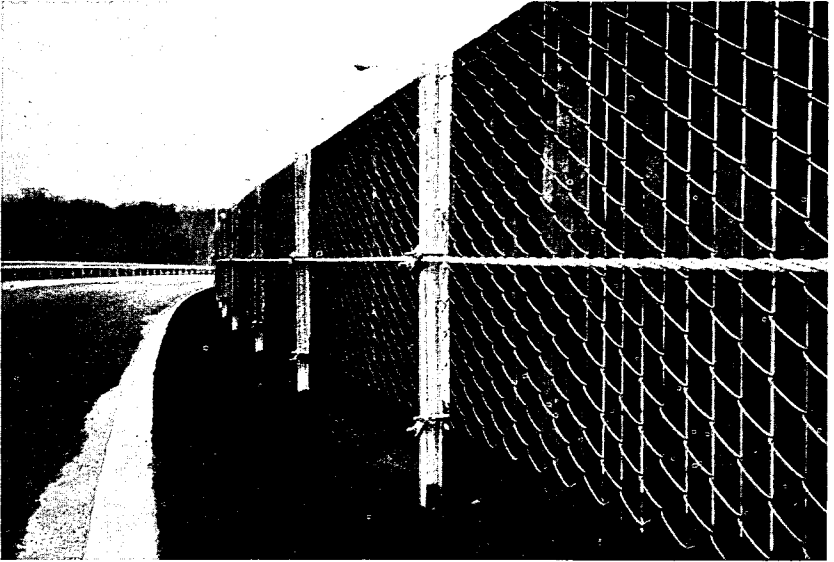


This, now, is a spur of I-95. There are some interesting things up here. This is a California-style barrier with slats incorporated in here so as to form a headlight glare shield.

Mr. WILSON. May I comment on that?

Mr. CONSTANDY. Yes, Mr. Wilson.





Mr. WILSON. This is even better.

The fact that you have a curb in front of this makes this barrier not perform like it ought to. It is almost essential when you use a cable barrier, because of the critical height of the cable itself, that there be a smooth path from the roadway to its contact with the cable. In this case here I am sure you are going to get enough bounce, you will either bounce over it or under it, or something.

Mr. PRISK. I think we are going to have an anticurb club here, Mr. Chairman, if this keeps up.

Here is another view. This is one of the hazards, of course, along the way on these cables; turnbuckles are pretty solid.

Mr. CONSTANDY. You have had some experience with the turnbuckles, Mr. Wilson, in California, have you not?

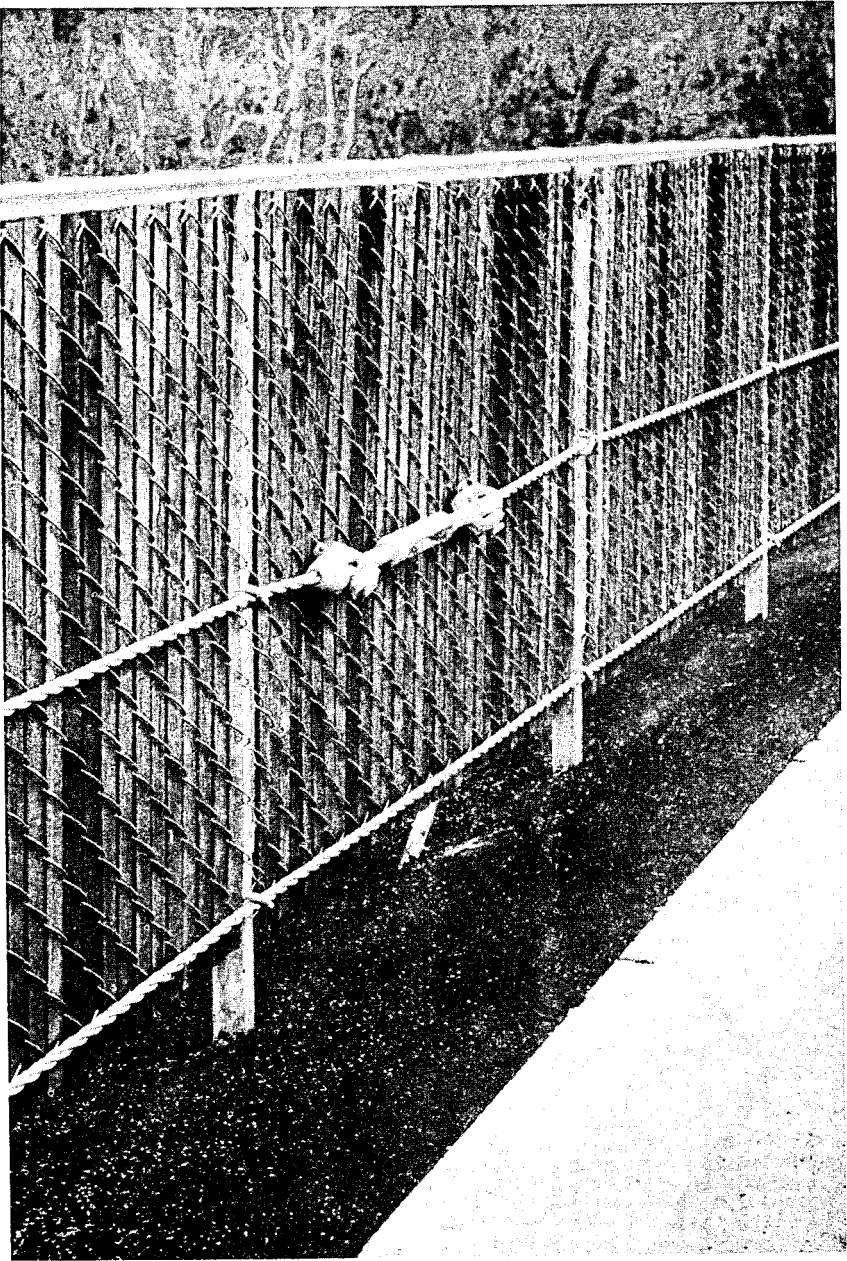
Mr. WILSON. Yes. They have to be designed so the vehicle will not get tangled with them. There should be as smooth a transition along the cable as possible.

I want to point out one other thing here. This has a lower cable, which originally was used to snag the vehicle and hold it into the barrier, but we no longer use that. We just use the two upper cables at about 30-inch height.

Mr. CLAUSEN. What problem did you run into to make you change that?

Mr. WILSON. Apparently it snagged the vehicle all right and I believe it had a tendency to rotate the car, and this was not desirable, because unless you are tied in with a seatbelt or something, you are liable to get thrown out of the vehicle. We no longer use it.

Mr. CONSTANDY. You have had quite a bit of experience in California with this type of median barrier. I wonder if you recollect any of the statistics?



Mr. WILSON. Well, we only use this barrier, this type of barrier, on a median that is 22 feet wide or wider, the reason being that there is considerable variation. When you hit it from one side, it is liable to deflect up to about 8 feet. And if you use it in a narrow median, you are liable to entangle a car coming from the opposite direction.

Mr. CONSTANDY. That would suggest this is a median not wide enough for it.

Mr. WILSON. I think that is correct.

All barriers, regardless of where used, cause some accidents, although we found they do prevent all cross-median accidents.

Whenever you put a median barrier of any kind, or in fact, any guardrail, it becomes a fixed object of one sort or other and it is going to be hit. So what you are doing here is trading lives for a few injuries; that is really what is the case, because these do cause some accidents. But it seems that hitting a cable barrier where you can use it—and you cannot use it in a narrow median successfully—why, there is a certain spring to it that decelerates you at a rather—well, a rate that you can stand.

Mr. CLAUSEN. This type of design, coupled with an adequate safety belt and shoulder harness, would this eliminate the problem of safety concerns?

Mr. WILSON. If it were used in a wide enough median and you do have the proper equipment, I would say yes.

I have read a lot of fatal-accident reports where the median barrier is involved, and the predominant cause of the fatalities that are involved with these things are because people are thrown from the vehicle.

Mr. CONSTANDY. Do you happen to know how often your barrier of this type is hit on the Los Angeles Freeway, per month or per year?

Mr. WILSON. I do not know. I cannot give you the exact number. I know we have about five crews that do nothing but fix this barrier. They are going at it all the time. Quite often they will run behind.

Mr. CLAUSEN. Mr. Wilson, I do not want to prolong this. Are you still using this type of design?

Mr. WILSON. Yes, sir. We are using it, as I said, on medians 22 feet or wider. It is an effective barrier. It is an economical barrier. Of course, without the lower cable here, it runs about \$3.50 a foot to place a barrier of this kind. It is about \$8.50 per foot for a blocked-out median barrier of another type.

Mr. CLAUSEN. In summing up your statement, if I understand correctly, you state that you feel you can save more lives—you may have some injuries, but you can actually minimize the number of injuries by coupling this with an adequate safety belt and shoulder harness program?

Mr. WILSON. That is my opinion.

Mr. CONSTANDY. In the course of this trip we made around the country, the staff found there is some opinion if you use both shoulder harness and seatbelt, you have a greater degree of safety than with just one.

Mr. SKEELS. Oh, let me talk. [Laughter.]

Mr. CLAUSEN. Do you want equal time?

Mr. SKEELS. The shoulder harness, diagonal shoulder harness should never be used without a lapbelt.

Mr. CONSTANDY. Without a lapbelt?

Mr. SKEELS. A lapbelt without a shoulder harness is not bad. A shoulder harness without a lapbelt is apt to be bad. Both of them together are good.

Mr. CONSTANDY. I was close.

Mr. SKEELS. The best restraint system we know is the lapbelt plus shoulder harness.

Mr. CONSTANDY. I see.

Mr. SKEELS. The worst one is shoulder harness without the lapbelt.

Mr. CLAUSEN. As a former aircraft fighter pilot that had to use both, when we grabbed the wire, I would agree with you.

Mr. SKEELS. I would like to make a little comment about this barrier if I could. I do not disagree with anything that has been said about it. We have run a test or two at the proving ground on this and have one conclusion, which Mr. Beaton, at least, agrees with.

If this barrier is struck at a relatively small angle, an angle, which, on a beam-type barrier, you just glance off of and continue on your way probably with a scratched fender, if you strike this type barrier at this small angle, it tends to snare you and make a much more major accident out of it. All he has said about the low deceleration is correct; it gives you very mild deceleration, but it tends to snare you and hold you in place and make a major accident or more major accident out of what perhaps, with some other types of barriers, might be only an incident.

It does have the advantage that I have heard espoused that it traps the car and enables the government to get the owner, driver of the accident car, to pay for fixing the fence. It keeps him there.

It does tie up traffic when you get an accident, and you get more of these accidents with this type barrier. However, agreed, you hurt very few people.

Mr. CLAUSEN. Would you agree with that, Mr. Wilson?

Mr. SKEELS. Give him equal time.

Mr. WILSON. That is right. Where we have used this barrier under the same conditions as a beam barrier, we find there will be a few more accidents involving this barrier than the beam. And as Mr. Skeels says, they will glance off the beam and go on their way. They may bend their fender up pretty badly. But this will snag them and keep them there.

You do have to get into that pretty far before doing damage to it.

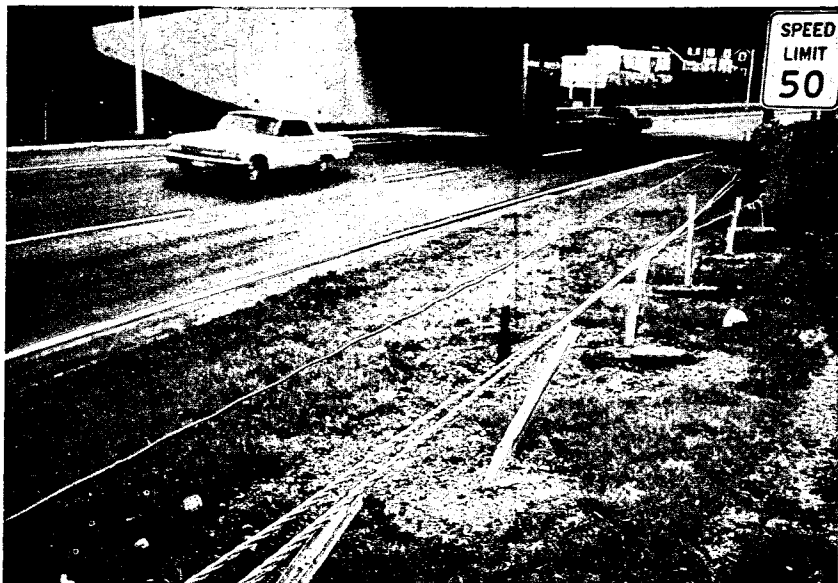
We do recover a considerable amount of damages from the owners of the vehicles.

Mr. CLAUSEN. If you had your choice, you would run the guardrail rather than this approach?

Mr. WILSON. Well, it would have to be used under two different conditions entirely. We would not consider any way using this median barrier anywhere where we could not park equipment in the median to fix it; because in this case here, if you park a truck along the road to do any repair work, you are going to have to take a lane of traffic away, and the first thing you know there will be accidents developing down the line you do not even know about, so we are very careful about that.

Mr. CONSTANDY. Mr. Prisk.

Mr. PRISK. Here is an installation where it actually was hit. This is not the same location, but this is the same type barrier without the glare shield in it, and the car was decelerated and knocked down about six or seven posts and presumably came to rest at that point. This is on a section just off the project.



Mr. CONSTANDY. Although it does not show very well in this picture, what the automobile does is cause the chain link fence to bunch up in a big wad, is that not right, Mr. Wilson?

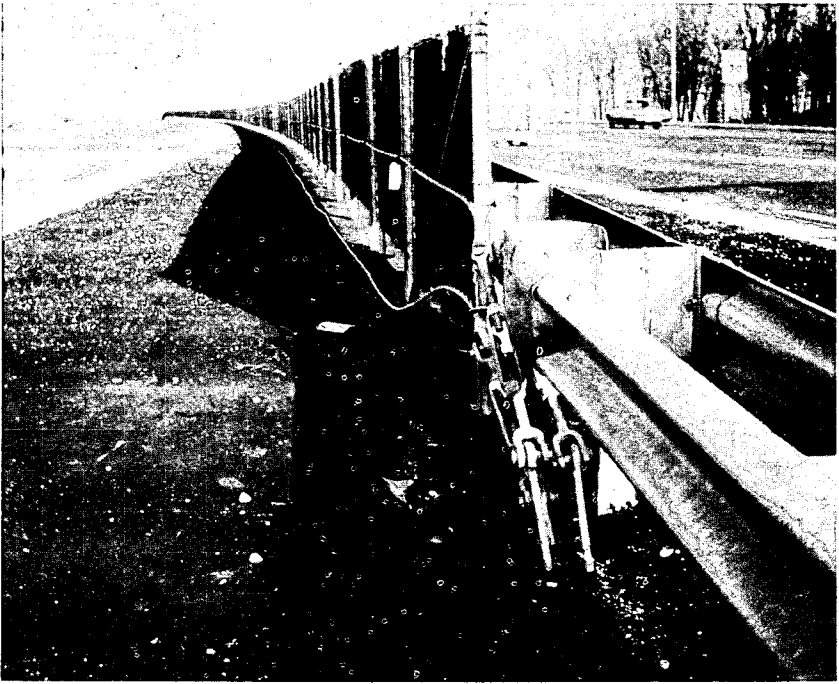
Mr. WILSON. Yes.

Mr. PRISK. It is in a pile down here [indicating].

Mr. WILSON. Incidentally, we found the chain link fence itself was not an essential part of this barrier. It performs just as well without it.

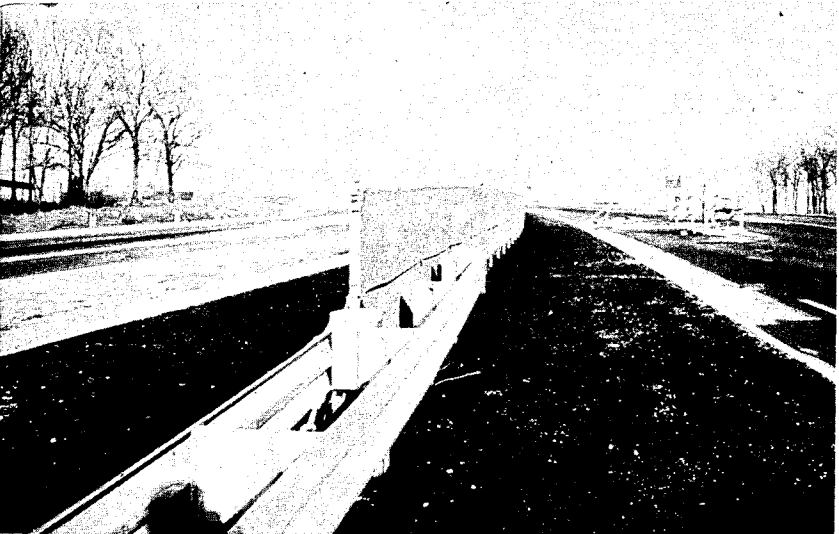
Mr. PRISK. Here we move right along.

Here is the junction, again, between W-beam rail and this California barrier we were just looking at. It is perhaps noteworthy that that lower cable was loose and laying on the ground unaccounted for.

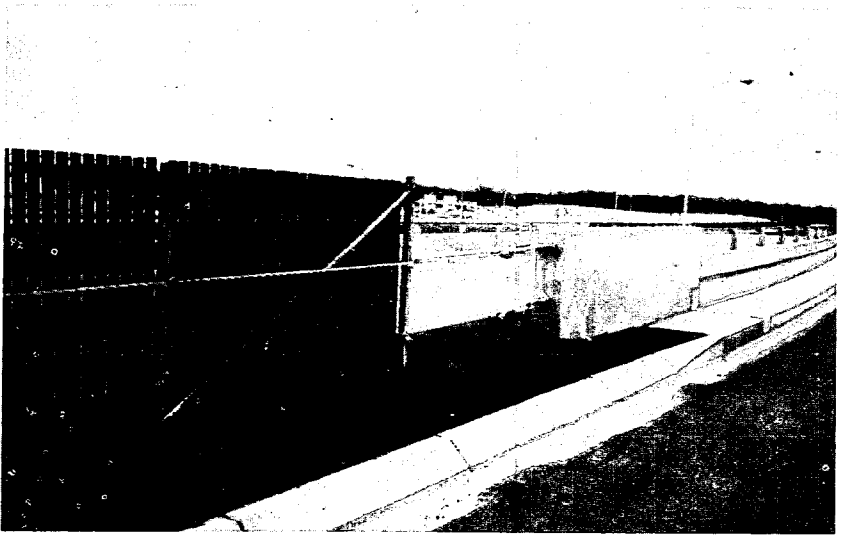


Here is the transition on the other side, which of course would be entirely satisfactory from that viewpoint.

I think the previous one here could get you into some problems, particularly with that top rail.



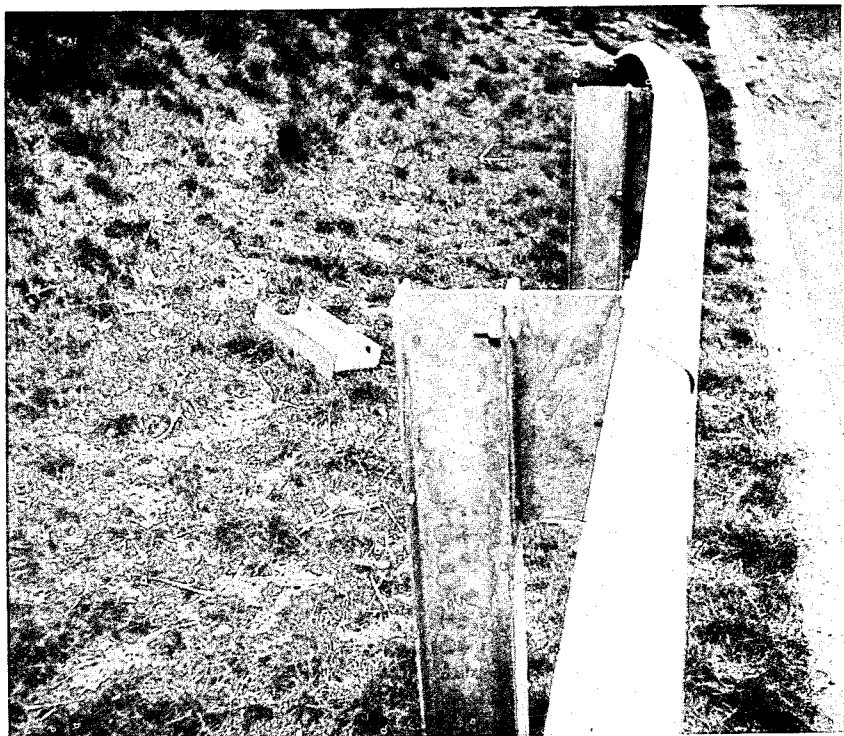
As we move along to the other end of the barrier, we find the eyebolts into the end post on the structure, and of course this is completely unprotected here for a short distance. This kind of subject will be discussed when we get to our bridge discussion.



Here now, on the newer section, the newer designs in Rhode Island, they have developed this style. You are looking now at a buried rail. This is flared and buried and they have also raised the rail up to 30-inch height at this point, which may be a little bit too high, particularly being on top of a curb again, because of the possibility of the vehicle jumping.



These are new designs. This is looking from the other direction. You see the steel blockout sections. These are just being installed. This does go directly into the ground.



Here is the way it lines up when they take it back into an embankment. This section is not completed yet, but it will be anchored, actually anchored in the slope in this case.

This is all part of the approach protection for that structure you see in the distance.

This is north of Providence.





And here, another newer section, newer treatment where they are running the end of the rail into the embankment right at a slope around their structure and beyond the structure, so this would be fairly well protected.

Incidentally, we shall be talking about structures and you will see that this wall is well back off the pavement, partway up the slope here. We will be discussing that later on.

Mr. SKEELS. I like this approach down under the bridge, this treatment of the edge of the road, this sloping portion. That is good.

Mr. CLAUSEN. The thought occurred to me—as a matter of fact, Mr. Howard and I were just chatting about that earlier—would it not be possible to utilize that sort of an approach from the bridge on down by applying this to landscaping rather than necessarily using the guardrails more and more? I think one of the preceding pictures there—is there a chance of backing up here for a moment?

Right there. Would it not be possible to extend the landscaping on down so as to minimize the need for the guardrail and have the same effect as what you had underneath the bridge?

Mr. PRISK. Well, the guardrail is a physical protection of the type that—I guess I do not understand your question. But I do not see that you can put in landscaping that would do the job that the guardrail does.

Mr. WILKES. Without moving the abutment back.

Mr. PRISK. That is right.

Mr. WILKES. The abutment is too close.

Mr. PRISK. Unless you are going to change the structure.

You are faced with the fact you have a fixed object very close to the edge of the paved way and this is put in here as a steel beam along these steel posts in order to keep some of them from hitting the end of the structure.

Mr. CLAUSEN. Maybe it would be more expensive, but the thought that occurred to me was if you were to extend this landscaping on down like this [indicating], it may not require the utilization of the guardrail. Let's move it up to where the bridge is and I will show you what I mean.

Right over in here, to have the same effect here [indicating].

Mr. PRISK. Yes, if you could recess the wall as this is done, certainly. Absolutely. This is very desirable.

We shall be talking about structures tomorrow and you will see a number of examples of this type. I think that should be applauded.

Mr. CLAUSEN. Would the expense of that type of landscaping be similar?

Mr. CONSTANDY. It is not a matter of landscaping.

Mr. PRISK. It is a matter of lengthening the bridge structure.

I misunderstood you, because you spoke of landscaping. You have to increase the span from this point here on out to this point [indicating] in order to accomplish what you are speaking of, I believe.

Mr. CLAUSEN. Yes.

Mr. PRISK. Jack, do you want to talk about this?

Mr. WILKES. I agree, the big expense would be lengthening the span, or lengthening the structure, a greater expense there than would be the landscaping itself.

Mr. CONSTANDY. Now we have moved on to Missouri, have we not, Mr. Prisk?

Mr. PRISK. We have some pictures from Missouri that are very interesting. We do not have very many for the simple reason Missouri has not made hardly any use of guardrail on this particular project. This is Interstate 35, north of Kansas City, a rather long job, but with hardly any guardrail on it.

Mr. CONSTANDY. Yes. In 28 miles, the only portion of the project having guardrails at the time we visited it was the guardrail protection at this first bridge at the southern end of the project. I think they were beginning to install it on a second bridge a mile or so above this.

Mr. PRISK. It would be pretty hard to fault them on this kind of an installation. The washer is there and it is blocked out and the height was about 26 inches.

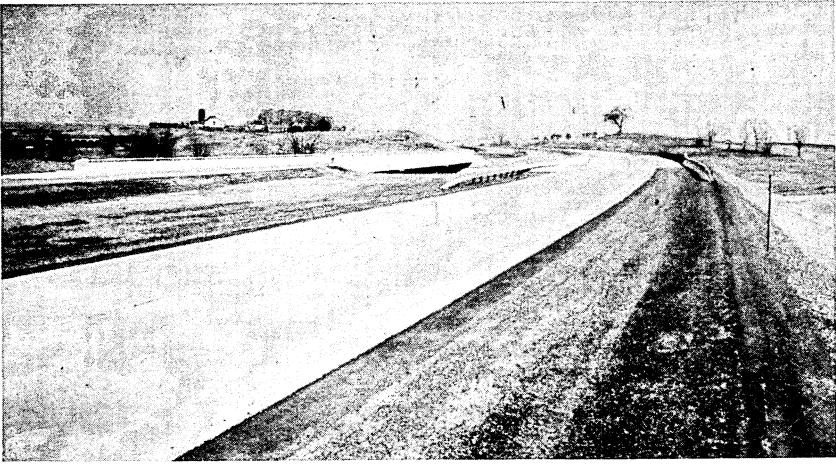


As we take another look at this first bridge which was equipped with rail, we find this approach rail on the right pretty well buried in line with the edge of the paved shoulder, as I am pointing out here [indicating], and on the left just about the same kind of treatment.

If anything, this may be a little bit short, but otherwise it looks fairly good as far as that part of it goes.

Now, this is a dual bridge and you must remember there is a hole down there [indicating].

Mr. CONSTANDY. Mr. Prisk, we might pause there. You say as far as this part of it is concerned. Remember, we are talking only about the guardrail. Tomorrow we will be concerned and discuss bridges.



We will discuss what is at the other end of the guardrail, where there is a transition from the guardrail to the bridge rail, a point to which you made reference yesterday.

Mr. PRISK. Yes. There is no protection.

What I was saying is there was no protection for the space between the dual bridges with that type of installation.

Mr. CONSTANDY. Mr. Huff, do you want to comment on that? If I understand what you said earlier, would this be the type of installation you could recommend?

Mr. HUFF. If I could see the connection at the bridge, it looks like what I saw.

Mr. PRISK. Here is the connection at the bridge.

Mr. CONSTANDY. I am not talking about the connection at the bridge; I am talking about the space between bridges.

Mr. Prisk made the point that this design does not afford protection to the motorist going between the two structures. If I understood correctly the comments you made earlier, you would prefer the guardrail to be parallel with the roadway.

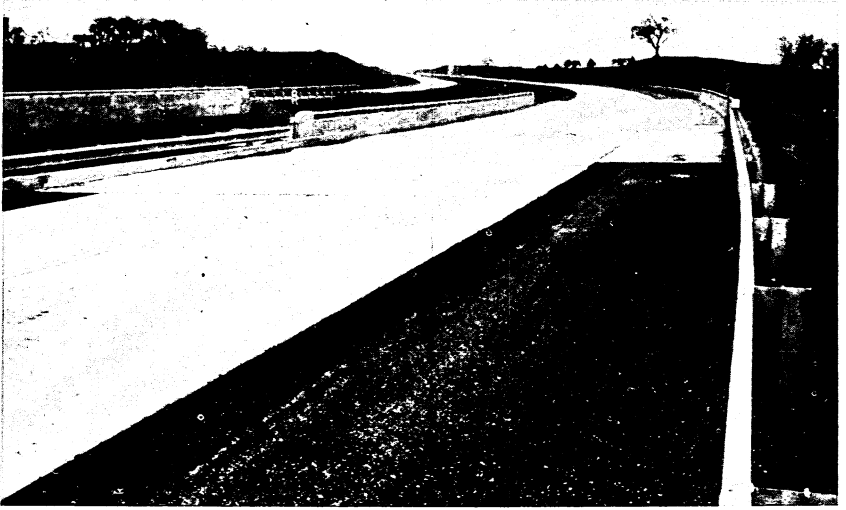


Mr. HUFF. But longer than the one he showed.

Mr. CONSTANDY. That would be your comment, this should be longer?

Mr. HUFF. Yes.

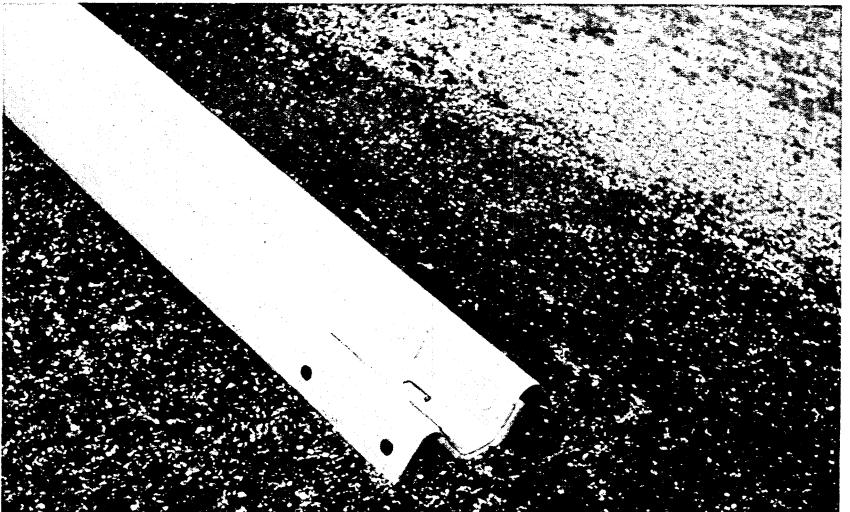
Mr. CONSTANDY. I see.



Mr. PRISK. This is a bit closer up. You can see the full shoulder width is taken across the structure. And even the little guardrail on the far side, on the right, continuing.

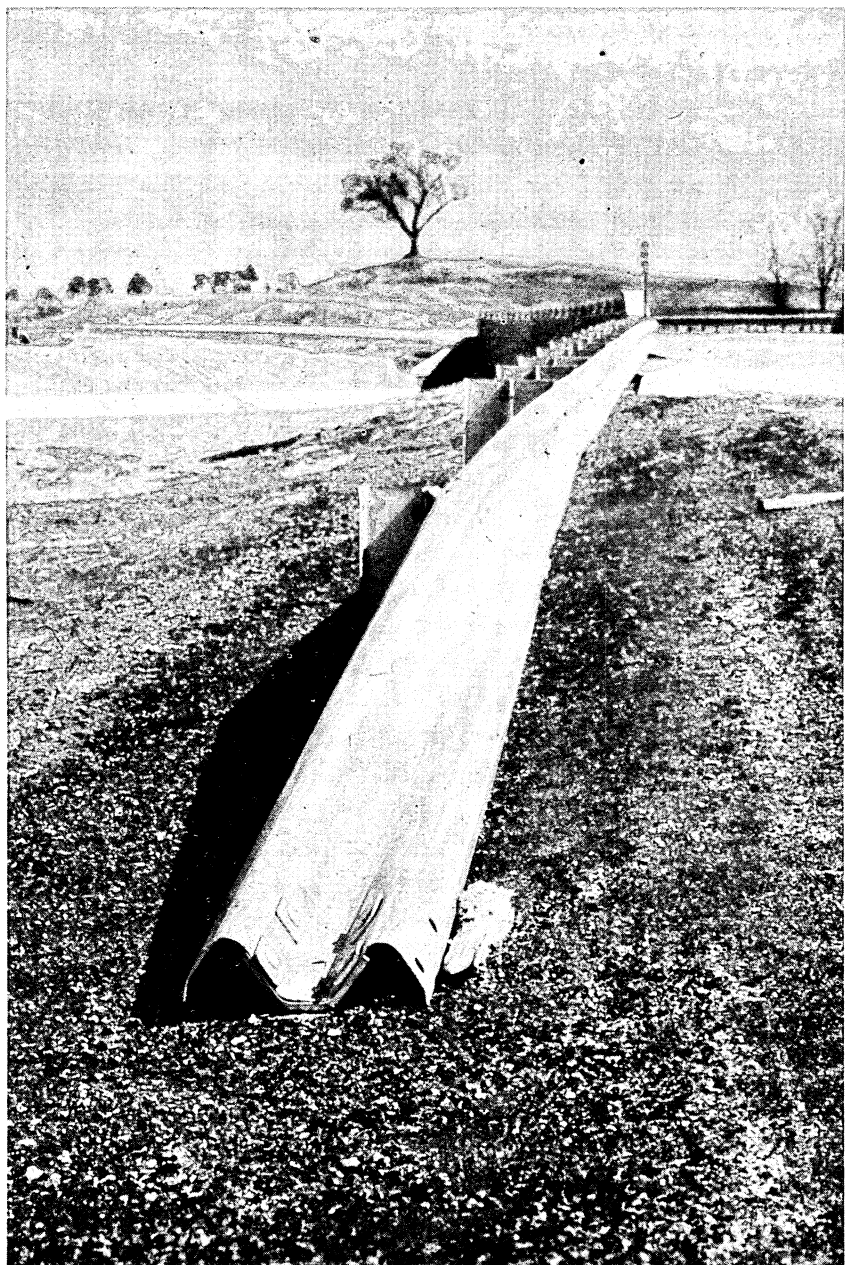
Mr. HUFF. We furnished to them our plan—that is almost exactly our plan—showing the continuity of crossing the bridge, and it operates very well.

Mr. PRISK. Here is the detail of the end as it is buried in line. They plan, if I recall the comments that we had from the field engineer at



the time, to put a plate on the top of that, so as to surround it—actually into the surface of the shoulder.

Here is the left slide. You can see again how this runs on up to the structure.



Now we are moving to Nevada and Interstate 80. This is a section we hit in bad weather. Actually we went from bright sunshine to a snowstorm that day. But here they have blocked-out rail and wood posts, as you see, in a fairly good-looking installation. This is typical, again, of what you find in that State.

Mr. SKEELS. Was it 6-foot spacing?

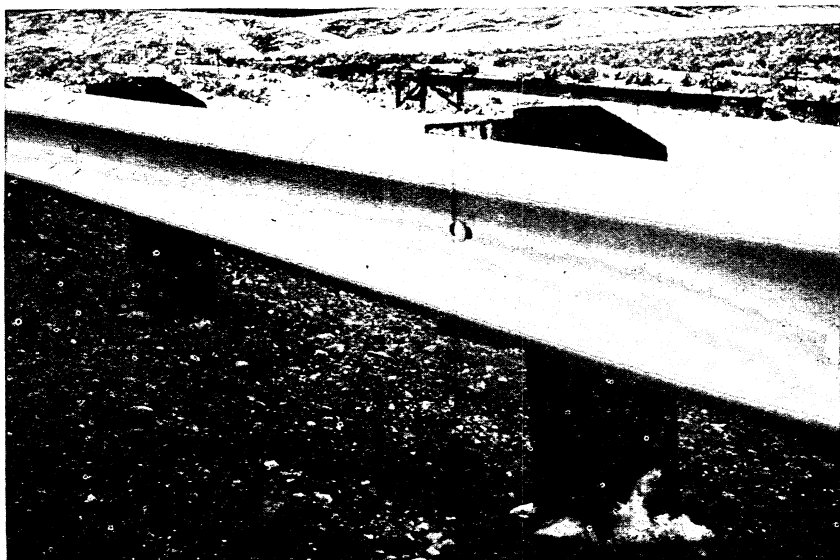
Mr. PRISK. The post spacing in Nevada is 6 feet 3 near the end of the run, 12 feet 6 normally.

They paint the rail white there and avoid the cost of galvanize. This matches up nicely with the snow.



Mr. SKEELS. No washers.

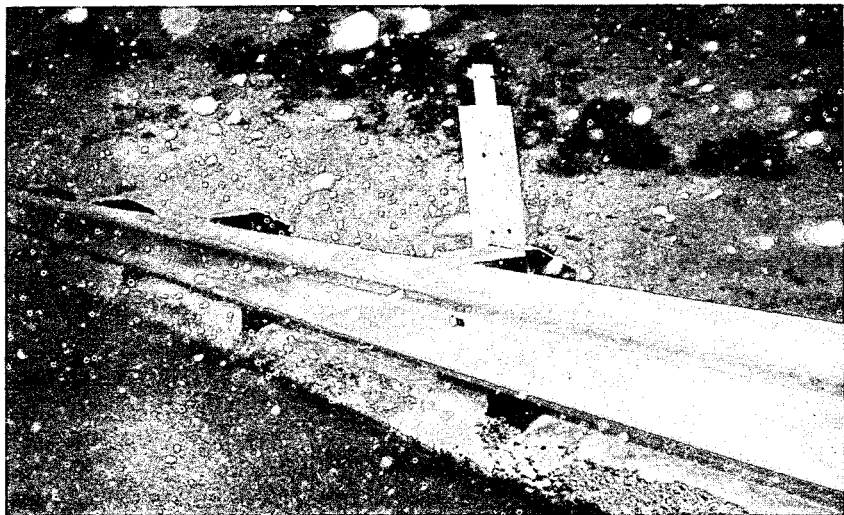
Mr. PRISK. There are no washers.



Here is a picture taken under very severe conditions—snowflakes you see there—but again showing the rail and the blocked-out position of the rail in relation to the paved surface.

Mr. CONSTANDY. It loses some of the contrast in the snow, the painted rail.

Mr. PRISK. That is true.



Mr. WILKES. Was that a curb at the face of the guardrail?

Mr. PRISK. There is an asphalt curb right at the face of the guardrail.

Mr. CONSTANDY. That is not throughout, though, is it?

Mr. PRISK. No, just along embankments and along structures, principally.

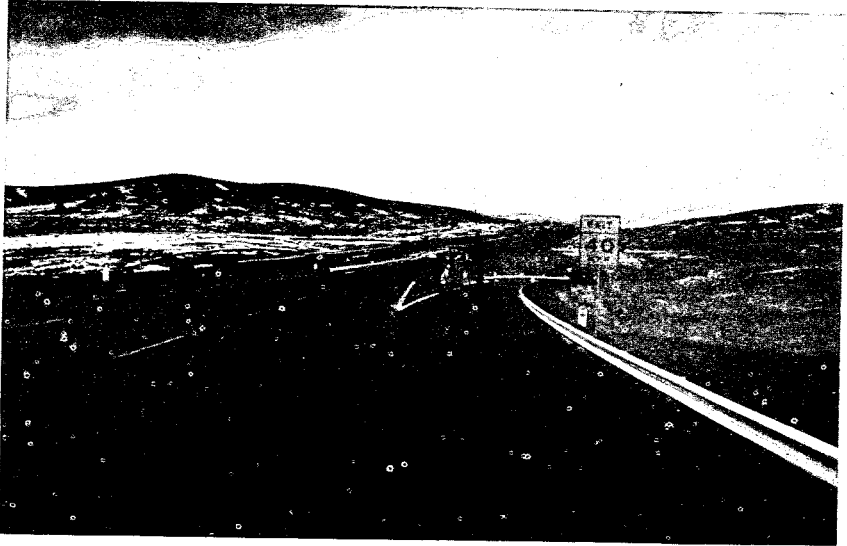
Here is the approach to the only interchange there was on this particular job we looked at, few and far between there. You will see the



approach rail is slightly flared as you move into this section toward the decision point.

Here is a good view of the gore showing how the rail sweeps off to the right and on down the exit ramp.

The rail picks up in the gore just a little way beyond the gore. These points that you see in here [indicating], these white spots are black and white painting on the asphalt curb to give it higher visibility.



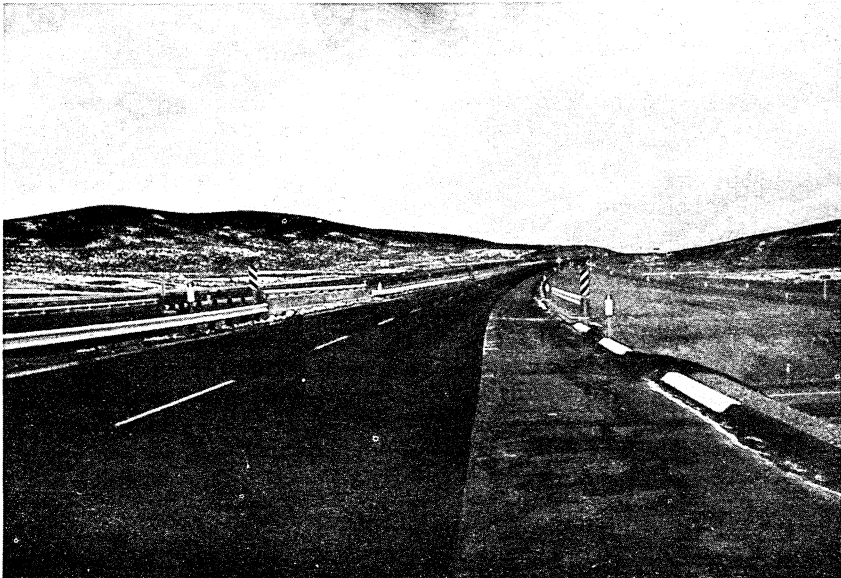
Here is the same view under poor light conditions and during a snowstorm, indicating again the relative position of the rail, the position of the gore.



Here is another view showing the small amount of flare that was used there.



This I think perhaps is one that I would call your particular attention to, because of the fact that this [indicating]—this is the one interchange structure on the project and for some reason it seems unexplainable. Even at this point in time, a month or so after we looked at it, there is no approach rail along this embankment as you move toward the parapet end of that structure. There is one on this side



[indicating] and there is one on the other roadway, but none on the approach side at the right-hand side.

Mr. CONSTANDY. I believe there is none leaving the bridge on the right side either, Mr. Prisk,

Mr. PRISK. I believe you are correct. There is some here on the left, but none on the right.

Mr. CONSTANDY. Does not the correspondence we received from them since then indicate they have either installed this guardrail or they are about to?

Mr. PRISK. A few days ago we had word—that is correct—that the rail was being installed by maintenance forces. It had been inadvertently omitted.



This shot—one thing shows—again this slight flare that is used, the rail is not buried but left exposed. You do see, as an incidental by-product of this photograph, a very good contrast between the surface of the shoulder and the surface of the roadway itself. That contrast was evident both under poor conditions and good conditions.

Mr. HOWARD. Now, Mr. Prisk, on that photograph, the previous one, what is the necessity for guardrail? You have fairly level land if the car should leave the roadway. It could be, as we were talking about before with Mr. Clausen, this idea of trying to keep the land as level and clear as possible off the road, that if an automobile does go off the road, the driver could very well have enough time to regain control of the car or bring it to a halt. But if he hits that guardrail, he is in trouble right there. I wonder what the purpose of that piece of guardrail is? There does not seem to be that much danger.

Mr. PRISK. Well, the land may look a little bit flat from this picture and perhaps in the others, but actually there was rock in this area, and without being able to recall any more about it, I can only conjecture that this rail would have been put in because of the nearness of some rock outcropping on the inside of that curve.

Mr. SKEELS. Is there any drainage across there?

Mr. PRISK. I do not think there is any drainage there.

Mr. HOWARD. You would think possibly landscaping could be a significant factor for safety here, making it safer than the guardrail?

Mr. PRISK. Certainly any place where you can reasonably take slopes back and get rid of guardrail, you are better off, because you for all time solve your problem. There is then no maintenance for guardrail and very little on the slopes.

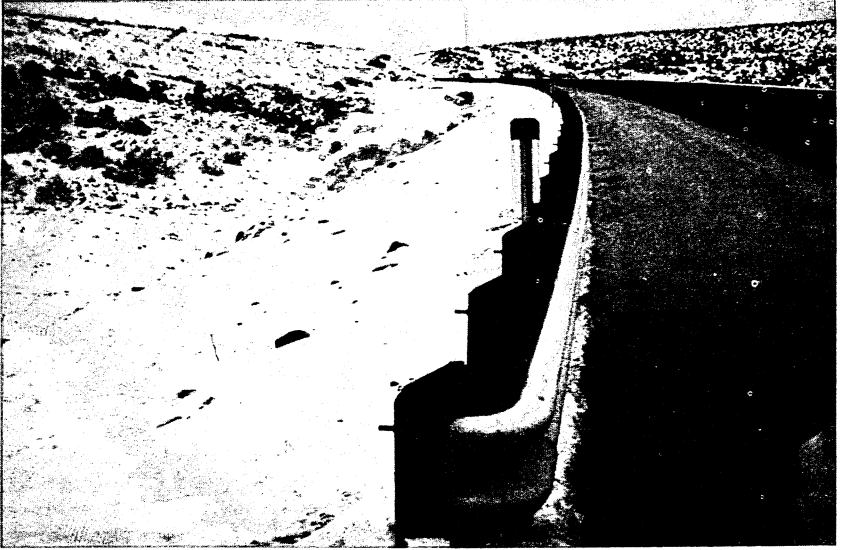
Going ahead, we see the advance sign coming in toward the interchange that I mentioned. We saw a closeup a little while ago.



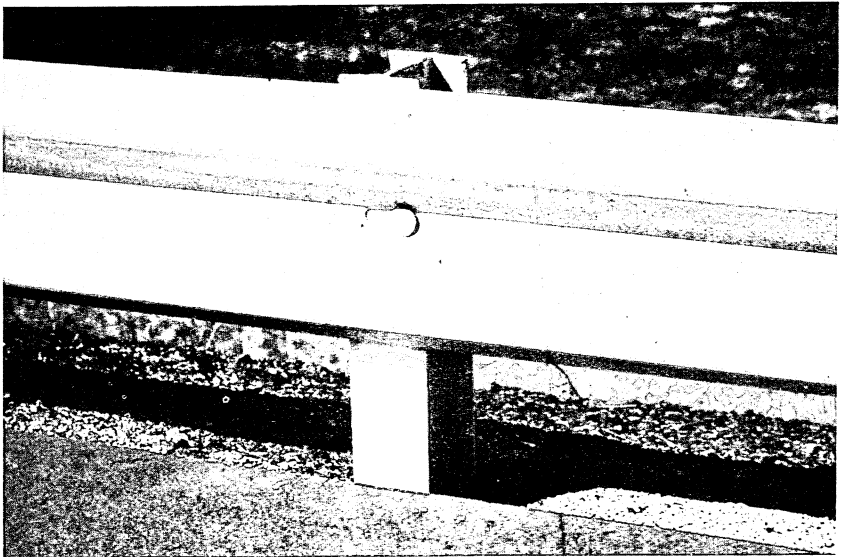
This is again the standard type installation, blocked out, through-out, and 6-foot-3 spacings.

This completes Nevada and we move next to a location in Indiana, where we looked at I-69.

This is a portion that runs between U.S. 24 and U.S. 224 just south of Fort Wayne, Ind.

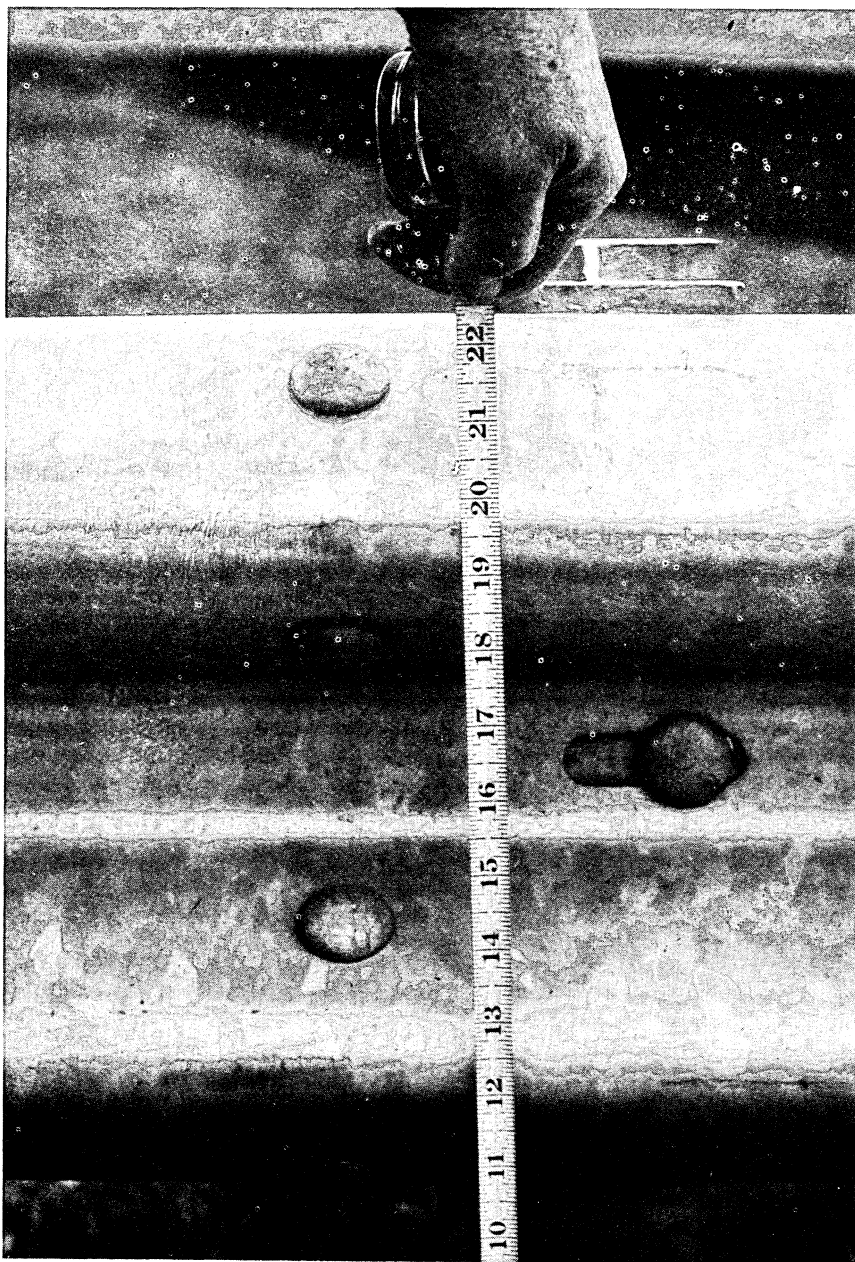


When you move to Indiana, you find this type of guardrail installation. It is not blocked out. There are no washers on the joints.



And as this measurement shows on this recently completed section, there is only 22 inches of height on the rail.

Mr. CONSTANDY. What do you think of that design, Mr. Skeels? The height, not blocked out, steel posts, and no washer?



Mr. SKEELS. Well, of course, it needs the washer. The steel post is probably not strong enough. And that height is a bit low all right.

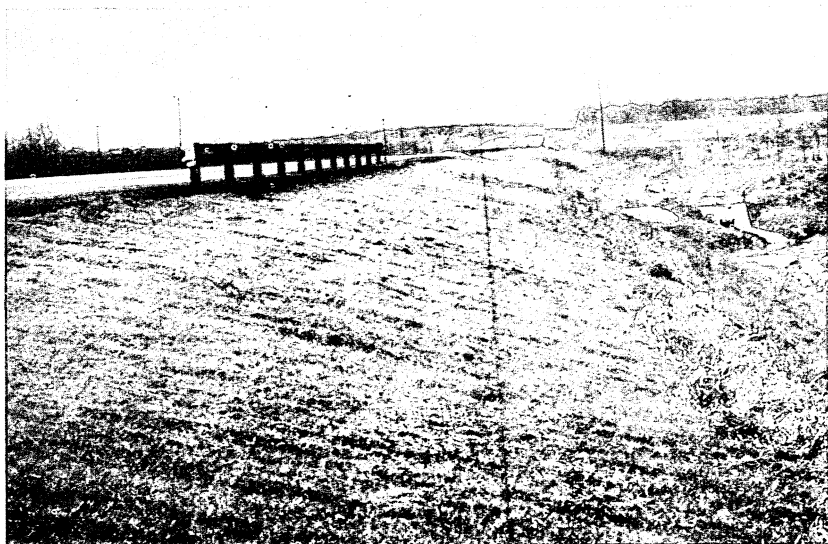
Mr. CONSTANDY. By about 5 inches would you say?

Mr. SKEELS. Yes. About 27 inches is about right.

Mr. PRISK. As I say, this height varied quite a bit in Indiana. I have guardrail measurements here up to 30 inches, so some of them are quite high and some of them were as low as 22 inches.

Mr. CONSTANDY. You cannot say it averages out.

Mr. PRISK. On the average it looks pretty good.



Here is a fairly short section of rail installed at the outer edge of the shoulder, and it is a recently completed and opened project, early this year now. I think we continually have to remind ourselves that these are very new projects; quite short.

You will see the reason for the rail. There is an extremely large pipe that goes all the way under the roadway here that is part of the irrigation system, of the drainage system, for the surrounding land. But in the process of protecting motorists from getting down here to that hazard and the headwall that you see here, a fairly short rail was installed.

I think you can conjecture, possibly, that this slope is a traversable-type slope and perhaps this introduces more hazard than it is worth.

Mr. SKEELS. I would agree; the pipe goes under the road.

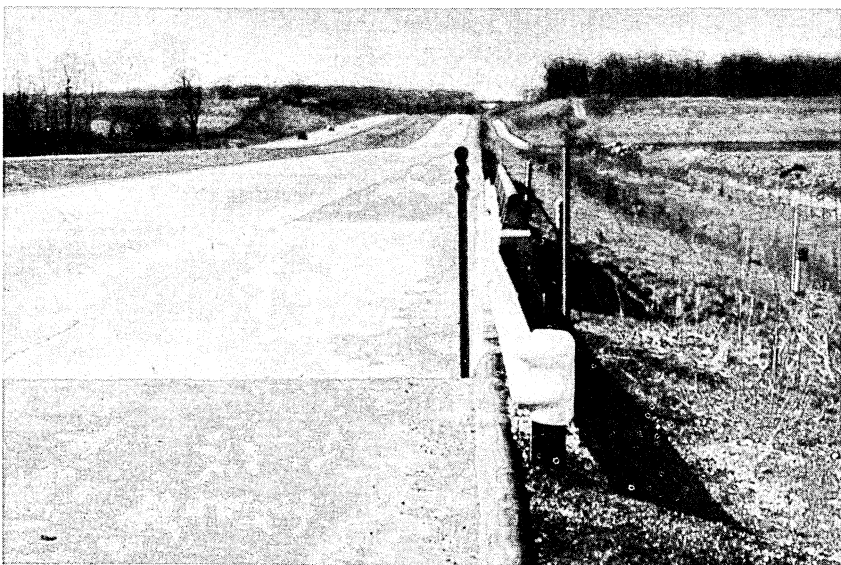
Mr. PRISK. Yes.

Mr. SKEELS. It could have been carried out another 20 feet and eliminated the hazard for all time without the guardrail. The guardrail is certainly contributing more hazard than it is remedying in this case.

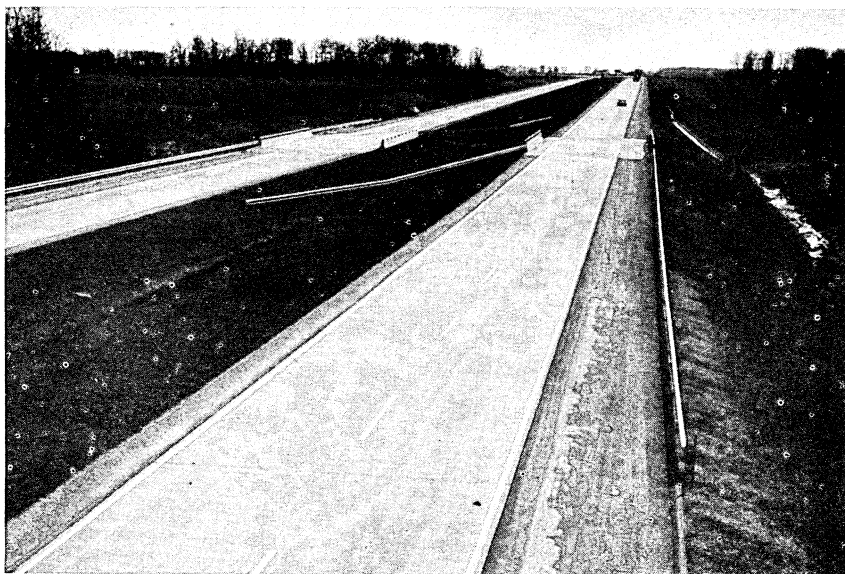
Mr. CONSTANDY. You gentlemen would agree the slopes are relatively flat?

Mr. SKEELS. That slope looks real good.

Mr. PRISK. Here is a treatment on the approach to short structures. You have an extremely short section there. I think this is only a 12.5-foot section of rail in advance of the structure, directly head on.



Here is looking from an overhead structure down to what you find again shows a great deal of respect for this hole between the twin bridges, because they carry the median rail all the way across, almost too close to this road, in order to protect against dropping in at this point.



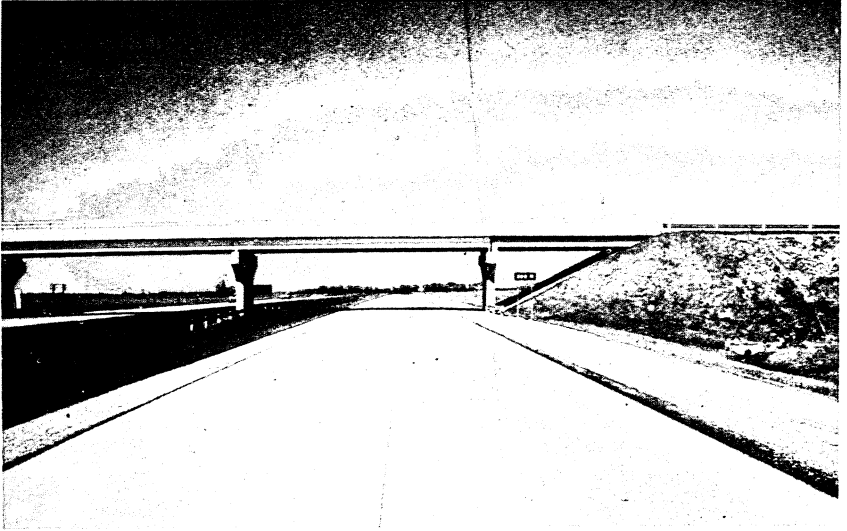
Here again [indicating] you have the head-on situation.

Mr. CONSTANDY. In that photograph it would appear the median guardrail there is on an angle as it comes across the median, but I believe I am correct, Mr. Prisk, that it is only apparently there and it is due to the swale? Actually that piece of guardrail is straight?

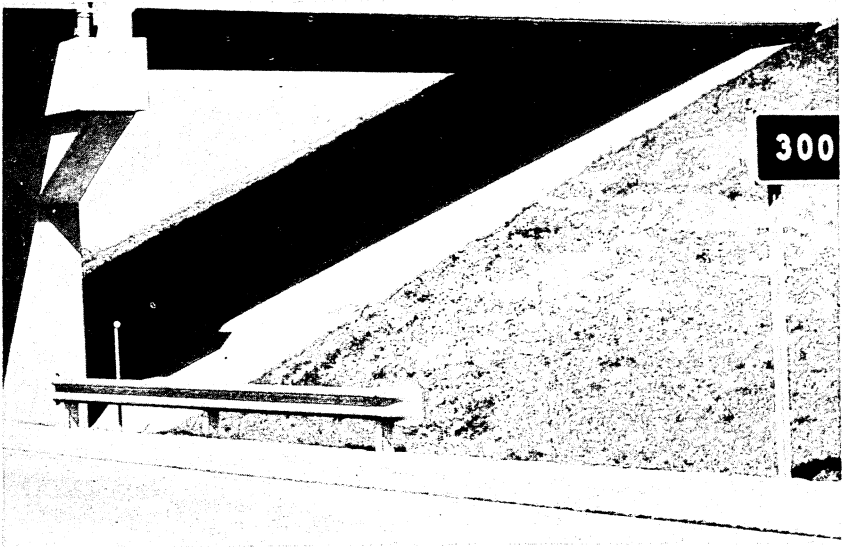
Mr. PRISK: Yes; it is straight.

I think we have another view to prove that.

Maybe not here. Here again, just one section of rail in advance of the side pier. You have two panels in advance of the center pier. So this is 50 feet of rail, gentlemen, and this is 25 feet on this side.



There it is close up.



Mr. CONSTANDY. I think that might be worthy of comment from members of the panel. Mr. Skeels?

Mr. SKEELS. This is useless; this is a waste of money. You certainly have got to put in a great deal more than this and a great deal better guardrail to get any protection at all of that pier.

Mr. CONSTANDY. This would seem to lead the automobile using it directly into the pier?

Mr. SKEELS. Well, if you visualize that if a car does happen to hit this thing on the face of this, on its very short face, the rail is going to be deflected backward and the car will probably line right up with the pier by the time it gets there.

Mr. CONSTANDY. What do you think about that, Mr. Huff?

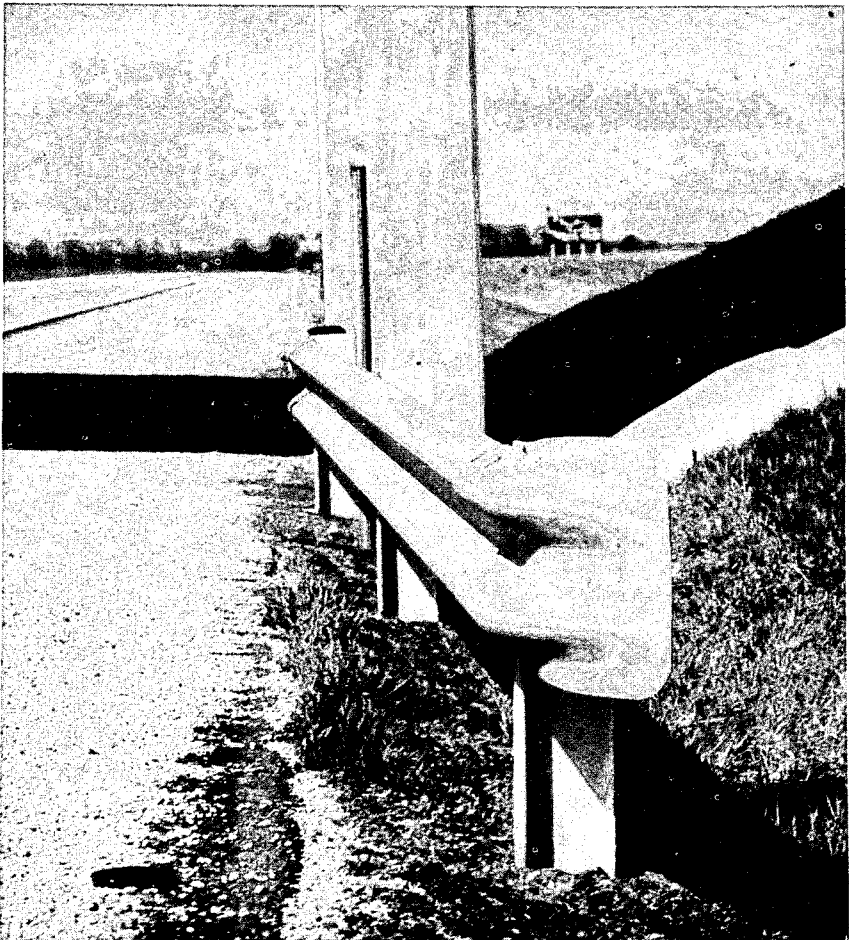
Mr. HUFF. I agree with him.

Mr. CONSTANDY. Mr. Ricker?

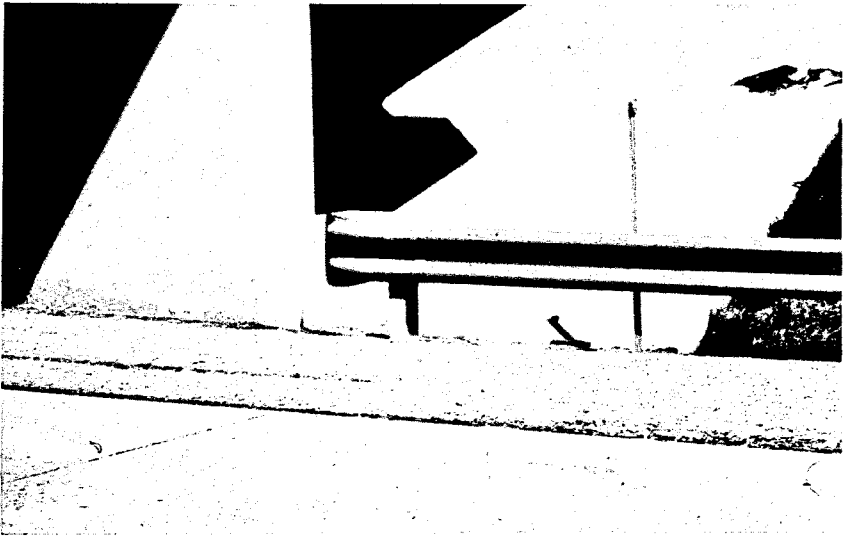
Mr. RICKER. I was going to reverse what you said and say it is not worth commenting on.

Mr. CONSTANDY. Beg your pardon?

Mr. RICKER. It is not worth comment. You need much more guard-rail to give adequate protection.



Mr. PRISK. Here is another view of the same thing.

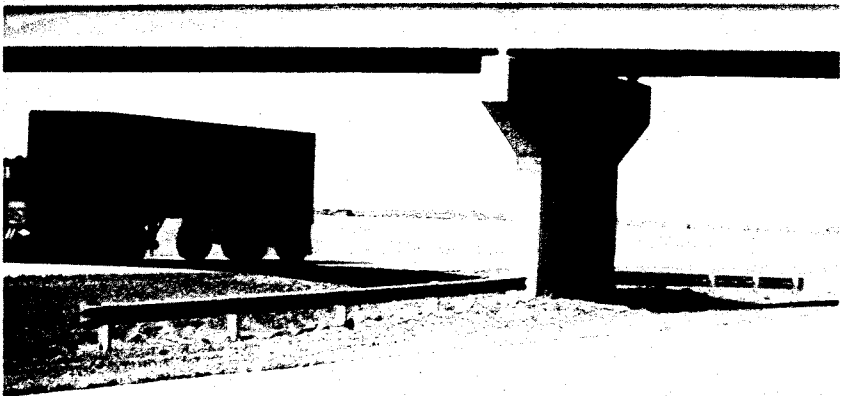


Here is the median side in a little more detail; 50 feet of rail.

Mr. CONSTANDY. Mr. Skeels, I was only going to add, these are all too typical. They are fairly common. They are not unusual.

Mr. WILKES. But I would like to observe it is in the right position. It is near the middle of the median and it is not at the edge of the paved shoulder.

Mr. CONSTANDY. That is true. I think that is worth while in light of a few of the pictures we have seen; it does leave something to be desired, however, the guardrail itself. Mr. Wilson, would you care to comment on this?



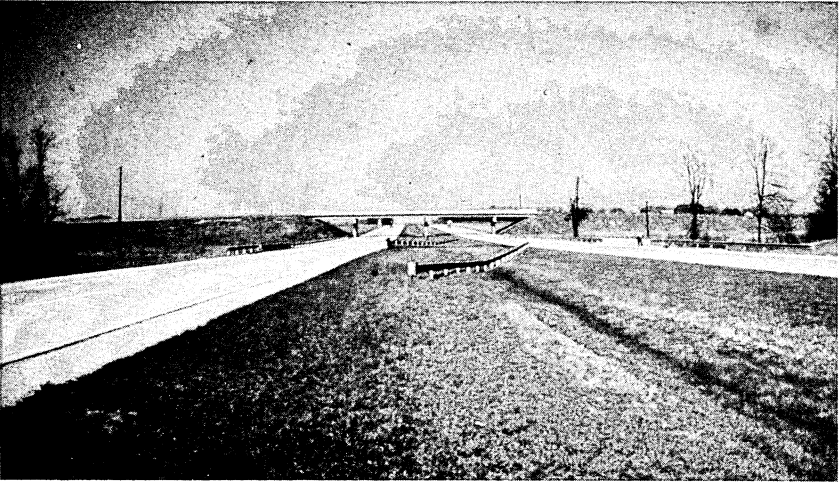
Mr. WILSON. I think about everything has been said that need be said about this particular situation.

In the previous picture, I did notice one other thing—[slide] no, I guess it is a couple of pictures back—[several slides]—the sign structure—there it is.

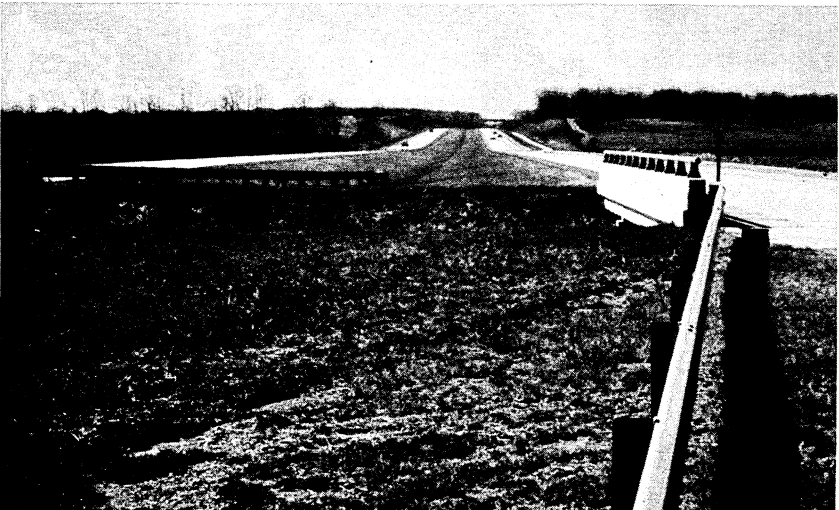
I suppose those are I-beams? If they are the sign should have been on the structure.

Mr. CONSTANDY. Yes. We will have another session which will relate to the signs and we will see more detailed views of signs on this project.

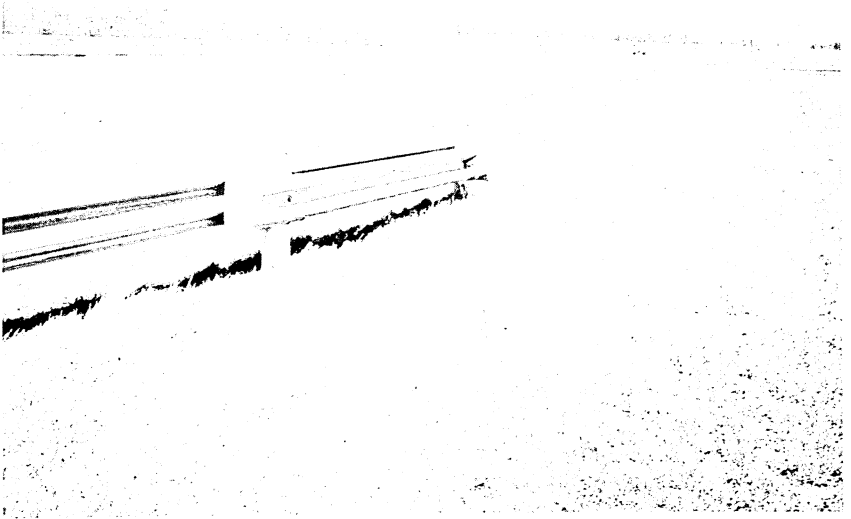
Mr. PRISK. Here is a closeup of the protection at the twin bridges showing how the approach rail has carried across the center of the median, also doubles back for a number of panels.



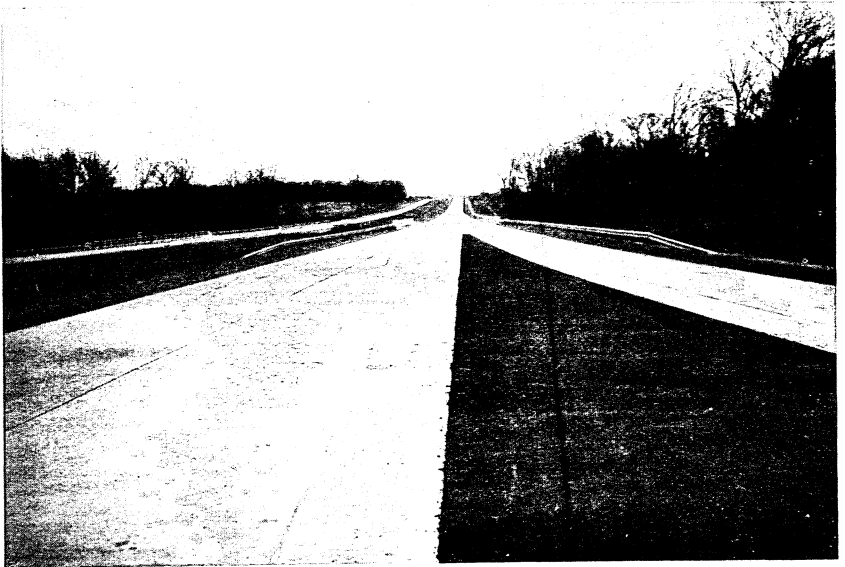
This is the way it looks as it reaches the structure itself.



And this is doubled back one panel—excuse me, only one panel.



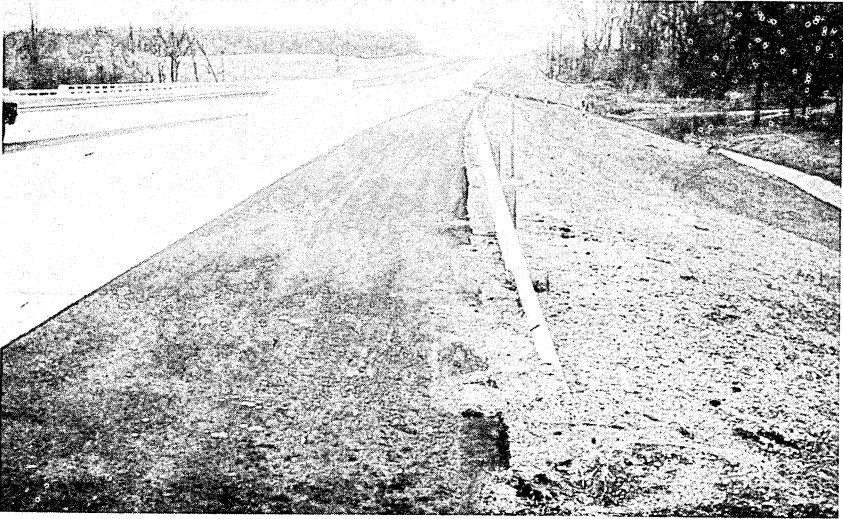
Now this is new work. We moved away from I-69, which is the route we were just looking at, and this is a portion of I-70, east of Indianapolis. And this is not yet even open to traffic. There is work still going on on it. So this is a brand new piece of work. And as you look at the first entrance ramp on the approach to a structure, this is what you see. The improvement has been made to lengthen the rails, both on the right and on the left, and the rails have been buried. The approach ends have been buried.



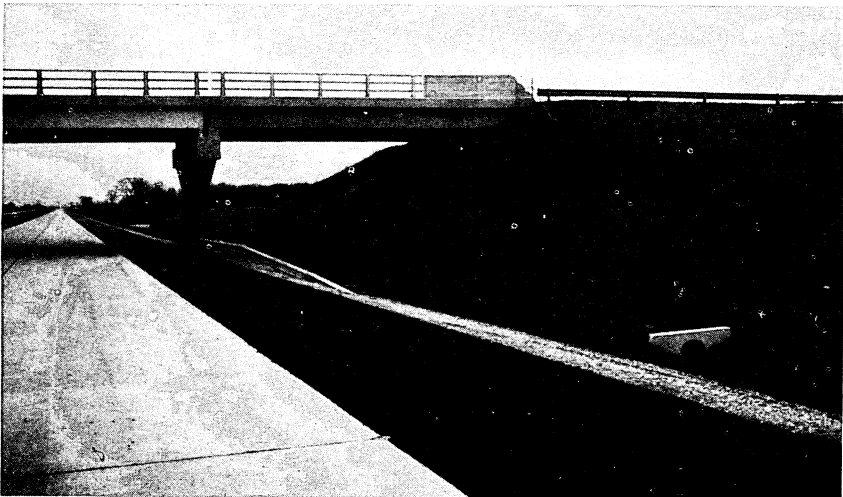
The detail of that shows again here. These are buried in line, not twisted; they are buried straight down.

You will notice as you get up to the structure that you have a little pocket up there, and as far as the rail is concerned, it pretty well cuts off your shoulder as you reach this particular structure. This is perhaps a little more detail about a structure than it is about a rail, but in any event you see the alinement of the rail.

Beyond this structure you can see how the shoulder picks up and makes a normal location of rail.



Here is a closeup of the undercrossing on that same project. They have not lengthened the rail too much but instead of having two panels here [indicating], which would have been stopping at this point, this has been doubled, at least, and brought out here a little bit farther and buried.



Even though this is brand new and, as I say, there has not yet been any public traffic on this highway, this would appear still to be somewhat short of desirable.

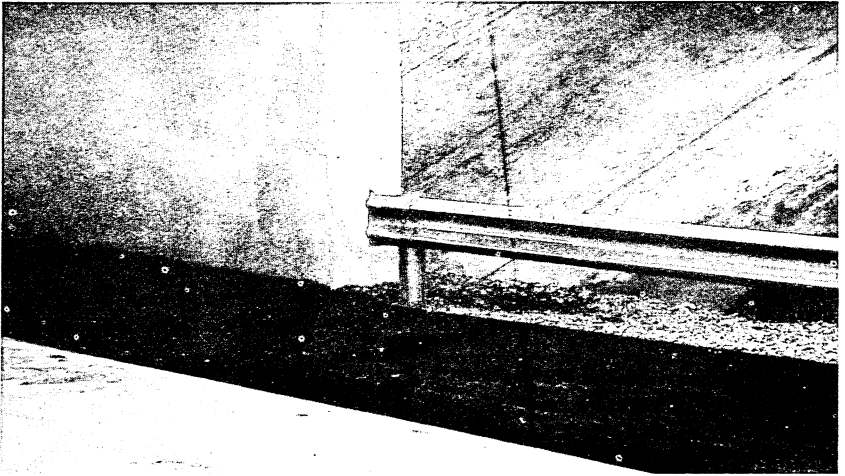
Mr. SKEELS. I would like to point out one other problem on this particular picture. It is that culvert down in the ditch. It is a flat wall, at right angles to the route of traffic, and a car going off the edge out of control can bottom right into that culvert.

It does not have the benefit of the back slope angle. It is a bad place that is all too typical on the roads.

I do not recall seeing any accidents involving these myself, but this certainly is a hazardous area that should be considered perhaps in some other area.

Mr. CONSTANDY. Yes; we will get into a segment on drainage installations later.

Mr. PRISK. As you reach the structure, this is what you find—no anchorage post driven close to the side pier.

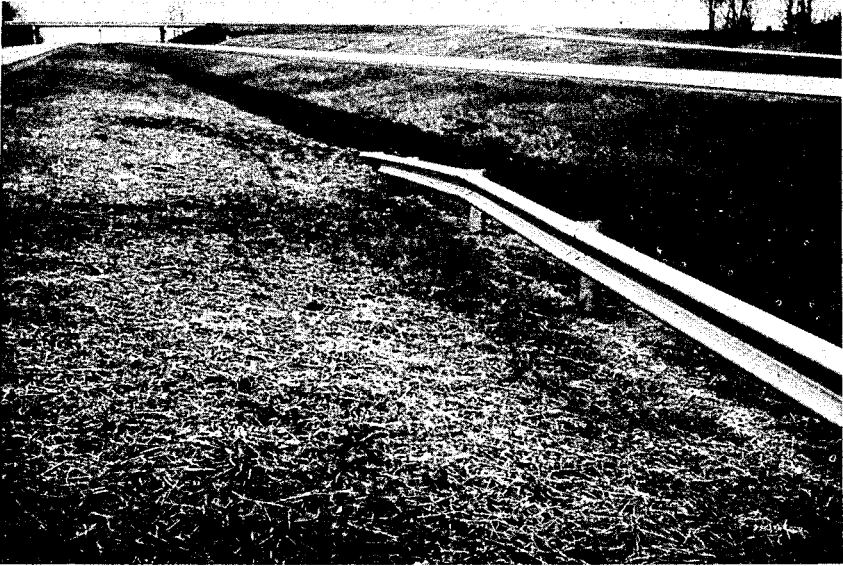


On the median side, this is what you have. Again with an extension from the previous job that we looked at on I-69, which stopped here



with a straight-up rail, to a section that now has a buried approach end at least.

This is what the median end treatment looks like a little bit closer to it.



I come back to still another job, and this is on the beltway around Indianapolis, where some work on guardrail and rehabilitation or improvement is underway. And this is the before condition.

Mr. CONSTANDY. Before you get to the after, as flat as that area is beyond the guardrail, is the guardrail needed at all?

Mr. PRISK. You took the words out of my mouth.



Mr. CONSTANDY. I am sorry. This is a very unusual picture, although the condition isn't, because several gores in that circumferential around Indianapolis are treated in the same fashion generally, which would be—I have forgotten the size of the supports for the sign, but they are enormous and they straddle the guardrail.

Mr. PRISK. This car over here gives an indication of the flatness of the land.

But the guardrail actually projected before the improvement started between the posts here, the I-beam supports, which if I recall correctly are 8-inch I-beams. And so you ran a chance of being impaled on the guardrail or hitting the I-beam, either one or both.

Now this is what has been done as a part of a multi—I was going to say multimillion-dollar project. It is not quite that much money.

Mr. CONSTANDY. The project for a number of improvements relating to guardrail is approximately \$800,000.

Mr. PRISK. Thank you.



Mr. CONSTANDY. Some 24 miles of this circumferential. It includes treating the ends as well as the installation of some new guardrail and installation of guardrail leading to the bridges.

Mr. PRISK. This is a part of a major improvement and this is precisely what has been done at such a location as we saw in the previous slide. This has been pulled down so that you have a buried rail here at this point and your choice now is only running into these 8-inch I-beams.

Mr. CONSTANDY. More than the rail is going to be buried there.

Mr. PRISK. That is right.

Mr. CONSTANDY. Could you back up again so we could fully savor this? [Slide.]

This is the before. [Slide.]

Mr. SKEELS. Is this the end of the improvement or is this a stage? Are you going to take the sign out now?

Mr. CONSTANDY. I could not tell you.

Mr. SKEELS. We have to get these signs out of these gores.

Mr. CONSTANDY. I think that is an ultimate objective. I think things are underway in some places to achieve it.

Mr. HUFF. With the apparent sharp angle of exit there, he had better take them out or somebody will take them out for him.

Mr. CONSTANDY. I am not sure of that. That is a formidable sign. It may be hit without much damage to the sign.

Mr. SKEELS. I recall a similar sign in Detroit at U.S. 24, intersection with 696. They put up the supports for the sign and before they got the sign on, one of the supports got taken out. They put it back up again and hung the sign on and within a week it was out again. And they took the two supports out and put the sign some place else.

Mr. CONSTANDY. Mr. Wilson, do you care to comment about the two pictures you have seen here?

Mr. WILSON. Not really. As Mr. Skeels pointed out, and Mr. Huff as well, we are going to have to take steps everywhere to get these gore areas clean of all obstructions. And some of us are working in that regard.

The most that should be located in this area is breakaway posts, of some sort, supporting small exit signs. Everything else should be gone.

Mr. CONSTANDY. Mr. Ricker, do you care to comment about this?

Mr. RICKER. I have the same comment. There is a question I would like to ask Mr. Prisk. Is this the second ramp of the cloverleaf?

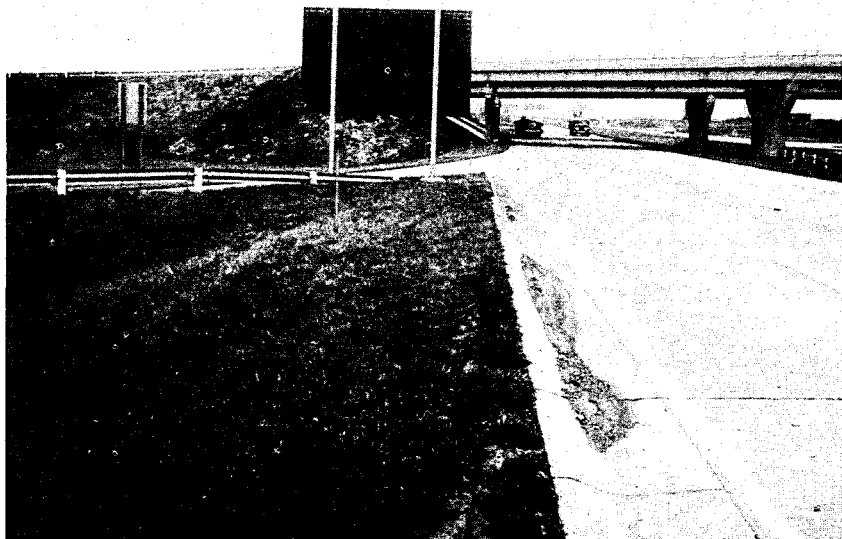
Mr. PRISK. Yes.

Mr. RICKER. This is the one some of us had proposed to change the text of the sign, so it did not need to be as large.

Mr. PRISK. Yes; true.

Well, that is a treatment in any event.

That is presently underway.



I expect this job is still active. This is the back of the sign you just looked at and there is the structure in the background:

The rail—the moment the picture was taken—was being put in through the structure so this is an improvement, you might say, to protect traffic from running into the side piers.

Mr. CONSTANDY. Yes. You can see at the median piers the installation of guardrail of similar design to the project we went to look at.

Mr. PRISK. Right.

This is just to let you know it is not isolated. Here is another point where, again, you have guardrail coming down here. Not quite so close this time, perhaps, but nevertheless coming down, and it has been buried. You still have a fairly flat area out here. It makes you wonder why you need rail in here at all.



Mr. SKEELS. You might eliminate the guardrail in this. It does not appear to be necessary.

Mr. PRISK. So I think there are places where you can say safety is not costing money, but is actually saving money. This would be one place.

Mr. CONSTANDY. Mr. Prisk, could you run back through that series of slides, please?

Mr. PRISK. I will be very happy to. [Series of slides.]

That is the first "before" situation. [Slide.]

This is the "after" situation, after the improvement. [Slide.]

This is the rear view of the same sign we just looked at. [Slide.]

Here is another location entirely where you also have a flat gore and the same treatment is being applied.

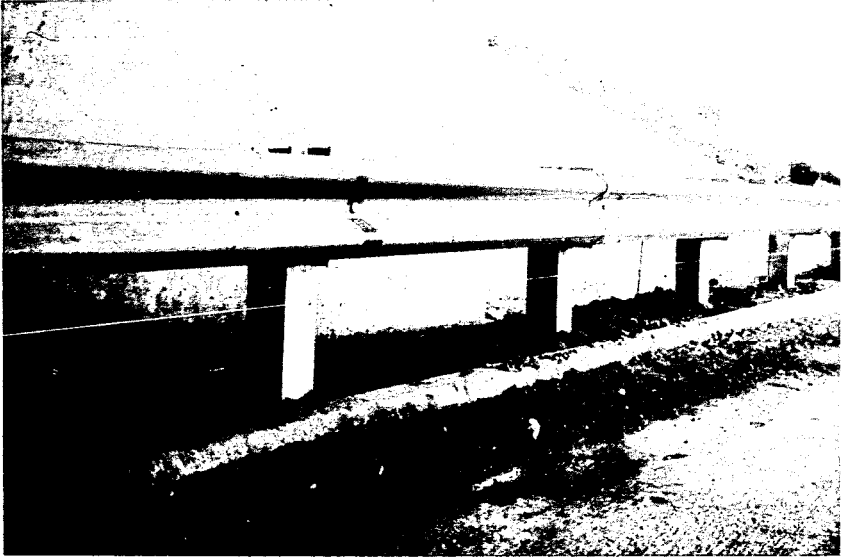
Now, this is one of the posts that is being erected underneath that undercrossing that you looked at a moment ago. The rail here again was up on top of a curb and it is, as you see, put in without washers. And it was none too high at this point.



Here is the view along the rail showing the blocked-out section. That much was being done.

Mr. HUFF. Is that a cable?

Mr. PRISK. No. That is just a string line; they were driving the posts while we were there and this just happened to be a completed section.



This is to show that other places are taking some account of what is happening in guardrail accidents. I put this slide in to show the committee that Switzerland has taken steps to improve their guardrail design. This is a view on the Lucerne-Geneva Expressway and shows that the guardrail is flared back and followed in to the embankment.



This particular installation is put in because of emergency telephone installations at this point.

Mr. HOWARD. Mr. Prisk, can I ask you about how much of a slope a car can reasonably expect to ride on off the road without overturning? Of course, I know speed and the direction that it goes off the road would have something to do with that, but has there been any research on that? Because it would seem, as it has been mentioned, that quite often we found that there is guardrail where really there need not be; in fact, if the car were permitted to go off the road, it might have a better chance of recovery rather than being hung up or damaged by a poorly designed guardrail.

Mr. PRISK. We are recommending 6 to 1 slopes off from the edge of the pavement on the foreslope, and 4 to 1 slopes on the backslopes as you go up into a cut.

Mr. HOWARD. I see.

Mr. PRISK. Go down on a 6 to 1 and go up on a 4 to 1. This is a traversable condition.

There has been quite a bit of work done at General Motors proving ground in support of this. I am not aware of any research at the Bureau, that the Bureau of Public Roads has participated in, as related to that very problem.

Mr. CONSTANDY. We will have more testimony on that later, Mr. Chairman, particularly about the slopes.

Mr. CLAUSEN. I want to ask some questions.

Gentlemen, I do not care which one of you responds to this, but I have just talked to a family that has driven all the way from California—as a matter of fact, they are going to be returning, probably by a different routing. The one thing that they complained about was the signing found prior to many turnoffs. It is my understanding that the committee is now receiving letters on this because of nationwide press releases about these hearings.

Now, is there any one of you who could respond to this? Do you see this as a problem, from your point of view? Because we certainly are getting a goodly portion of correspondence complaining about a lack of adequate warning on the signing prior to the actual turnoff.

Would anyone want to comment on this? I will ask Mr. Ricker.

Mr. RICKER. The reason I was smiling, I received a letter from the vice president of a steel company complimenting the New Jersey Turnpike Authority on the quality of their highway, and so on.

Mr. HOWARD. What State was that?

Mr. RICKER. That was the New Jersey Turnpike. [Laughter.]

But he said there were no signs for the connection leading to Pennsylvania Turnpike.

At that time there were six signs, five of them overhead. Some you could walk through the sign. He did not see any of them.

This is a problem I am not sure we have solved yet, to communicate with the public as to what they should be looking for.

The standards on the Interstate System require a sign beginning 2 miles from the exit, another sign at 1 mile, another sign at a quarter of a mile.

Mr. CLAUSEN. Driving down the highways, I have noticed this myself and I have talked to many others who have had similar experiences. You will see people weaving back and forth; they are approach-

ing the turnoff point and all of a sudden make this last-minute discovery. To me this is one item that needs to be given a priority, I believe, as far as evaluation by the committee plus the subcommittee recommendations.

Would you all agree with this as a panel?

Mr. RICKER. I am sorry; I am saying I don't quite agree there are not enough signs there.

We do have a need for a better communication with the public so they know what they should be expecting and how to use the signs.

Signs are there, but we need to explain them better so that they can plan their trip and look for the proper sign.

Mr. CLAUSEN. What you are suggesting, then, is content rather than numbers?

Mr. RICKER. No. As a matter of fact, driver education, if you wish to call it that; public understanding. We need some articles by people like Jim Wilson in Life magazine or Saturday Evening Post to tell people what we are doing.

Mr. CLAUSEN. All right. Mr. Wilson?

Mr. WILSON. If the requirements of the Bureau of Public Roads and the requirements as set forth by the National Joint Committee and other responsible highway officials are met—and they are in fact; they are followed on the Interstate System, I think, quite precisely throughout the country as far as advance notices are concerned—this is just about all you can do, except to instill in the motorist himself the idea he has to plan his trip a little bit better. I get a lot of complaints, a lot of letters just like Mr. Ricker does, and quite often we will go out—in fact we do go on and investigate these complaints and find the complainant has driven past two or three signs that said precisely what he was looking for.

Mr. CLAUSEN. Yes.

Mr. WILSON. But with the driving task this day and age and the traffic you have to handle, it is a very complex problem and you have to plan ahead.

Mr. HOWARD. I have one brief question I would like to ask the panel.

You are familiar with the practice in Europe; many of the directional signs and informational signs are used by merely using a picture or drawing. This is done mainly because of the language differences that you run into over there.

It is true, however, that you can see, once you get used to them, much more quickly what the information is that the sign is trying to convey than by reading several, sometimes many, words.

Have you any opinions as to the serious consideration that maybe we ought to give to this idea of information?

Of course, I am aware of the fact the name of a town could not be done any other way, but "Go Slow; Children at Play," things like that, could be done so much quicker with pictures.

Is that being used in the country extensively, at all, or is it considered to be not very good for us?

Mr. WILSON. If you will look at any State sign chart—and I am sure every State has a sign chart giving standard signs—you will find a great many symbol signs on it. All your curve signs, of course, are symbolized, and I am sure you are familiar with these.

I think the last meeting of the national joint committee adopted a symbol for notifying "Telephone Ahead."

Mr. HOWARD. Yes.

Mr. WILSON. Just a picture of the hand set. I cannot recall any others right now, but I am sure there is some consideration.

Mr. HOWARD. School zoning picture.

Mr. WILSON. I think one of the pictures that has slowed this activity down here is the fact I think there were studies in Europe and Mr. Prisk can probably verify this, or he may disagree with me entirely, but I understand there is not a very good understanding of the symbols they are using in Europe. They are poorly understood by the bulk of the people.

Mr. HOWARD. That may be it. I know they use them because of the language barriers over there, for "Parking" and "No Parking" and things like that.

I didn't understand it very well myself, but I assumed they did. If we had it over here, in time we would get to understand; it might make it easier for people, for information.

Mr. PRISK. I think it might be worth saying, Congressman, that the Bureau of Public Roads about 2 months ago entered into a contract with a private consulting firm, to undertake a behavioral type study of reaction and response to symbols and shapes and colors and sizes of signs, so as to get down to the foundation of our physical and human reaction to signing and the use of symbols in particular, and how many of these can be made to be meaningful.

The sign that is most understood by you is the one you are most familiar with, usually, and so if we move toward adopting new principles for a signing system, we must be careful to see that these are understood and acceptable to a substantial number of our population. Some of these signs that Mr. Wilson referred to that they had difficulty with in Europe are based on the fact that the symbol is a rather abstract and arbitrary type of symbol. Where a symbol was used such as a railroad train moving toward a crossing, and you have a picture of a locomotive and crossing gate, it is well understood that you are approaching a railroad crossing, so we are in a process really of picking and choosing now or will as soon as this research is completed.

Among the symbols are a great many that I think can be gradually introduced into our own system, through the medium of the committee that Mr. Wilson heads.

Mr. CLAUSEN. Well, Mr. Wilson, will it be your attempt then to get a cross section opinion from the traveling public? I think there is a tendency sometimes maybe to have engineers talk among themselves and what they understand is not necessarily what the average citizen will understand. Will it be your intent to conduct a survey among members of the driving public?

Mr. WILSON. Well, it will and probably through consultants or the University of California, and the Institute of Transportation and Traffic Engineering. We have had that organization do quite a bit of work for us in connection with signing. We have several small contracts with them, and I might mention one and this deals with a symbol too. We were looking for some device to keep people from entering ramps in the wrong direction, and Dr. Slade Hulburt out at UCLA made an intensive study of the European symbol and also compared it

to other ideas that we had; and it came out that we adopted a new sign, a red sign with the words "wrong way" on it, rather than the symbol because the symbol did not do the job we thought the other one did, so we have been working in this area and will continue to work in this area.

Mr. CLAUSSEN. Well, in conclusion—I know we are getting ready to wrap up, Mr. Chairman—I certainly want to thank these gentlemen for what I think has been some very helpful testimony. We will be looking forward to it for the balance of the week and to the additional evidence you will be able to give us.

Mr. HOWARD. Thank you, Mr. Clausen.

Mr. CONSTANDY. I think it would be appropriate, Mr. Chairman, having guardrail in mind, and what you might consider a representative cross section of the Interstate System in the United States at this point in time, that the members of the panel express their opinions generally and overall on what they have seen.

I would like to begin with you, Mr. Wilson, and ask if you care to make some comments?

Mr. WILSON. Well, I would.

It appears as if there is quite a bit of knowledge available to highway departments, and it appears to me it is not being used in a proper manner. I think even in our own State, we have certain problems in connection with implementing new developments.

I do not want to make all the comments but I would like to say one thing, that I do not subscribe wholeheartedly to the fact that a guardrail ought to be buried every time there is an end. I think in a good many cases, particularly in rough country where we build a lot of highways, the end of the rail can be buried at the side of the slope, does not have to be buried in flat ground, and I think that a modest flare can be used to advantage, and I would have to disagree with some of the other experts on the panel here who feel perhaps it should be buried every time.

Mr. CONSTANDY. Overall, Mr. Wilson, would you say you are satisfied with the installation of guardrail generally as is shown in the United States?

Mr. WILSON. There are considerable inconsistencies to be sure. Obviously there is a lack of communication in getting the word to the people who are actually doing the work. The variation in heights, the lack of washers, all of these things point up that while we know this information, it is just not getting to the right people.

Mr. CONSTANDY. Mr. Skeels.

Mr. SKEELS. I have about the same comments. First off, I would like to make the point that we believe guardrail should be used only as a last resort, when the need for it cannot be eliminated. If, even by spending more money, you can make a guardrail unnecessary, you are better off to thereby solve the problem permanently.

As to actual construction of guardrail, as we have seen, there are many faults; there are many times when apparently it is not intelligently applied. Knowledge is available to cover most of the situations. I am sure that we can all conjure up situations that we do not know how to solve, but most of them I think we can solve with the available knowledge that has been published in the Highway Research Board papers and bulletins and elsewhere. The primary need is to get this

knowledge into the hand of those who are actually picking out the design that goes at this particular place and make sure that it is applied.

You must realize that in many cases this will involve an expenditure of more money than they are spending now. If we put in more posts this costs more money; if we put in longer lengths of guardrail, which in many cases is needed, this also will cost more money—not a lot more but some more. We have to recognize that we cannot do the excellent job that our knowledge will let us do, for the same money we are now spending.

Mr. CONSTANDY. I think it is worth recognizing this, that the expenditure of additional money does not necessarily mean it is less economic. It may be more economic to spend the additional sum of money to make effective a mechanism in which you already have investment and which will fail if you do not improve it. Mr. Huff?

Mr. HUFF. It has been a privilege to me to see all the pictures you have shown. However, I have not seen anything very new because I have traveled over most of these States by automobile, as well as some of the States that have not been shown. I think I have seen them all generally, what you have shown. Most everything you have shown is subject to criticism, valid criticism.

We have seen places the chairman pointed out this morning where a guardrail was built where it should not have been, and places where a guardrail should have been built, where it was not built.

I think that is a very valid point he made, and in my opinion we have in most cases built too much guardrail.

I think that one danger we have, and I voiced this to the panel at noon, and other times, is getting into the smug feeling that we know now how to build a safe guardrail. If we do not watch ourselves, we will put all our eggs in one basket and find out we have come up with something that is not satisfactory.

Now we have got a lot of people studying this subject, and we should keep them studying it, and possibly we should try innovations that we experts have not thought of before.

I would like to go back with you in my own experience. I guess I could claim to be the senior member of this panel without any argument. I have been in the business a little over 40 years, in highway engineering. Now to my certain knowledge, construction of guardrail up until—this is the State I have been involved in—up until somewhere around 8 to 10 years ago, was mostly the function of our maintenance people. There was no engineering control involved. Now, some 8 to 10 years ago, I suppose 10 years ago, we began placing this under engineering control and I think we have gone a long ways in the 10 years that we have been working on this, and I believe with people like the traffic engineers here and a great many other people who I know will begin instituting improvements you might have another get-together 5 or 10 years from now, and we would be in wonderful shape.

I believe once you get it under engineering control, the problem will be solved.

Mr. CONSTANDY. Mr. Wilkes?

Mr. WILKES. Well, we have heard some difference of opinion expressed in the panel itself, and to illustrate that, there is not uniform

100 percent consensus on the name of the item. Some States do not even call this a guardrail. They identify it as a guiderail, because they do not want to imply that this installation will guard and will preserve life. New York State calls this a guiderail.

I do not want to introduce another subject for discussion, but some of the remarks seem to imply an inherent weakness of a round post and, of course as a structural engineer, I do not entirely agree. There is difficulty in using a round post for installation simply because of blocking out the rail, but the form of the post does not mean it is deficient in strength. You can provide any strength that you would need in a round post. That is a kind of side comment.

I do not want to appear to defend the practices that we saw which were easily identified as being deficient, but I think that most of the panel members will agree that all of these projects that we observed required a minimum construction period of 18 months to possibly 3 years, so that many of the standards that were used in the contract plans were standards that were certainly old, possibly 2 or 3 and maybe 6 or 8 years old, because there is a normal timelag in the development of standards.

As I mentioned before, guardrail is an item that is generally installed by use of State standards. In the photographs we saw of the recently completed projects, and when you observe projects under construction, you can see improvements. This is, I think, a tribute to the highway departments that were responsible, in that they recognize that there is room for improvement. I think all of us can see that improvement.

Mr. CONSTANDY. Did you see something else, that some of them yet fail to understand why they put a guardrail in?

Mr. WILKES. I would agree.

Mr. CONSTANDY. With the upgraded standard, in one case, the guardrail was improved at the approach end but it still leaves you going into the pier and dead at the other end. I think while it is necessary to recognize there is a continual process of evolution in the upgrading of standards for these facilities, and we have certainly seen examples of that, it is more a question of the time it takes to do it. Mr. Ricker?

Mr. RICKER. I pretty much agree with what the other panel members have said. I would point out that most of these pictures showed a growing knowledge of the design of guardrail. Some of them are using the washer, some are bending down the ends, and so on.

The other thing that seemed to be typical of them is they are applied to fixed objects. A guardrail has been used for many years for the second purpose here, on steep, high embankments, and has served the purpose. This is a sort of new art, putting in short sections to protect fixed objects, and everybody is learning or has been learning over the past 10 years, as Mr. Huff said.

I think just about now we know what we should be doing. It is fine, the sort of publicity which these hearings will bring about, which I am sure will sharpen everybody's wits a little bit, to get it in the right place and proper advanced position. This has happened in my State within the last 5 years or so. The criticisms I had of guardrail placement, particularly when it was not long enough or did not begin soon enough to protect a steep embankment, I do not find that complaint any more. It is being done correctly now. I think this will come.

Mr. CONSTANDY. I want to thank you all for what I feel has been a most productive session, and you people certainly contributed to make it so.

We will continue on the same basis, if it is still agreeable, tomorrow.

Mr. HOWARD. Thank you, Mr. Constandy. I am very sorry that official business made it impossible for our chairman, Mr. Blatnik, to be with us in the latter part of the hearings this afternoon.

Today we have been privileged to hear expert opinion from this panel of distinguished specialists in the field of safe highway design and traffic engineering. Each of these men is outstanding and nationally known in his field, as is Mr. Charles W. Prisk of the Bureau of Public Roads, whose experience and advice has been so helpful to us in these hearings.

The continued presence and assistance of these gentlemen as we analyze and discuss the design safety of some of our newest Interstate projects around the country is greatly appreciated by the subcommittee.

It has been disquieting, although not surprising in view of earlier testimony, to learn from today's testimony that the same unsatisfactory installations of roadside appurtenances common elsewhere are to be found on new Interstate projects in various parts of the country.

There have been some encouraging signs of progress, but not nearly enough.

Many of these features are as dangerous as they are unnecessary. And it appears as late as 1967, they continue to be designed and built into our highways.

Some of these mistakes are capable of quick and sometimes inexpensive correction. Some may be much more costly to alter, while others, I am afraid, will just continue to exist for generations to come.

It will be the continuing purpose of these hearings to explore fully the problems brought about by design practices which have been the subject of testimony thus far. Certainly the observations and expert opinions of this distinguished panel can be of great help in that regard.

We look forward to your assistance when this subcommittee resumes its hearings tomorrow morning at 10 o'clock.

The subcommittee stands adjourned.

(Whereupon, at 4:35 p.m., the hearing was adjourned, to be reconvened at 10 a.m. the following day, Wednesday, June 21, 1967.)

HIGHWAY SAFETY, DESIGN AND OPERATIONS

Roadside Hazards

WEDNESDAY, JUNE 21, 1967

HOUSE OF REPRESENTATIVES,
SPECIAL SUBCOMMITTEE ON THE
FEDERAL-AID HIGHWAY PROGRAM OF THE
COMMITTEE ON PUBLIC WORKS,
Washington, D.C.

The subcommittee met, pursuant to recess, at 10:15 a.m., in room 2167, Rayburn Building, Hon. Kenneth J. Gray (acting chairman) presiding.

Present: Messrs. Gray, Fallon (chairman of full committee), McCarthy, Howard, Cramer, McEwen, Duncan, Schadeberg, and Zion. Staff present: Same as previous days.

Mr. GRAY. The Special Subcommittee on the Federal-Aid Highway Program will please come to order.

We resume hearing testimony in the nature of comment and observation by a panel of distinguished witnesses. They are specialists of many years' experience in the field of highway design and traffic engineering. We will resume the analysis and consideration of photographs made by subcommittee personnel and Mr. Charles W. Prisk of the Bureau of Public Roads, in each of the nine regions administered by the Bureau throughout the country.

In each of the nine regions a look was taken at recently opened projects on the Interstate System. This testimony concerns some of the design features that were noted at that time.

With that, I will recognize our distinguished counsel.

Mr. W. MAY. Mr. Constandy.

Mr. CONSTANDY. Thank you. Yesterday, Mr. Chairman, we reviewed the slides that related to the first two elements that we intend to look at in this project, guardrail and median barrier. I think it is correct to say that we found improperly installed guardrail on each of the nine projects we reviewed.

We go back to our original thesis that these nine projects are intended to be representative of the Interstate construction in the United States as of February 1967.

Mr. Prisk, do you have something further relative to guardrail and median barrier for this morning, or do you want to go directly into the next element, bridges?

Mr. PRISK. I think at a proper time, perhaps in the summation, it would be well to make some general remarks about guardrail. I would suggest that we proceed with consideration of structures at this time.

Mr. CONSTANDY. Fine. We will follow the same procedure as yesterday.

Following that, time allowing, we will get into another element, perhaps lighting or slopes. If you will begin, then, Mr. Prisk.

Mr. PRISK. Yes, Mr. Constandy. Gentlemen, Mr. Chairman, I think in contrast to what we saw yesterday, looking at guardrails, which is a relatively low-cost item on highway sections of the Interstate System, we are concerned today with a high-cost item, a structure crossing another highway, crossing a river or undercrossing, crossing a railroad.

In other words, affording a grade separation in absence of intersection friction which is responsible for accidents and hazards on our conventional-type highways.

Looking at structures on the Interstate System during the course of the observations in the nine States, I think the things that we are concerned with included the matter of the uniformity of the roadway width, as it crossed the structure, or went through the structure, as that relates to the approach width of the roadway.

We are concerned with the clearances to abutments, to the edges of medians, piers, and other elements of the structure.

We are interested in the heights of curbs on structures and the rail heights that were used on structures, the connection between the element that we spoke of yesterday, guardrail on the approach sections of roadway and the bridge railing, and the structure itself.

These are the kind of things that I think we will be stressing in the presentation today as we proceed with this pictorial review of the nine interstate projects reviewed during April. May I have the first slide, please?

Mr. CONSTANDY. Mr. Prisk, before you begin, I think the record should reflect that we are again honored to have the distinguished members of the panel who were very helpful to us yesterday; and I am sure will be so today and throughout the hearing.

I would also, Mr. Prisk, just run down the order in which we have the slides prepared by States.

We will begin with Indiana, then Missouri, Oklahoma, Nevada, Rhode Island, Montana, Ohio, Utah, and finally Georgia. So go ahead, Mr. Prisk.

Mr. PRISK. When this slide was drawn, the intent was simply to define some of the elements that we shall be talking about. These are all bridge rails and parapets of rather common vintage.

On the left you will see a vertical parapet. This is the roadway side out here. This parapet rises directly from the roadway surface and is topped by a metal rail. This area here is concrete.

Over here is about the same kind of a structure with the addition of a brush curb. This dimension here is the critical one [indicating], usually running 4 or 5 inches, something of that sort.

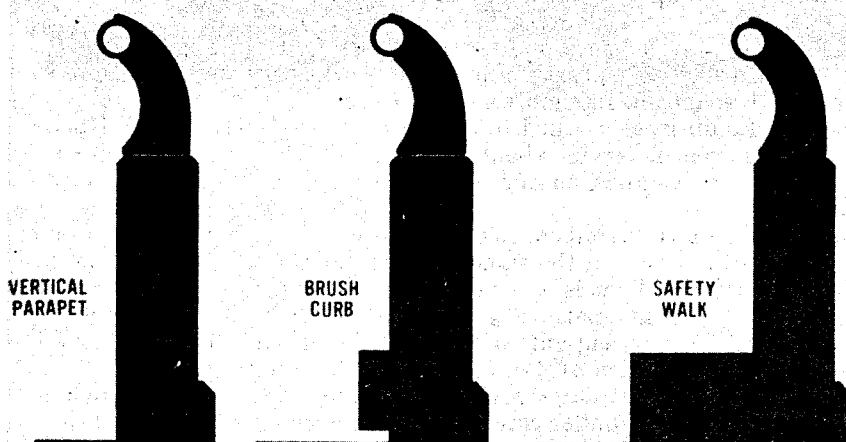
Over here we have again the same backup structure with a safety walk in front of it. The safety walk has been thought of as something that probably has been misnamed in the past.

Mr. CONSTANDY. You feel it perhaps is not a safety walk after all?

Mr. PRISK. I would prefer to call it a so-called safety walk.

Mr. CONSTANDY. Mr. Prisk, is it true that the vertical parapet and the brush curb are more apt to be used on projects where the shoulder

BRIDGE RAIL AND PARAPET



is carried through to the structure and perhaps the safety walk being something of a compromise on those bridges where the shoulder is not carried full width across the structure?

Mr. PRISK. This I would say is true; yes.

Mr. CONSTANDY. Before we leave that slide, do the members of the panel care to make any observations relative to any type of design—

Mr. SCHADEBERG. Why does the guardrail not have the same type of structure as you talked about, the New Jersey Turnpike that you explained yesterday, that was built in such a way that it would direct the car away from it?

Mr. PRISK. You are talking about this surface, which would come up on a parabolic shape or two inclined slopes, as against the vertical side?

Mr. SCHADEBERG. And then the slanted curb.

Mr. PRISK. Yes, I understand. There is not much of that in use throughout the country. These are simply illustrative of what we found on the nine interstate projects. In fact, I can say factually that we did not find any of the New Jersey-type bridge rail and parapet designs on the nine projects.

Mr. SCHADEBERG. Did you say that New Jersey type was—the type that was studied—was considered to be one of the safer structures?

Mr. PRISK. Yes.

Mr. SCHADEBERG. Any research on this being done for rails—for guardrails?

Mr. PRISK. On bridge railing, yes.

Mr. CONSTANDY. I believe there have been research tests conducted in California on the use of that parabolical, New Jersey type. What do we call it?

Mr. PRISK. It is a bridge railing.

Mr. CONSTANDY. They are testing it both from the standpoint of its use as a median barrier and as a parapet on bridges.

Perhaps Mr. Skeels could comment, since they have developed and installed a similar type structure on the bridges at the proving ground.

Mr. SKEELS. Well, that is correct; we do have bridges with this type of bridge parapet installed. It is a modification of the New Jersey style. We adopted this after looking and doing what we considered a thorough engineering job on available bridge rail designs.

We are very enthusiastic about it. It works very well, and I am sure you will see it come into more and more use.

The design is, as applied to bridge rails, relatively recent. I believe ours has been in service about 3 years. There also is a section of the same design installed on one of the Detroit expressways as a median barrier.

I would like to avoid confusion when we talk about bridge parapets or median barriers in the same breath; but they have the same basic job to perform. That is, to prevent a vehicle from penetrating and to turn the vehicle to a path roughly parallel to the road with a minimum of hazard to the occupants of the vehicle, and a more secondary objective is a minimum of damage to the vehicle itself.

This has the advantage that if you do not damage the vehicle, the driver can keep it under control, and a car can strike this parapet in a mild type of impact and go on his way.

Whereas, perhaps with other types, he might be immobilized and there will be an accident.

Mr. SCHADEBERG. Thank you.

Mr. CONSTANDY. I can attest to that. Mr. Skeels has given us the pleasure of hitting a parapet at 45 miles an hour and it is a most exhilarating experience. It was surprising that there was practically no impact at all; and the car was directed back onto the roadway.

Mr. WILKES. I might add that there are several States that have adopted this New Jersey-type parapet as a standard for their full-shoulder-width structures.

Mr. CONSTANDY. Thank you. Perhaps we will move along, Mr. Prisk.

Mr. PRISK. One other thing that might be said before we leave this slide is the fact that this rail, unlike the guardrail used at the edge of the pavement, is normally considerably higher, somewhere in the vicinity of 40 inches, as against 27 inches; and upward, possibly, on a bridge rail up as high as 50 inches, 55 inches.

This practice differs, also.

Mr. WILKES. Could I comment on the safety walk?

The purpose, one of the purposes of the safety walk would be to provide a refuge for the pedestrians that are on the structure. And I am sure that is the origin of the term, safety walk.

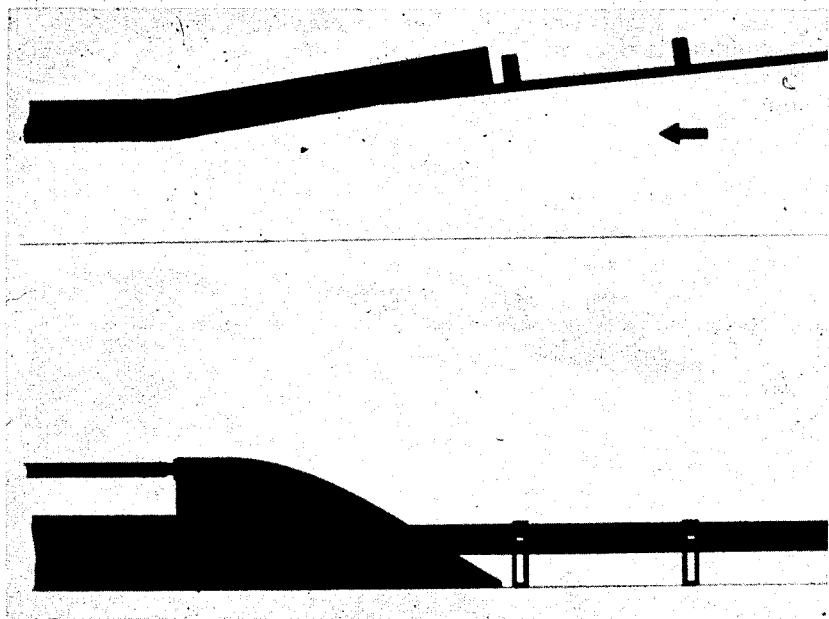
Mr. CONSTANDY. Isn't it true that pedestrians are uncommon, and that pedestrians are not allowed to use the Interstate?

Mr. WILKES. That is correct. Your statement that no pedestrians are allowed would apply to the Interstate, but this feature is included in bridges for all systems, primary, secondary, and urban areas of course.

Th safety walk is widened to provide a sidewalk for pedestrians.

Mr. CONSTANDY. Proceed, Mr. Prisk.

Mr. PRISK. This is an indication of how the approach rail and bridge railing might be handled as a means of taking care of this condition that you have in the vicinity of the transition from roadway which is



back here to the bridge which is up here. The roadway barrier, edge barrier, as I mentioned, normally is mounted at about 27 inches.

This rail may run as high as 50 or 55 inches, or at least twice the height of this rail. And this is one way that you will see that some of the States are beginning to come, as a means of smoothing out the transition from the approach to the structure itself.

Up here in the top photo, this is an airplane view looking down, where your approach rail is flared into the structure itself and made integral with that end wall.

This is not necessarily offered as a desirable solution at all. It is simply something that some of the States are trying in an effort to solve that problem.

Mr. CONSTANDY. **Mr. Huff.**

Mr. HUFF. My department has adopted the standard which carries the rail continuously across the bridge.

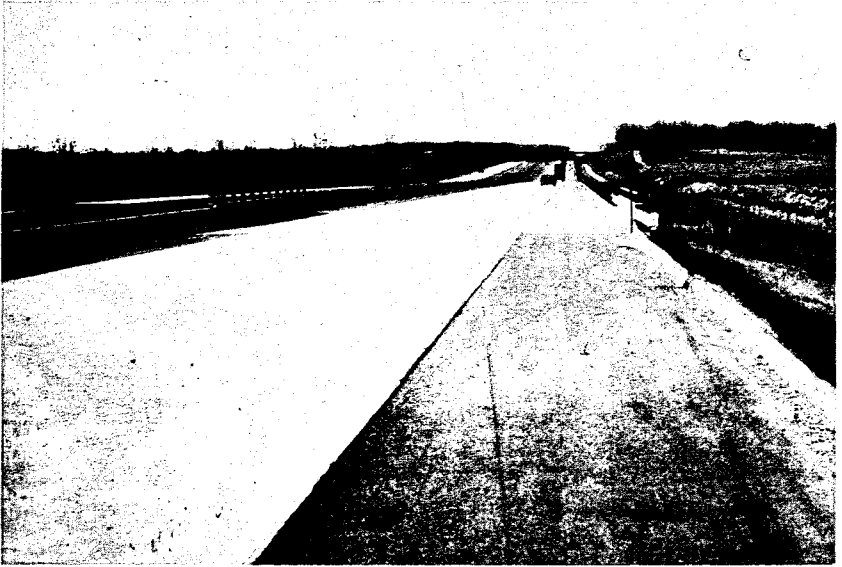
Mr. CONSTANDY. At some point we will show some slides showing that and contrasting it with another State which has attempted to do the same thing, done it a different way, perhaps less desirably.

Mr. PRISK. Now we move in the State-by-State illustrations of what we found in this area of bridge structures.

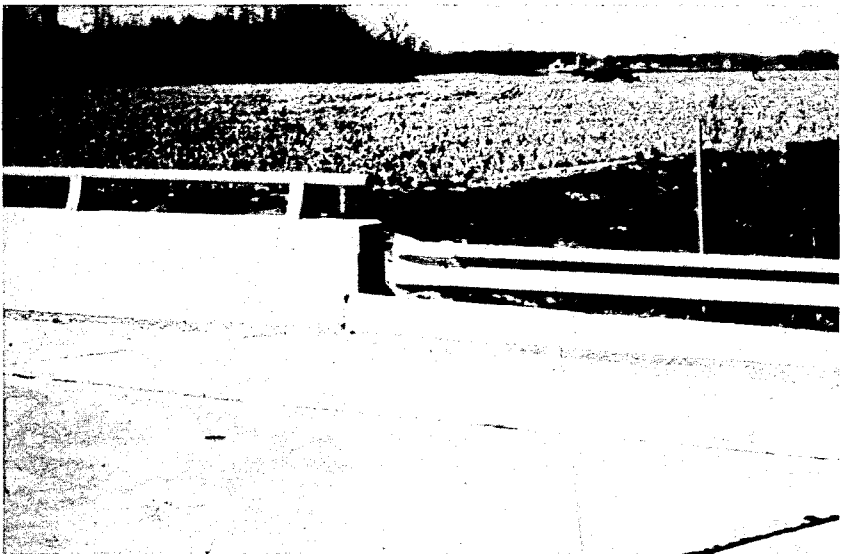
In the first case we come to Indiana, I-68, somewhat similar to the pictures we saw yesterday.

This bridge has the merit of carrying the full shoulder width all the way across the bridge. This is very desirable to have this unobstructed area, regardless of whether you come to a bridge or not. The side shoulder is always carried through here.

Next is an instance of a vertical parapet rising directly up, I-69, Indiana.



Here is one of the focal points of our study of bridge structures. We find this time and time again, not just here in Indiana, but in all of the nine States. This rail is brought up to a point where it almost



reaches the end of the parapet wall on the bridge structure. Any deflection of this rail, being struck on the approach to the bridge, would cause a car to stop at this point, and of course this is pretty much an immovable object, and collision here gets pretty violent.

Mr. CONSTANDY. Is that typical of the installation in Indiana, Mr. Prisk?

Mr. PRISK. Yes. This is typical of Indiana, and a good many of the other States that we will see.

Mr. CONSTANDY. You relate what would happen when the guard-rail is struck by an automobile and the consequences of it; could we conclude that this is wrong?

Mr. PRISK. I think it would be necessary to conclude that. We have no post support in the picture for a very considerable distance, and there is a 12-foot-6 spacing on the post. An additional post in this area would help somewhat to reinforce that guardrail against lateral deflection.

As it stands, this could rather easily be moved back by the impact of a car, and the car would collide with the structures.

Mr. CONSTANDY. That is a very severe type of accident, is it not?

Mr. PRISK. It is. It is a violent collision.

Mr. WILKES. Could I point to another undesirable feature, and that is the end of that bridge rail, which is obviously an ornamental feature.

Mr. CONSTANDY. How could that be better done?

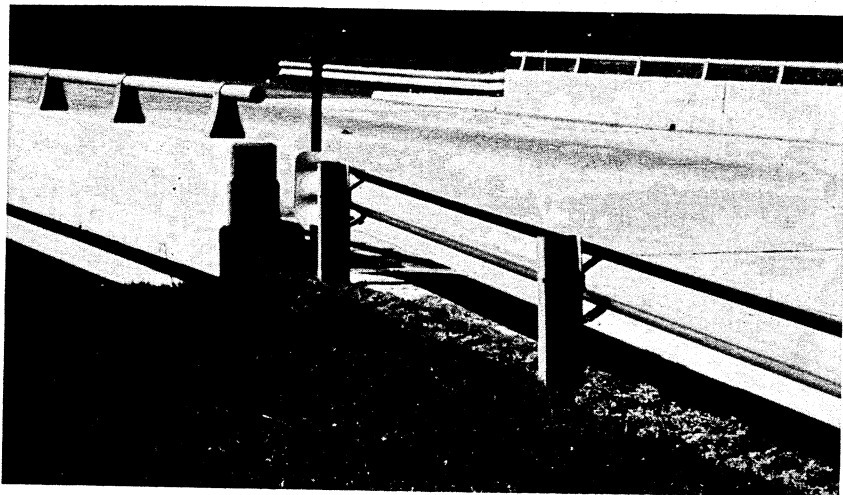
Mr. WILKES. Even with the parapet extended to protect the end of that, to keep the rail from hitting the driver or occupant in some cases, the rail could be turned down.

Mr. CONSTANDY. We saw that same point in Utah yesterday. In that instance it was turned down and that round part that we see at the end was curved down to where it meets the top of the parapet, making it a smooth curve.

Mr. SKEELS. I was simply going to add one comment. On this very short bridge it is doubtful in my mind that the rail is justified at all.

Mr. CONSTANDY. The entire structure on top of the parapet?

Mr. SKEELS. The metal rail installed on top of the concrete.



Mr. PRISK. Here is the other side of this same bridge. It is a short bridge in fact, as you can see. And the median side, left-hand side, also has this same arrangement.

There is no physical attachment between the rail and the concrete structure, and these posts can be rather readily displaced by a colliding car, which would then be faced with that same condition we saw on the right-hand side.

Mr. CONSTANDY. Something perplexes me, Mr. Prisk. Why is it necessary that that bridge rail be higher than the height of the guardrail?

Mr. PRISK. Well, this has bothered me a long time, too. I do not know that there is a good answer for it.

There is a little more hazard certainly, mounting a bridge rail, than there is running down a slope.

Mr. CONSTANDY. If we take this view here, I am not sure you can distinguish between the result of a car going over the parapet itself or coming through this type of guardrail installation, in advance of the bridge. He is apt to suffer the same consequences.

Mr. PRISK. With this approach rail, chances are that he would fare worse hitting the approach rail than he would hitting something out here, even without this ornamental rail at the top.

Mr. CONSTANDY. That fellow in Utah survived; but we have seen a number of these bridge accidents, where the occupants of the car did not survive.

Mr. WILKES. Mr. Constandy, I might state for the record that the standards of the American Association of State Highway Officials is that a traffic rail must be a minimum height of 27 inches if there is no curb wider than 6 inches. If there is a curb wider than 6 inches, then the rail or parapet must be 27 inches measured from the top of the curb.

Mr. PRISK. That is this point [indicating].

Mr. CONSTANDY. The rail is supposed to be 27 inches.

Mr. WILKES. Right. And if it is for pedestrians, it is general practice to increase that height.

Mr. CONSTANDY. Then it would be a handrail?

Mr. WILKES. Then it would be a handrail.

Mr. PRISK. What you are looking at is, according to what Mr. Wilkes says, a standard installation in accordance with the specifications, if this rail is in fact 27 inches high, and if this parapet also is 27 inches—do I understand you correctly?

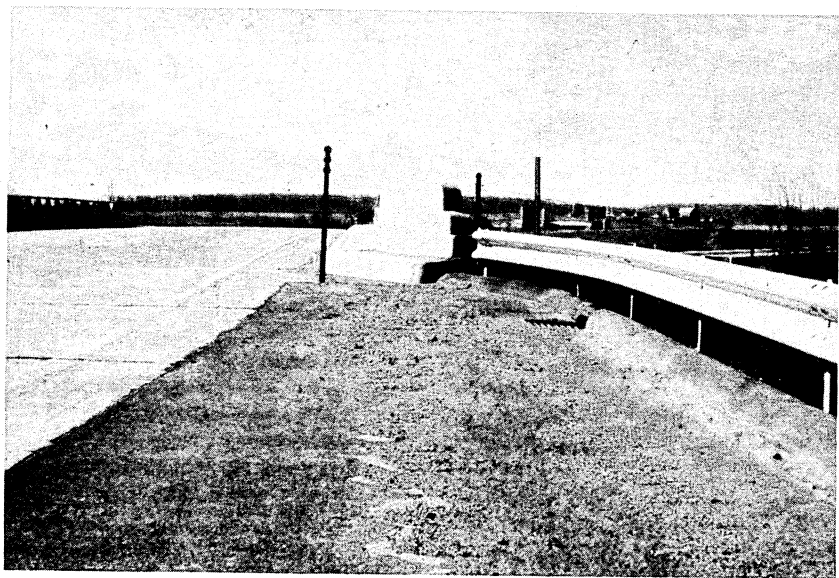
Mr. WILKES. That is correct.

Mr. PRISK. This is what we did find in Indiana.

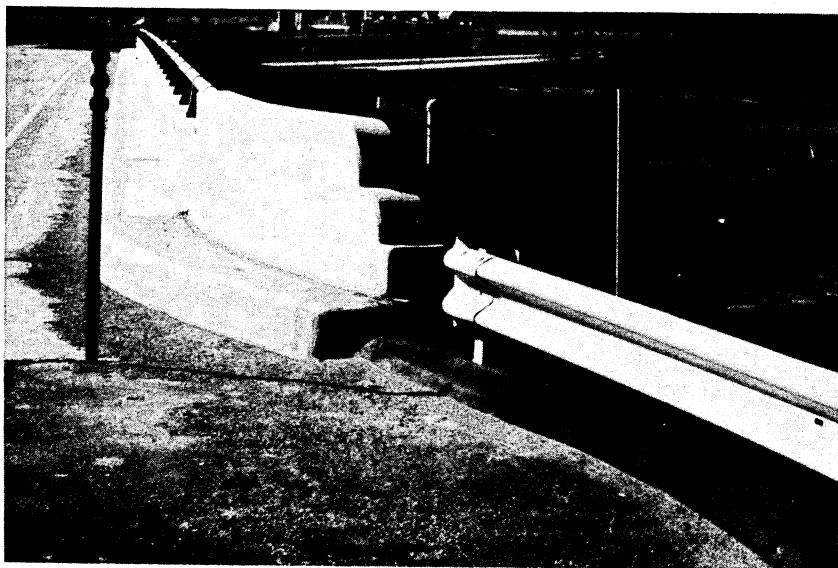
You see other illustrations of this sort, also, in Indiana, on major structures; this is a longer bridge. These bridges were not built to include the full width of the shoulder.

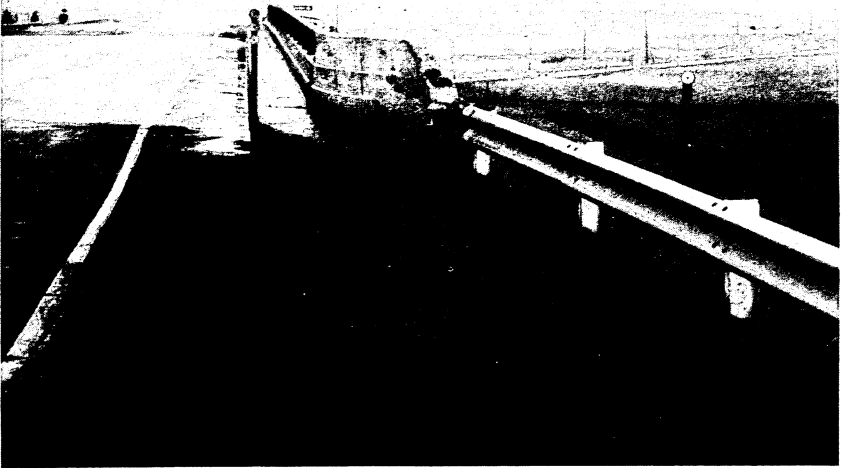
The bridge shoulder amounts to about two and a half feet of clearance outside the edge of the traffic line. This short distance here.

There is a wall on the structure, as you see, and a very bulky end wall parapet, and the guardrail is curved in, sort of in a pocket fashion, to reasonably meet the alinement of the curving rail, which then straightens out directly on line with the camera.



Let me show you another shot, closer in. This shows more of the structure and more of the condition there at the end of the structure. This rail, as I said before, is not too difficult to displace.





As we move on into this condition, this is the scene of a fatal accident on this type of condition, where a car in fact did strike the approach section of the rail and stopped, with fatal results, on this heavy mass of concrete here at the end of this relatively long structure.

Mr. CONSTANDY. We became familiar with this particular accident. It did not happen on the project, it happened on a project contiguous to the one we looked at. You will notice the similarity of this structure to the preceding one.

The man was driving a pickup truck loaded with furniture, moving from Michigan to a new job in Missouri, and was being followed by his wife and little kiddies in a car directly behind. This pickup for some reason—they never did find out why—went out of control, struck the guardrail and slammed into the parapet. He was killed, and the furniture was destroyed by flames.

Can you tell us about that massive piece of concrete? We see them all over the United States. It is a very common thing; what function does it serve?

Mr. PRISK. This has no function according to all the information I have been able to get. Perhaps Mr. Wilkes will have a better explanation for it.

Mr. WILKES. Well, this is standard practice, design practice, for most highway departments. This wing wall can be seen in all States, or a similar wing wall. One of the purposes is to retain the embankment of the approach roadway—this would be from the ground level on down.

Mr. CONSTANDY. Could you talk about the ground level on up?

Mr. WILKES. A little background would be helpful. From the roadway down, something must be devised to slope the earth from the roadway surface down to the bottom of the structure.

That is the ground line down.

And from the ground line up they have made an effort to make a curb return designed to transition from the roadway cross section of the safety walk, back to the full shoulder. In plan view, that looks like a generous radius; but when viewed from the approach roadway, it does give a very abrupt change.

Some States have provided longer radius. Other means have been to have a longer transition of approach guardrail.

Mr. CONSTANDY. That would be a means of eliminating a hazard. I would like to get more directly to the function of that parapet as it extends above the rail.

Does it perform any function?

Mr. WILKES. The function it performs here, it does mask the metal handrail, whether that is aluminum or steel.

Mr. CONSTANDY. For what purpose?

Mr. WILKES. Well, you do not have the exposed end of the guardrail that you saw on the earlier photographs.

Mr. CONSTANDY. You cannot be serious. This thing will kill you before you ever get to the exposed handrail. It is putting a more lethal thing in front of one that already is lethal.

I have heard that from other people. I do not mean to sound so incredulous. It has been spoken of before.

Mr. WILKES. Well, the height of the rail is necessary for pedestrian traffic that you would have on the bridge, and from that pedestrian rail there should be some transition down to a roadway section. And this is the solution that was developed, I am sure, by the highways department.

Mr. CONSTANDY. But by itself it bears no relation to the strength of the bridge; does it?

Mr. WILKES. That is correct.

Mr. CONSTANDY. If it performs any function, it is to kill you before you get killed by the end of the handrail. In fact, here is an example—

Mr. WILKES. It certainly would depend on the angle of attack. It does have a feature of a radius—was built on a radius to flare out; and there are just as many or perhaps more wing walls that are built parallel to the railing.

Mr. CONSTANDY. I suspect from our earlier conversations that you are not pleased with this type of design itself. You do not care for the existence of that lethal mass of concrete; is that true?

Mr. WILKES. I cannot say that I necessarily agree. There has been an attempt to flare the bridge railing, which is restrictive, out to the full shoulder width. The criticism that I would have is that the radius is too short, that you need a longer transition.

Mr. CONSTANDY. So it would be possible to design and build something which would achieve the result that you desire?

Mr. WILKES. Definitely.

Mr. CONSTANDY. And at the same time eliminate the hazard that is produced by the existence of this form?

Mr. WILKES. Yes.

Mr. CONSTANDY. We do see these all over the country.

Mr. WILKES. Where you do not carry the full shoulder across the bridge, some appropriate transition must be provided. I can agree that this is certainly massive; and if you hit it head on, it is a lethal weapon.

Mr. CONSTANDY. Yes. We will see other examples.

I think, Mr. Prisk, is it not true that this is the site of a large segment of fatalities on highways?

Mr. PRISK. The most frequent thing that cars hit when they leave the road is the guardrail, and the next most frequent thing hit, after guardrail, is some component of the bridge; and this comes first on the bridge. I would classify it in the way you have mentioned, yes.

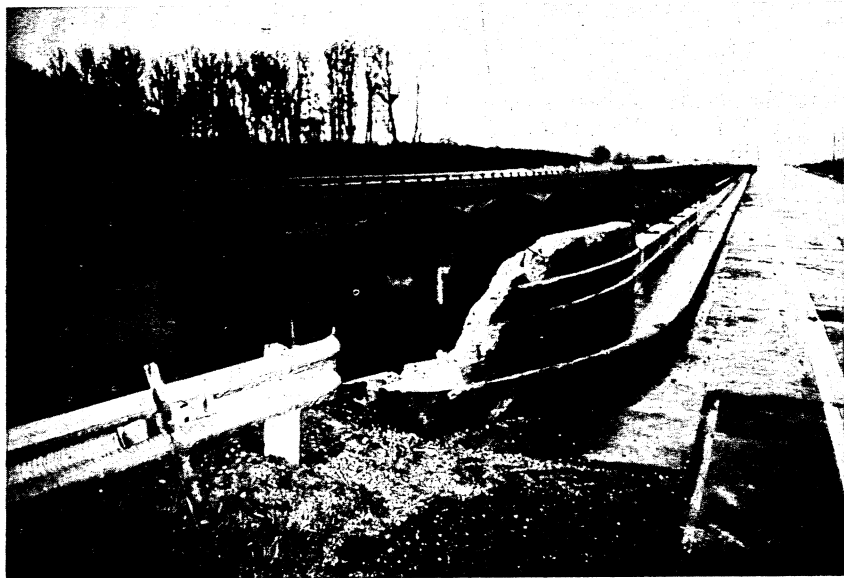
Mr. CONSTANDY. Did you want to say something further, Mr. Wilkes?

Mr. WILKES. No.

Mr. CONSTANDY. If we could go along now.

Mr. PRISK. I would like to compare, if I may, this bridge on the job which perhaps shows the curvature Mr. Wilkes spoke about a little bit better than did the accident photo, but this is the bridge on the project.

This is the bridge where the fatal accident occurred, which is very close to the project.



And this is another case. Here another fatal accident actually occurred. As you will see, this bridge was hit hard enough to take away not only a portion of that end wall, but a very considerable length of the rail running on up to the bridge.

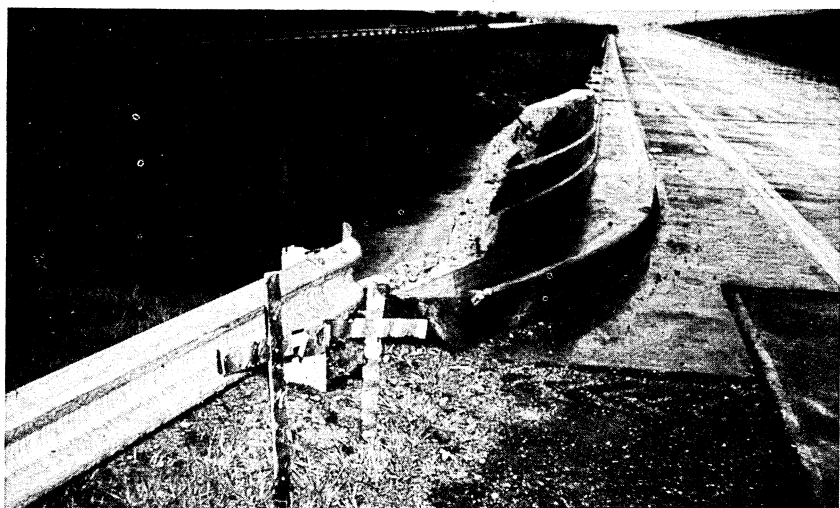
This was obviously a very severe collision.

Another view of this same accident location. Here the rail came to an end stopping, and with that terminal section on it, flared back. This did bring the car in violent impact causing two deaths at this point.

This is another location, but a similar designed condition.

Mr. CONSTANDY. This is between the project and Indianapolis. We do not know what happened there, but perhaps we can speculate.

Mr. PRISK. Two deaths occurred.



Now here is an attempt to remedy that situation that is going on today. Brackets blocking out from this curb section end wall are being fastened to the bridge, and the rail will then be extended to come up into this bracket, and this will afford somewhat better transition from the approach rail to the narrow structure.

This, at best, I think is only a partial solution. Just how much value this would have, I do not know. I expect that it would prevent contact directly—head on contact with the end, getting more glancing contact here.



The curb, of course, and the safety walk are still a very considerable hazard and remain unprotected.

Mr. CONSTANDY. Mr. Skeels.

Mr. SKEELS. One brief comment. This will certainly provide a big improvement over the original arrangement that they had. However, we have to realize that when a car strikes a guardrail, the guardrail does not stay put. It moves in the direction the car was going, that is it moves away. This commonly produces a condition known as pocketing.

When you run into a guardrail just short of an immovable object, such as we can assume the end of this bridge is, this happens. It will help the situation, but what you really need to do is put in a much stronger section of guardrail adjacent to your very strong bridge structure.

More posts is a way of doing it, putting in more frequent posts right adjacent to the bridge structure. In other words, there are ways to handle this that are still better than we see in this picture.

Mr. McCARTHY. I wonder if we could clarify a point, Mr. Prisk. Pedestrians are not permitted on the Interstate System, is that correct?

Mr. PRISK. Not normally, that is correct. It is usually a matter of State law.

Mr. McCARTHY. State law?

Mr. PRISK. State law.

Mr. McCARTHY. But all States have them?

Mr. PRISK. I cannot answer in that respect, but, most commonly, pedestrians are prohibited from the Interstate.

Mr. McCARTHY. Well, then why the safety walk on an Interstate highway?

Mr. PRISK. This is a carryover from the tradition that Mr. Wilkes mentioned, and I think the safety walk has been regarded in the past as an important aid to maintenance workers who come to the bridge, so that they have a place to get across the structure without being in the traffic lane.

Mr. WILKES. Could I reply to that?

Mr. GRAY. Mr. Wilkes.

Mr. WILKES. There is a requirement in the AASHO specification for Interstate highways that tunnels and long bridges on which the shoulder is not carried across the structure must be provided with safety walks.

Mr. CONSTANDY. That is in the current Interstate standards?

Mr. WILKES. That is correct.

Mr. CONSTANDY. Would you consider this a long bridge, Mr. Wilkes?

Mr. WILKES. Well, it does not have the full shoulders carried across. And one interpretation that has been made on this specification requirement is that when you do not have the full shoulders, then it is necessary to provide safety walks.

Mr. CONSTANDY. So that the critical fact is whether you carry the full shoulder, rather than the length of the bridge. You might have a short bridge.

Mr. WILKES. The specification has both parts of that statement. The long bridge on which the full—long spans on which the full shoulder is not carried.

Mr. CONSTANDY. The whole philosophy is predicated on a 6- or 8-inch curb being sufficient to prevent the car from hitting the pedestrian anyhow, is it not?

Mr. WILKES. No. Another part of the specification is that a safety walk must be 18 inches. Anything wider than that is called a sidewalk by definition.

Mr. CONSTANDY. Well, assume a pedestrian on the 18-inch safety walk, with a curb 6 or 8 inches above the roadway. If an automobile does go out of control, will a 6- or 8-inch curb cause it to keep from hitting the pedestrian?

Mr. WILKES. No; it will not.

Mr. CONSTANDY. It raises the question of whether it is really a safety walk. Does it cost more to install a safety walk than if the safety walk were omitted from the structure? You have to take into consideration the concrete that you use to make it, and secondly, it would seem to add additional weight—might it not add additional weight to the bridge that you may have to take into account in the design of the strength of the structure?

Mr. WILKES. In the design of a structure, the design load of course is a heavy truck. And by having a curb in the design consideration, the wheel is placed a certain dimension from the base of the curb. Now if the curb were not there, then the wheel could occupy the entire roadway, so that my answer is this: By eliminating a curb or safety walk, much more of the structure can be loaded with a truck, and would therefore have to be strengthened as a general rule.

Mr. CONSTANDY. In other words, the bridge has to be stronger if it does not have a safety walk, than if it does have it?

Mr. WILKES. Then the structure has to be designed in the event a truck gets against the parapet, whereas with the curb the design assumptions are that the vehicle will be contained inside the curb. As an overload condition, in which overstresses are permitted, the designer then places a truck wheel up on the safety walk or sidewalk; but under those conditions, he is using higher unit stresses and considers that to be an unusual occurrence.

Mr. CONSTANDY. I think the pedestrian would too.

Mr. WILKES. Of course a pedestrian load is much less.

Mr. CONSTANDY. There is some weight to the safety walk itself, is there not?

Mr. WILKES. Yes, there is some weight, and it is generally expensive concrete to build a sidewalk or curb.

Mr. CONSTANDY. Would you prefer to see bridges built without safety walks?

Mr. WILKES. Very definitely.

Mr. CONSTANDY. You would?

Mr. WILKES. Yes, sir.

Mr. CONSTANDY. You feel they create a hazard?

Mr. WILKES. I do.

Mr. CONSTANDY. Mr. Wilson.

Mr. WILSON. As a matter of information, in the early 1950's, California did in fact design a bridge rail without a safety walk and utilizing the whole width—in other words, we ended up with 2 feet wider distance between the rail itself and the travel way.

We built several of these bridges, and we had difficulty in developing a rail that would hold cars on the bridge. And then several years later we went back to building a concrete rail—not like you see here—but with the narrow rub curb against it.

We did try this without some success, and we went back to concrete.

Mr. CONSTANDY. You used what is called a brush curb; is that right?

Mr. WILSON. For the most part; yes.

Mr. CONSTANDY. To keep the vehicle wheels from the parapet, but not wide enough that it creates a hazard?

Mr. WILSON. That is the type that we used.

Mr. CONSTANDY. How wide is that?

Mr. WILSON. I would imagine 4 inches, something of that nature.

Mr. CONSTANDY. Mr. Ricker.

Mr. RICKER. There is another rationale for the safety walk on long bridges, and that is if a vehicle becomes disabled and the passengers have to leave it and walk off, they have a place of refuge. This does not protect them from a violent collision—a vehicle that would otherwise strike the rail. But it does protect them from ordinary traffic crossing the bridge. They have a place to walk.

I do not know that this outweighs the other comments made; but it is a reason why a safety walk is provided on bridges.

Mr. CONSTANDY. We are back in that area where we have to realize that you cannot get perfection. There has to be a compromise, which affords the greatest degree of protection to the person, whether he is pedestrian or motorist.

How do you feel yourself, Mr. Ricker, about safety walks? Would you eliminate them?

Mr. RICKER. In most cases, I think I would. On the other hand, with very long bridges, there needs to be some refuge for people who must leave their automobile because it is broken down.

Mr. CONSTANDY. Of course if there is a full shoulder, that is preferable is it not?

Mr. RICKER. Very definitely.

Mr. CONSTANDY. Mr. Prisk.

Mr. PRISK. Yes, I might say further with respect to this picture, that this is part of the \$800,000 guardrail rehabilitation project that we mentioned yesterday outside Indianapolis.

Mr. CONSTANDY. So if that is to be effective, would it not be necessary to treat, in some fashion, the safety walk on this bridge?

Mr. PRISK. I should think so, yes.

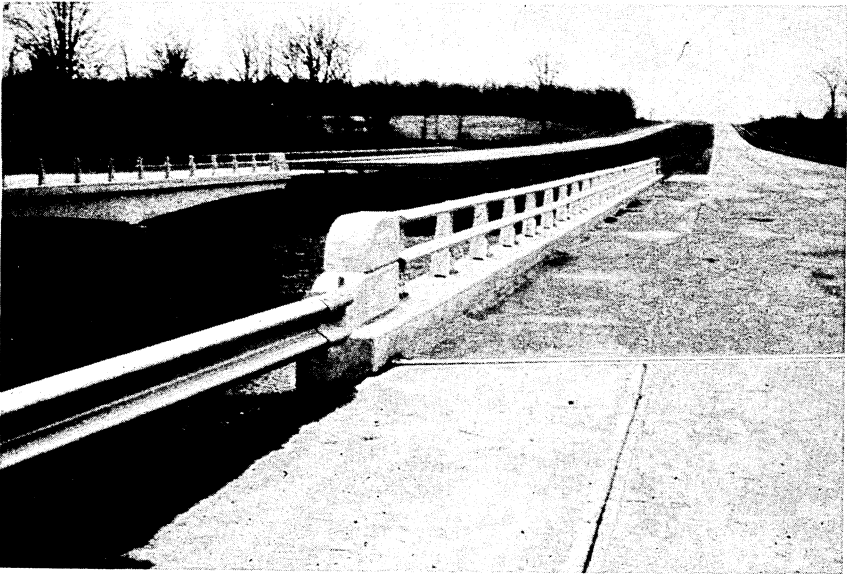
Mr. WILKES. I think I would agree that attaching the guardrail to the wing wall is a partial solution. Perhaps the complete solution would be to provide a longer curb return underneath the guardrail to make an easier transition.

Mr. CONSTANDY. Perhaps they could chop off that piece that sticks out.

Mr. WILKES. That goes all the way across the bridge.

Mr. CONSTANDY. Can you cut it off on an angle or would you create another problem once you do this, trying to find a safe solution?

Mr. PRISK. In terms of transition, it might be of some interest to know that this adjustment in the position of the rail runs back 100 to 150 feet.



Looking now at a brand new project, not yet opened, and also at this same critical point of junction of approach guardrail on the roadway and the railing and structure of the bridge, we find this condition. This is a new project just outside Indianapolis on Interstate 70.

You will see that the shoulder is carried through on the normal width on this side. This is the lefthand shoulder.

You will see the absence of that wide walk. This again, the weak point is the lack of attachment of this rail to the structure.

Mr. CONSTANDY. What Interstate?

Mr. PRISK. Interstate 70.

Mr. CONSTANDY. Just east of Indianapolis?

Mr. PRISK. Right. About 15 miles.

Mr. ZION. Do you have any figure on the number of deaths on I-69 in Indiana from June of last year when it was opened to traffic?

Mr. PRISK. We do not have the accident data for any of these projects specifically summed up. It would be possible to get that for the record if the committee would like it.

Mr. CONSTANDY. Congressman, it was my suggestion that we did not. Some of these projects have been so recently opened that they have not had the opportunity for sufficient traffic to make these statistics meaningful.

Mr. CONSTANDY. This particular project is not completed and is not open, but being completed to this extent, could we say that this is wrong, Mr. Prisk?

Mr. PRISK. I think it has a weakness that we spoke of before, certainly the lack of any considerable transition between the roadway and the structure.

Mr. CONSTANDY. Mr. Huff.

Mr. HUFF. I believe it should be said somewhere in this discussion that the basic fault is not having full shoulders completely across the bridge, and I think we will all remember that there were national

standards at the time this work was being designed, which would prohibit the placement of the shoulders entirely across the bridge.

Mr. CONSTANDY. Did they prohibit it or did they prohibit Federal participation in the cost of it?

Mr. HUFF. It may be that in the adjustment of the curb ends the basic solution there may be to go back and take the full operation and widen the bridge and carry the full shoulders across.

Mr. CONSTANDY. A lot of these other problems stem from that initial decision to not carry the shoulders through?

Mr. HUFF. I could not speak for Indiana, of course, but we did have national standards which limited the length of the bridge on which you could carry full shoulders across. I say this in defense of the Indiana engineer who designed this, that—

Mr. CONSTANDY. Of course this bridge, we will see, does have full shoulders. The opportunity is afforded to them to make a transition from the guardrail to the bridge rail correctly; and while I am not saying this for or against them, they have not done it right.

This is on the left side. We will see in a moment the view from the right side.

Mr. HUFF. It could be argued that this is not a full shoulder.

Mr. CONSTANDY. Let me ask you this. The same shoulder precedes the bridge on the roadway. So we are really not concerned with restriction of anything, whether 6 feet is wide enough or not is really not the point. The significant thing is whether there is a reduction in the shoulder as it is carried across the bridge. In this case there is not.

Mr. HUFF. It could be argued that the 6-foot shoulder on the roadway is not enough. Those are the kind of decisions made based on what people thought at that time when the span—

Mr. CONSTANDY. This particular bridge on the right side does carry the full shoulder. It is a little complicated inasmuch as the ends have an acceleration—

Mr. HUFF. It has not been hit.

Mr. CONSTANDY. For what reason? There has not been any traffic on it. If it is hit, as it stands there now, just in advance of this path, what might you reasonably expect to have happen?

Mr. HUFF. It could still be hit like it is; but if it had wide shoulders on it, it might not be hit. You get into the range of probability there as to whether it would be hit or not.

Mr. CONSTANDY. Yes, but I think we agree that there is no restriction as it goes across the bridge. Whatever shoulder crosses the bridge is the same shoulder on the roadway. It is a straight line.

Mr. HUFF. That would be true if you say 6 feet—it does not represent a restriction.

Mr. CONSTANDY. OK.

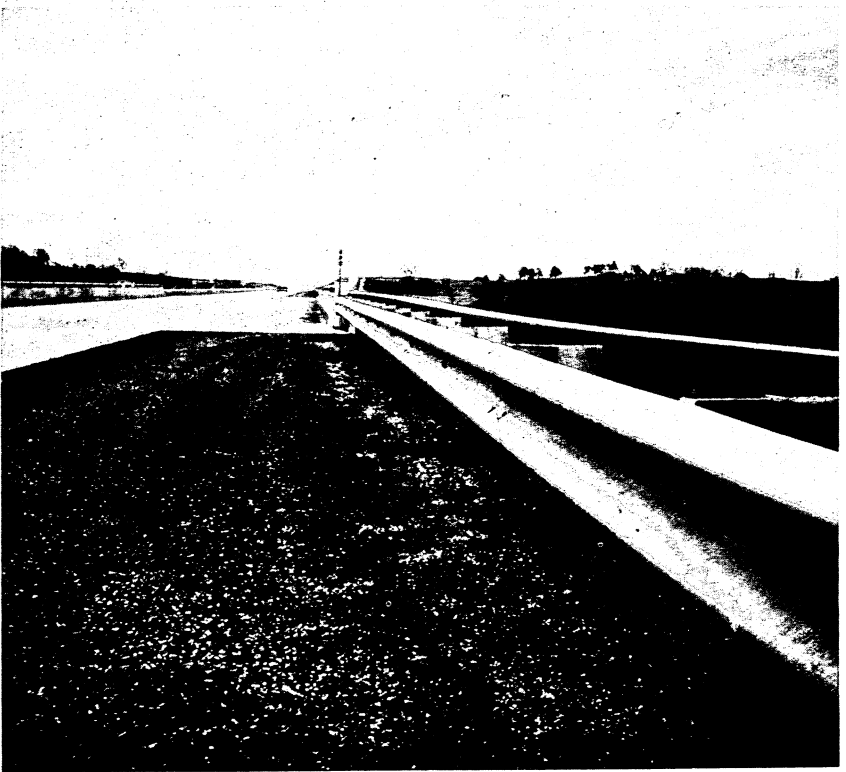
Mr. PRISK. This is a closeup of that transition point between the approach rail and the guardrail, approach rail and the bridge rail, excuse me. Some architectural treatment has been given to this end wall, and we know there is a similarity in the design here and this is the same State. It has been straightened out. The bridge rail is aluminum of a new design.



Here is the right side of this same bridge, and you will see here the acceleration lane coming in from behind camera and being carried on across the bridge to the normal width up here.

The approach rail in this instance is lined up nicely with this aluminum rail on the structure, and you have a modest width curb on the bridge. Unfortunately, it extends somewhat outside the rail face in this section here.

This is the right-hand side of the same bridge. Perhaps there will be some comment on that. Actually, the only clearance allowed here is this very short distance. I think that is about 18 inches there.



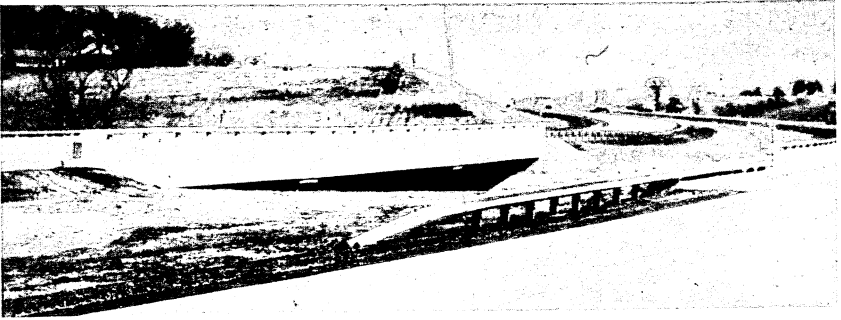
We move along and we see another structure in our next State, Missouri, I-35. Here we have a structure. This is about 180 feet long, if I recall correctly, which would classify it as a major structure. Here the full width of the shoulder is carried across, both from the right and from the left.

When you get to the end of the concrete parapet wall, this is the condition that you find. This little wing section comes off the guardrail and is blocked off, and of course this is desirable; but you do have no attachment here or structural association with the bridge.



This is another view showing the left-hand side, buried end rail going on up to the structure.

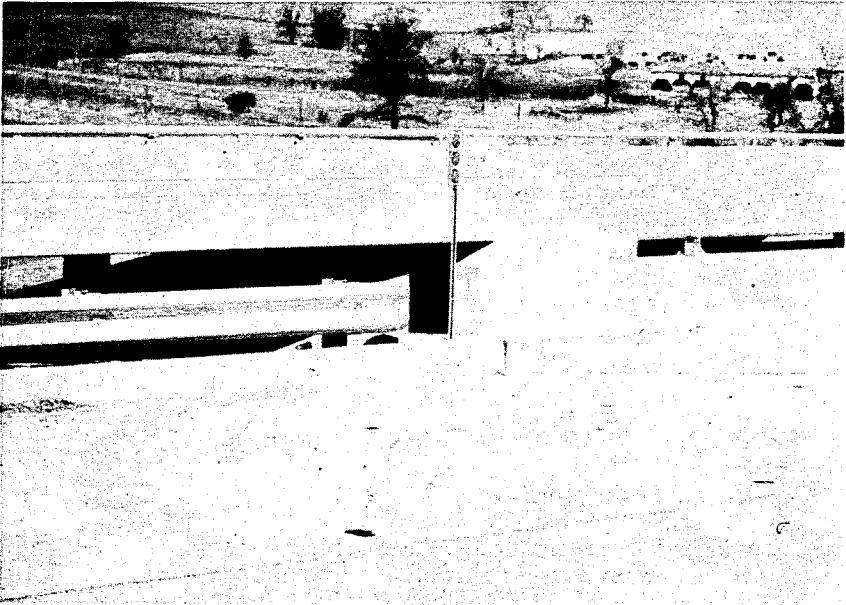
Again, on this side, this section of the curb projects in front of the rail which is an undesirable feature.



This is a closer view of this same bridge. This is the only bridge, as I recall, on this whole section which had any guardrail treatment. But there is a good view of the curb, carrying drainage down to an outlet at this point.



Now here is a closeup. In Missouri's treatment, it doesn't have all of the grooves in it that we found in Indiana; but essentially it is the same massive block of concrete standing between a rail here that is intended to guide traffic along the course up to this point. The rail is about 24 inches here and the top of this is about 27 or 28 inches.



Mr. CONSTANDY. Can we say that it is wrong?

Mr. PRISK. I think it is subject to most of the faults that we have just been discussing.

Mr. CONSTANDY. The same thing basically, is it not?

Mr. PRISK. Yes. The only advantage I see here is the close spacing of the rails, which will offer somewhat more support than we have previously. Otherwise, the same.

Mr. CONSTANDY. Is there anyone on the panel who would question whether to consider that wrong?

Mr. WILSON. I would question it; there is no way of telling here how much additional strength that end post might have. I do not subscribe to the fact that it is 2 and 3 feet away from this concrete abutment; but we have made an attempt to strengthen the end of the rail by using a 10 by 10 post in lieu of an 8 by 8 and putting it into the ground at a considerable greater depth; recognizing that it is a critical area.

Mr. CONSTANDY. It would be desirable, would it not, to carry the guardrail across the face of that parapet so that there is no break in the continuity in this area across which the car is sliding?

Mr. WILSON. I would have to agree with that.

Mr. CONSTANDY. Mr. Skeels?

Mr. SKEELS. One additional comment. If they had carried that section on down to grade level, they would have eliminated that vertical space which is the primary problem here, and then leaving the rail about where it is it would have been in front of the wall, and could have been anchored to it.

My point is that with really minor changes, this could be a reasonably good design. I note also that they do have the post at a 6 foot 3 inch spacing at that location.

Mr. CONSTANDY. Mr. Prisk, what is that stick with three amber reflectors on it?

Mr. PRISK. Delineators.

Mr. CONSTANDY. What does it mean?

Mr. PRISK. It is a marking for the end of the bridge, essentially indicating to the motorist under nighttime driving conditions where the edge of the roadway is or the presence in this case of a hazard.

Mr. CONSTANDY. The sign indicates the presence of a hazard?

Mr. PRISK. Yes.

Mr. CONSTANDY. In other words, this would otherwise be a single white reflector, is that true?

Mr. PRISK. Normal delineation is carried by a single white reflector, yes. This is a hazard marker.

Mr. CONSTANDY. It is paradoxical, they just finished building the bridge, and then they put up an indicator that they considered it a hazard. I think we will see this on some of the others. Mr. Wilson, this comes within your committee, does it not?

Mr. WILSON. Mr. Constandy, we sometimes call that a clearance marker. Normally you would see that on the right along the deceleration lanes or acceleration lanes of a facility like this and it merely tells you that—stay on one side or the other, depending on which side you happen to be.

It is not necessarily a hazard marker. It is a clearance marker.

Mr. CONSTANDY. Mr. Prisk.

Mr. PRISK. I will proceed.

Then here is another structure that we next reach showing no rail in place at all. Essentially the same type of structure with no rail in place.

Mr. CONSTANDY. You could drive between the bridges there, or you could go down on the right, or, in the alternative, could hit any one of the bridge parapets?



Mr. PRISK. That is right. This project is not heavily traveled, but it has been open as a relief route for about 6 months now.

Mr. CONSTANDY. They do have plans, do they not, for the installation of guardrail on this project?

Mr. PRISK. Yes; it may be that now—today is almost 2 months since this picture was taken—guardrail may be in place at this point. Guardrail work was deferred until after the project was opened.

Mr. CONSTANDY. In spite of the existence of these hazards, even though they be temporary, I have had occasion to speak to a police officer on this project, and I think what he said is worth repeating, to keep this in perspective. He was impressed with the overall reduction of accidents in this area as a result of the existence of this road, even though it does contain some of these hazards. The road which the traffic had been using before is not of this type. They had a considerable number of accidents on it. And when this was completed and opened, the rate of their accidents fell off considerably.

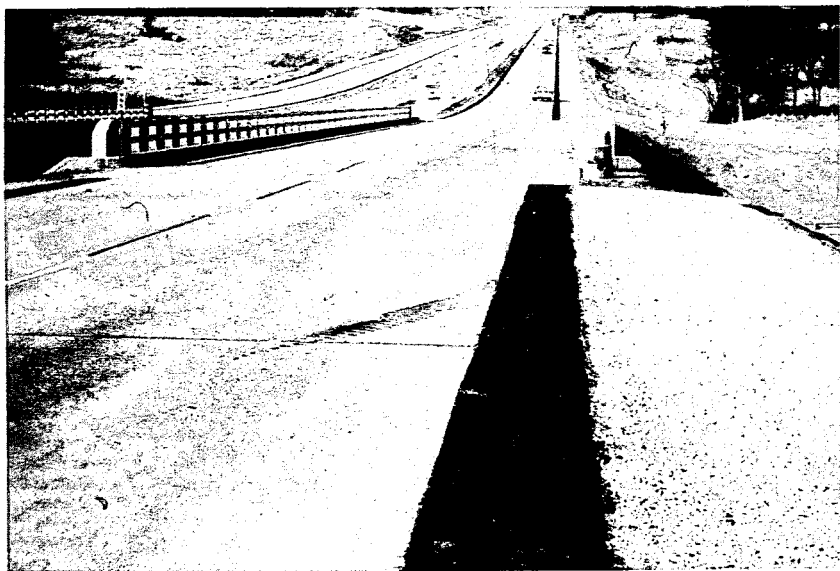
He did make mention of the fact that they had adopted a practice in the morning, with the first light of dawn, of the patrolman on duty driving the length of the project and looking for skidmarks, and particularly at those places where they were unprotected by any kind of device and which would allow a car to have gone off the road out of sight of the traffic. A sergeant, while making his morning tour, noticed skidmarks leaving the pavement and entering the median in a situation very similar to the one that you see, between the bridges, that have the space between them unprotected. When he stopped and

went to look, he found down in between the two bridges an automobile, the occupant lying on the ground next to it with a broken back. He had been there for some time.

We do have accidents as a result of the lack of protection on these hazardous points. But overall, the features involved in the freeway type of design have themselves reduced the total accidents in the area. It is worth bearing that in mind.

Mr. PRISK. This paralleled U.S. 66 and the heavy traffic relief evidently has benefited the overall experience.

This is a closeup of another structure just a few miles farther along the way. This is the full shoulder width. This section here, to give you some dimension to judge by, this paving, this asphalt mat is 2 feet wide. You will see that there are about 2 feet 6 inches clear to the curb, and then a steel rail behind the safety walk on this bridge.



Mr. CONSTANDY. Mr. Prisk, I notice in each of these photographs, at the end of the bridge, the approaching end, there is always a yellow barrel with a number of dents in it. What is that there for?

Mr. PRISK. I did not ask anybody what that was there for and I do not believe I can do any more than guess that it serves to reinforce this yellow delineator up here, clearance marker, or hazard marker, as you will.

Mr. CONSTANDY. Thank you. It is not one of your devices Mr. Wilson, your committee's, is it?

Mr. WILSON. No, sir.

Mr. PRISK. This structure is almost exactly the same length as the other one and does have a different curb-to-curb width. As I recall, it was 32 feet curb to curb; the other one was about 40 feet, the reason being the difference in design period, one design a little earlier than the other one.

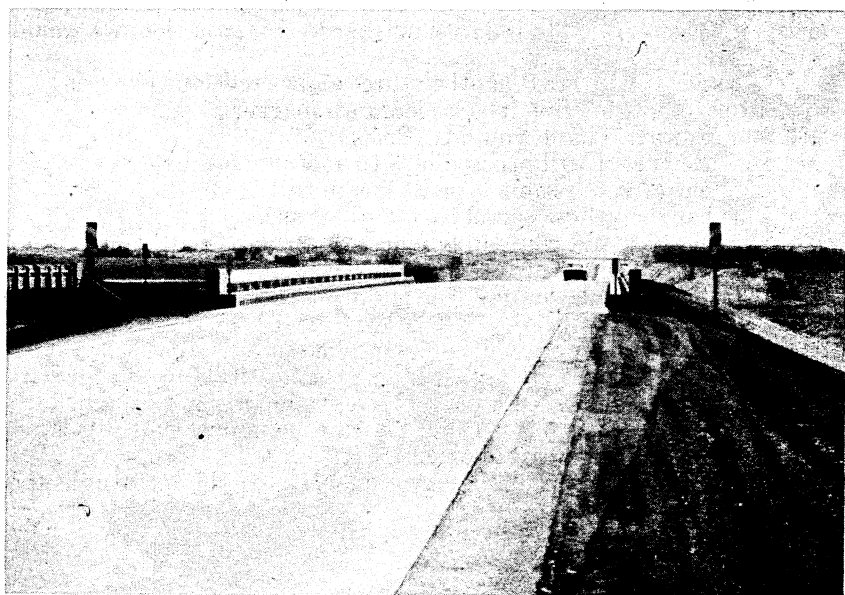
Here is a view on that same structure and you will see that someone did get up on top of this safety walk and put a pretty good dent on this steel channel that runs along the top.

This is that narrow section of bridge.



Here is another one, still another bridge at the same width, I might say. There is a marker out here.

Mr. CONSTANDY. What is that marker, Mr. Wilson? The panel with the black and white stripes?



Mr. PRISK. I hoped you would ask him.

Mr. CONSTANDY. I asked you because you are chairman of that committee. I do not mean to pick on you.

Mr. WILSON. Really I am not familier with that type of marker, although I have seen it in several of these pictures. I am not even sure it is a standard marker.

I would gather that you are to travel to the left of it, because if you will notice, the one on the right over there is sloped down the other way.

Mr. CONSTANDY. You will forgive me, Mr. Wilson. You had better travel to the right of the one on the left and travel to the left of the one on the right?

Mr. WILSON. I think there is something more basic than what we have gotten down to yet. Apparently it is a practice in some States to put in signs and traffic control devices by subsequent contracts after the highway is open to traffic. I can only speak for California in this regard; we do not open a highway until all of these devices are in. We do not think it is the right thing to do.

I think it is obvious from this picture here that at least the traffic control devices other than signs ought to be in place here.

Quite often you can have sign contracts following the major construction by the use of temporary signs, maybe a smaller variety. But in my opinion and the opinion of our State officials in California, we would not open a road like this until it has all of these devices on it.

Mr. CONSTANDY. Mr. Ricker, do you know what that panel is for, the black and white striped one? Are you familier with it?

Mr. RICKER. It is another type of clearance marker and, as Mr. Wilson said, the slope of the lines indicates which side of it you should go. Perhaps subconsciously, not by any written explanation of it.

Mr. CONSTANDY. Is that to inform the motorist of the existence of the edge of the shoulder?

Mr. RICKER. We use a number of these on narrow bridges on secondary roads, and we place them in line with the parapet. In other words, if we were going to use that marker in this situation, we would put it nearer the highway.

Mr. CONSTANDY. Where that other-three amber reflector panel is?

Mr. RICKER. Right. But it is a clearance marker.

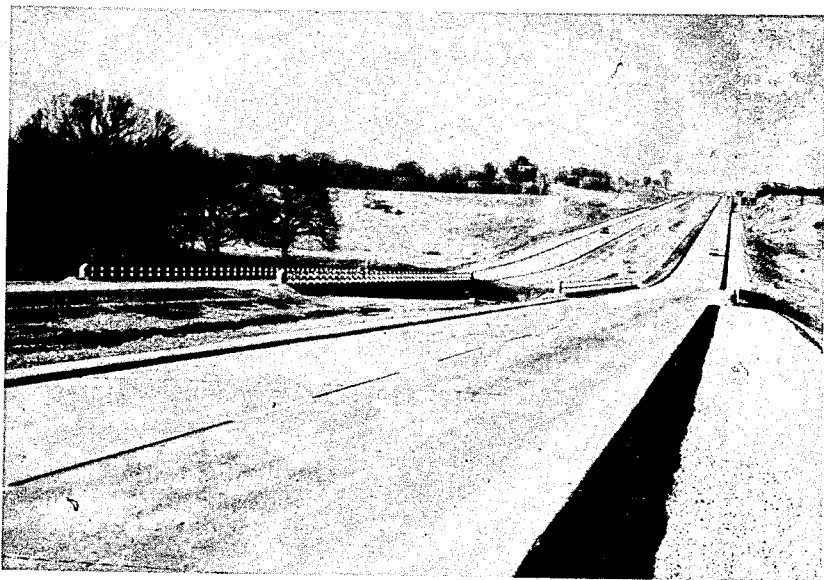
Mr. CONSTANDY. Thank you, Mr. Prisk.

Mr. PRISK. Yes. I will proceed now to another steel bridge and you will see, essentially, the same type of treatment.

This one has the yellow barrel back with us as an assist for marking. I do not see a black and white diagonal marker here at all. In this case the yellow reflector units are in place, however. This is the same condition we just observed, similar condition on the same project, I-35, Missouri.

This is a little closer up view showing better, perhaps, what is involved in this opening. You have a drainage structure, I mean a culvert headwall, sticking up here at a place where you might go through. This could only add to your problem, complicate your problem in getting down here safely, if you had to enter that area.

Mr. CONSTANDY. If you are lucky, you will have the accident at the headwall?



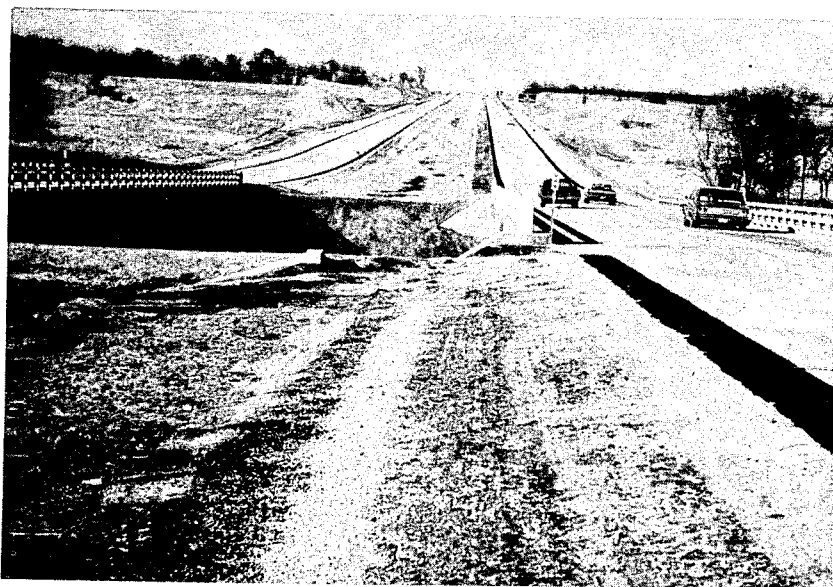
Mr. PRISK. You are not assured that that is going to stop you, even so. This would stop you. [Indicating.]

Mr. CONSTANDY. Yes.

Mr. PRISK. This is essentially the same condition that we have seen before, narrow bridge.

Mr. CONSTANDY. Mr. Wilson?

Mr. WILSON. I notice on this project the signing is in, but the safety devices are not.



Mr. PRISK. That is right.

Mr. CONSTANDY. When you make reference to the safety devices, are you speaking of the guardrail?

Mr. WILSON. Guardrail, delineation. I do not think I see a stripe—oh, yes, there is a stripe there.

Mr. CONSTANDY. I think it is interesting, is it not, that Missouri, Mr. Prisk, has a different philosophy about the delineators? Or do I have the wrong State?

Mr. PRISK. Excuse me, I did not quite get the question.

Mr. CONSTANDY. The delineators you normally find on the edge of the shoulder on the highways, do they have a different philosophy?

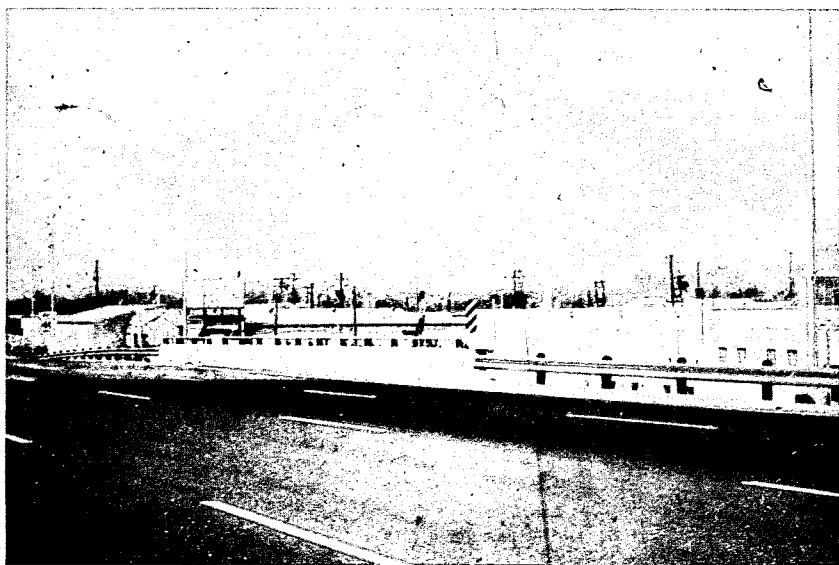
Mr. PRISK. Yes. As I recall, during the conversations on this project, we were advised that the State of Missouri did not want to use delineators on the Interstate project.

Mr. CONSTANDY. This is an optional thing, whether you do it or not?

Mr. PRISK. It is not an optional thing; it is required.

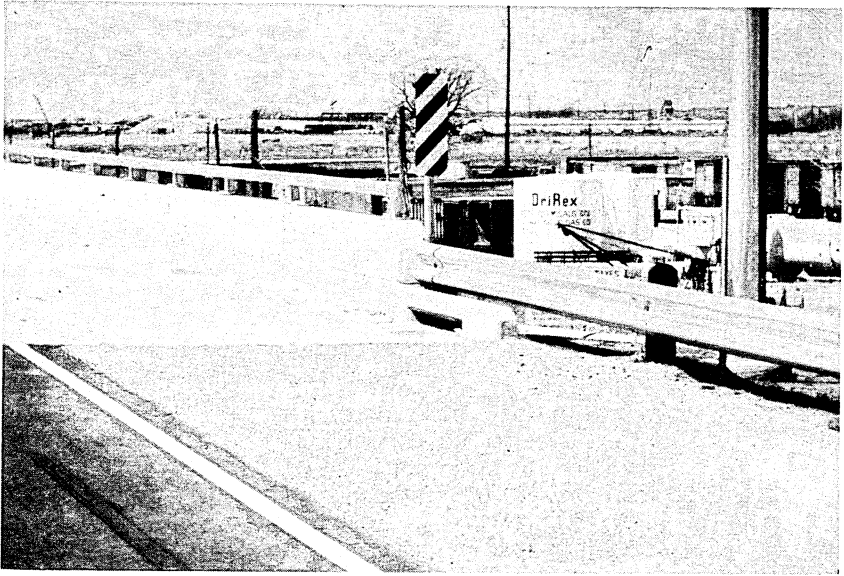
Mr. CONSTANDY. Maybe it lends more significance to the fact that while they do not believe in it, generally, they do put the three amber ones on the end of the bridge?

Mr. PRISK. That is right.



Here now we come to Oklahoma, and the project that we see there, again, presents the same difficulty essentially with a bridge in an urban area where there is no transition treatment.

There has been an attempt here at a transition treatment, where a portion of that wall has been recessed to anchor a bolt and to permit a single five-eighths-inch bolt to go through the end guardrail into the concrete, so as to sustain that last panel.

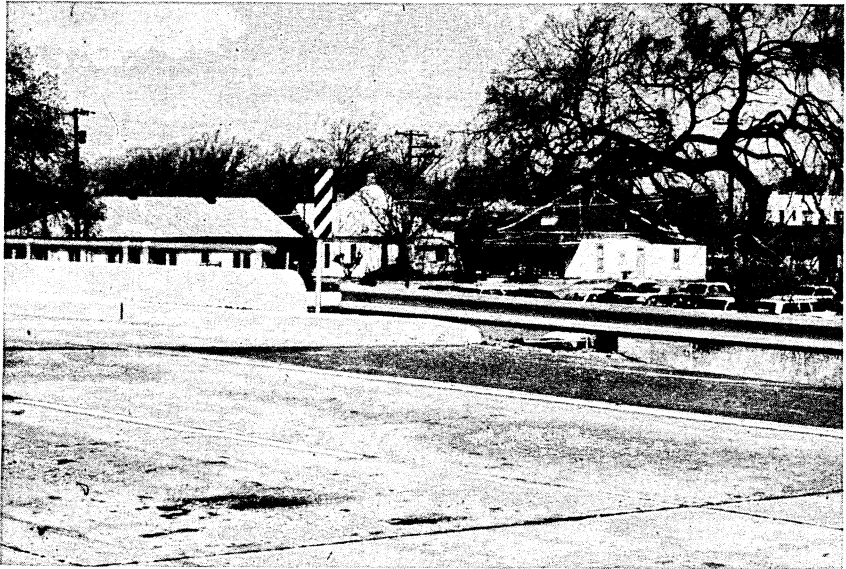


Mr. CONSTANDY. Not on this one, though, it is? I think that is on a later slide.

Mr. PRISK. Well, on this project there is that treatment.

I have a close-up.

There is one again that is quite open. In the previous case we saw the New York box beam rail; this one has a round rail on the top.



Here is another structure on this project where there is quite a mass of concrete here, with clearance from that point to the end of the bridge rail, and, of course, plenty of clearance here.

Mr. CONSTANDY. How does this one strike you, Mr. Wilkes? Forgive me for putting it in those words.

Mr. WILKES. I think that you can see that this is the longer wing-wall, and I would surmise that this superstructure would be a deep beam rather than shallow, because there is a relationship to the length of the wingwall and depth of the superstructure support. So I would say had the approach guardrail been fastened to that wingwall, that would have been an acceptable design.

Mr. CONSTANDY. Mr. Prisk?

Mr. PRISK. I expect the point Mr. Skeels said earlier about taking this down to ground level at this point would apply equally well here, if that rail could be brought into this wall.

Here is what you find at an exit point where essentially the same thing only doubled up, back-to-back walls. There is a hazard marker. I think I miscalculated the other one. This one is.

Mr. CONSTANDY. This is an extremely difficult type of situation; is it not?

Mr. PRISK. Yes, it is. It is an elevated roadway and this is the exit ramp that you see the car on. The entire thing is in an urban area. There is a narrow walkway along most of the main line section.

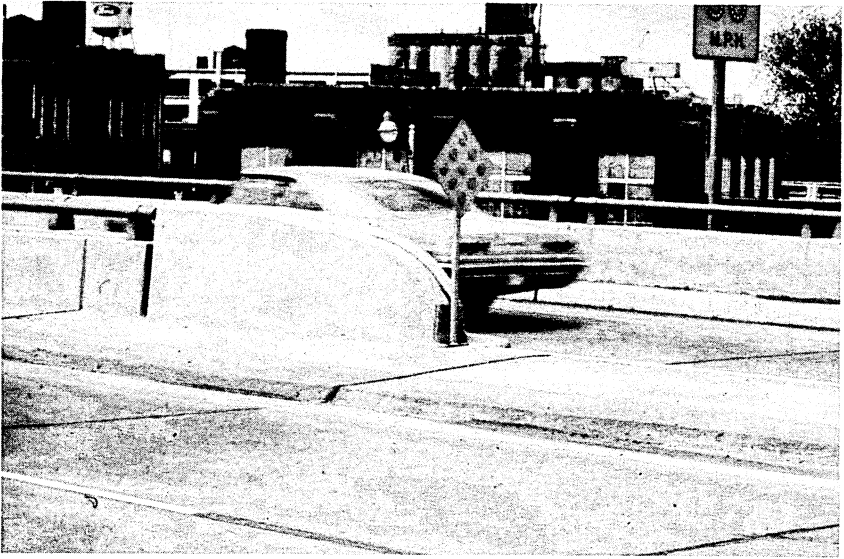
Mr. CONSTANDY. What possibly could be done to that—what do you call that big concrete end?

Mr. PRISK. That is an end wall.

Mr. CONSTANDY. Is that a parapet, too?

Mr. PRISK. End wall. It is almost in the shape of a cowl here, I guess.





Mr. CONSTANDY. Could that be extended, tapered more and perhaps be less of a hazard?

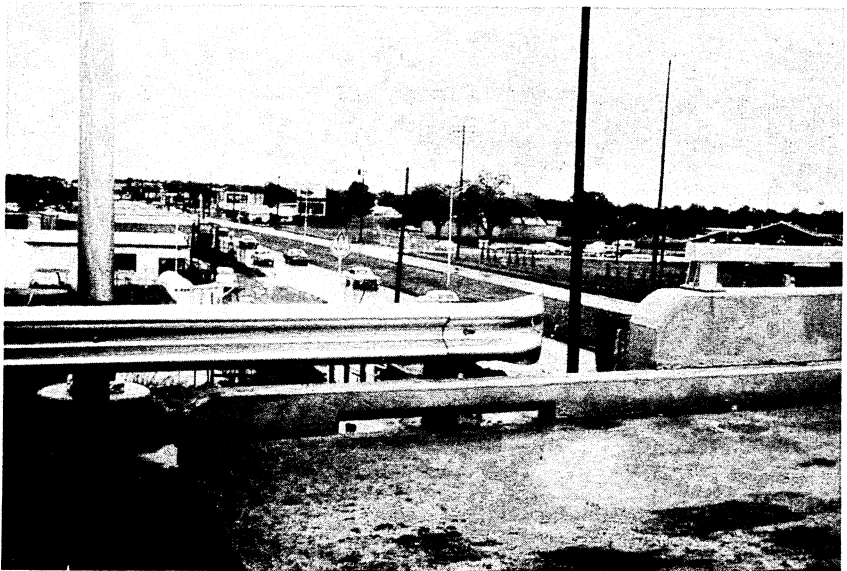
Has anyone on the panel had any experience with such a situation?

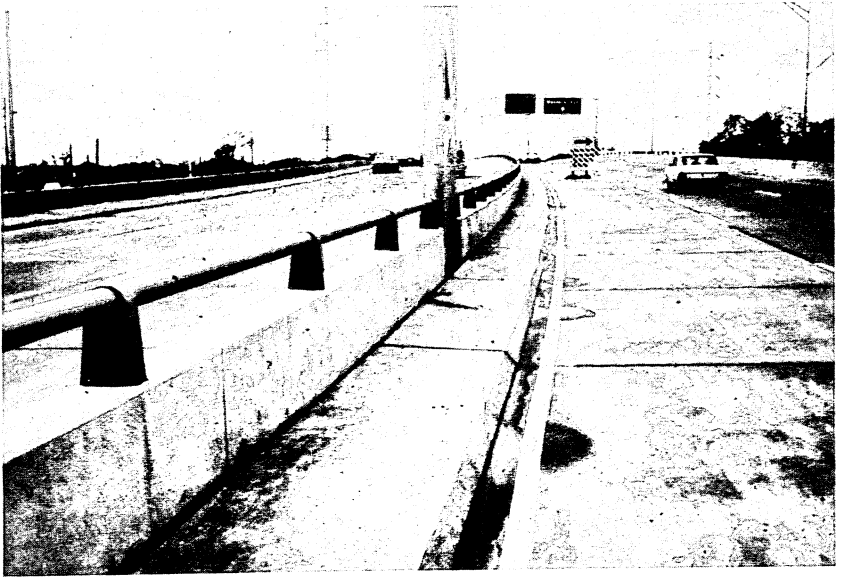
Mr. RICKER?

Mr. RICKER. Such cowls have been built and used successfully where they slope up more gradually and also in width.

Mr. CONSTANDY. Mr. Prisk.

Mr. PRISK. Continuing, this is another view of a connection between the rail and the structure on the project. This is the square box beam on top of a parapet, essentially the same height as the approach rail. Here is the steel light pole behind the rail in this case.



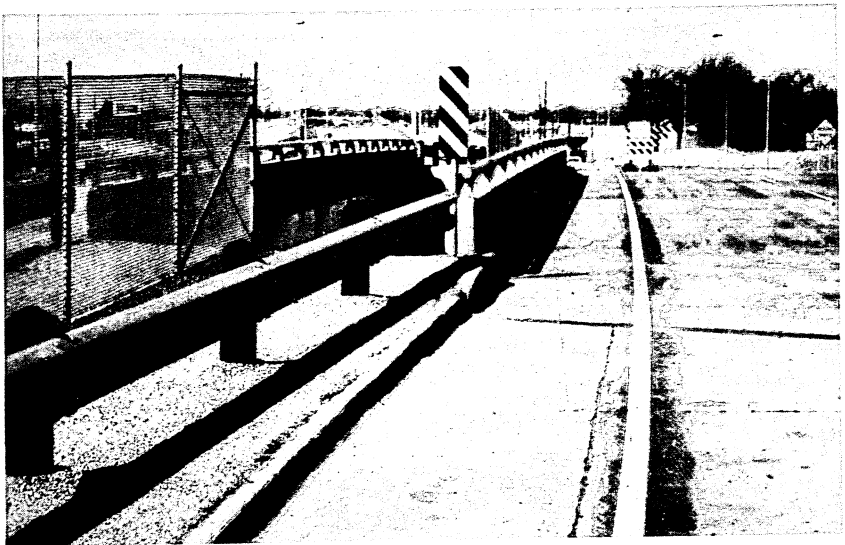


Here is the general view looking along the roadway. What you will notice here perhaps is the provision that has been made to accommodate the sign support structure within the wall.

On this one there is a disturbing element; you do have this narrow curb, which is a desirable feature. But coming back along that same line and in front of the guardrail, the curb is continued parallel to the line of the highway.

Mr. CONSTANDY. With what effect if struck?

Mr. PRISK. To the degree the curb has any height at all, it begins to introduce the possibilities of a car jumping and hitting the guardrail



at a higher point than would be desirable. There should be a lack—I mean a clear surface from the roadway onto the guardrail.

Mr. CONSTANDY. I notice in this bridge, compared to the one you made reference to a few minutes ago, Mr. Wilkes, it just ends without that parapet or wingwall extended above the grade. There is a difference in design; is there not?

Mr. WILKES. Obviously there is. In this case I think the preferred end treatment would be to bring the metal rail down to the top of the parapet wall.

Mr. CONSTANDY. And even then, of course, carrying the guardrail across the face of the parapet?

Mr. WILKES. Correct.

Mr. CONSTANDY. Mr. Ricker.

Mr. RICKER. The AASHO Safety Committee made a tour last year and wrote a report which I think the committee knows as the yellow book.

Mr. CONSTANDY. Yes.

Mr. RICKER. One of the points in there is that the space between twin bridges be covered over, if it is narrow enough to be 20 or 28 feet. I would suggest in a case like this bridging that opening would be better than constructing a parapet.

Mr. CONSTANDY. Thus eliminating the hazard of the parapet on the left side in each case?

Mr. RICKER. Right.

Mr. CONSTANDY. And also permit continuity of the median barrier across the bridges.

Mr. Wilson, I know your State has had considerable experience in doing that and you do have a design practice wherein you will bridge the space where the span is up to—what—20 feet?

Mr. WILSON. In years past we have been decking them over if they are 22 feet or narrower. It is based on that—that was picked pretty much on the basis of economics because you can deck it over just about as cheap as you can build the walls and build all the accessory hardware you need to protect the walls.

Mr. CONSTANDY. So when the median is 22 feet, at the same cost you can have a vastly improved facility.

Mr. WILSON. Yes. We have recently widened our base to 30 feet and intend to deck these over.

Mr. CONSTANDY. Do you have any approximation of the additional cost to deck them over on a 30-foot median?

Mr. WILSON. No, I don't; but any traffic or maintenance engineer would certainly subscribe to it even if there is a modest additional cost.

Mr. CONSTANDY. The additional cost for 30 feet would be modest?

Mr. WILSON. In comparison to the total cost of the structures, I would say so. I am not a bridge engineer and I cannot—

Mr. CONSTANDY. But there would be additional savings on maintenance, to say nothing of the reduction in hazard.

Mr. WILSON. Oh, I am sure there would.

Mr. CONSTANDY. Mr. Wilkes, would you care to comment?

Mr. WILKES. If you would like for me to guess. I would say for a normal short span bridge, the additional cost would be in the neighborhood of \$120 to \$150 per foot of bridge to—this is additional

cost or the difference in cost between paving a 20 foot and about a 30 foot.

Mr. CONSTANDY. So it is a nominal amount relative to the cost of the bridge itself?

Mr. WILKES. That is right. Probably the total cost between the minimum 6 foot and the 30 would perhaps be \$200 or \$300 per foot.

Mr. GRAY. Mr. Wilkes, are you referring to modification or are you referring to if this additional width were written into the specifications before it was actually built? Are you talking about modification?

Mr. WILKES. I am thinking if it were built additionally it would obviously cost much more than that to remove the parapet.

Mr. GRAY. You are talking about the initial cost?

Mr. WILKES. Yes.

Mr. GRAY. You wouldn't hazard a guess how much it would cost to go back and do this? Double?

Mr. WILKES. Oh, maybe triple. I think it would be very expensive.

Mr. CONSTANDY. Triple what? Triple the thing you are getting, not triple the costs of the bridge?

Mr. WILKES. It may be \$400 to \$600 per foot.

Mr. CONSTANDY. To go back and correct?

Mr. WILKES. To go back and remove the parapet, widen the substructure, provide additional beams. Normally contractors are less—let's say the cost of rebuilding and widening bridges is greater than for a completely new bridge construction.

Mr. GRAY. So the adage "An ounce of prevention is worth a pound of cure" is certainly true, isn't it, in this type of situation?

Mr. CONSTANDY. We have a panel behind Mr. Ricker depicting the two situations, the upper one being the bridge with space between the twin spans being decked over and the lower one showing it as it is in this picture, on the slide, where it has not been.

You can see there how much it improves the overall appearance. all appearance.

You find now up to 30 feet it is feasible. Perhaps we will no longer see twin structures 30 feet and under being built.

Mr. Prisk?

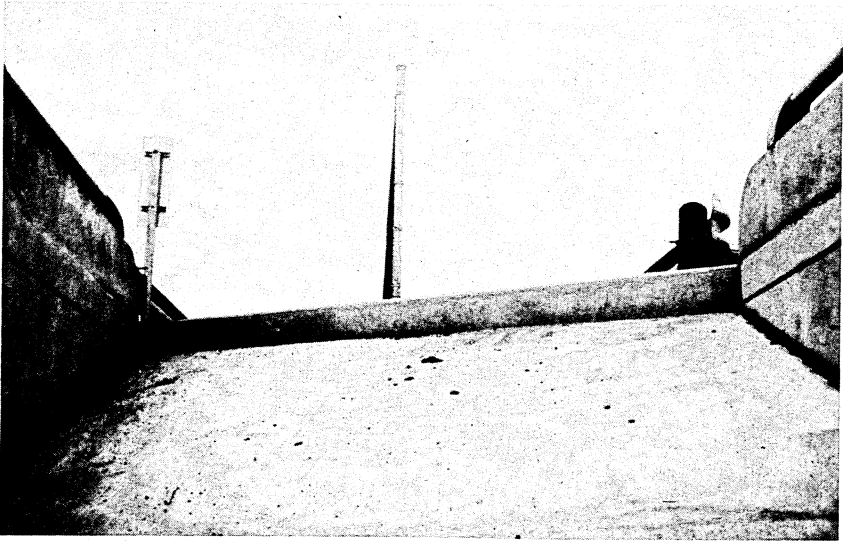
Mr. PRISK. Yes.



This again is a closeup view of twin bridges, rather close together. And again the lack of anchorage between the rail and the structure. This is repeated over and over.

This rail up on top of a curb, of course, would not function as well as one that was clear.

Here is the type of hole that you drop into at this particular location. You can see the fence, anchor fence, up here at the top, and the ends of the two rails, with the daylight between all the way around.



This is another structure showing the attempt here at anchorage. This is the one I thought I had before. But in this case, the rail

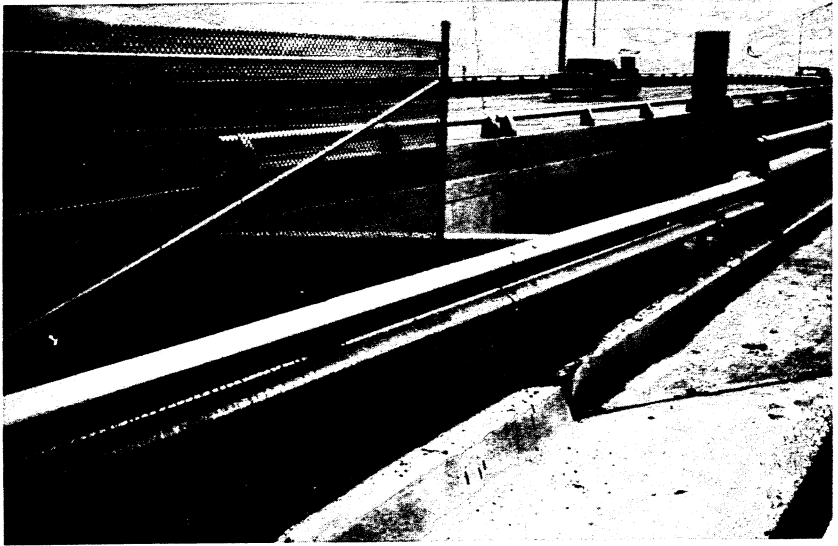


is in fact recessed into the parapet walls so that the face of the steel rail is the same as the traffic face of the parapet wall.

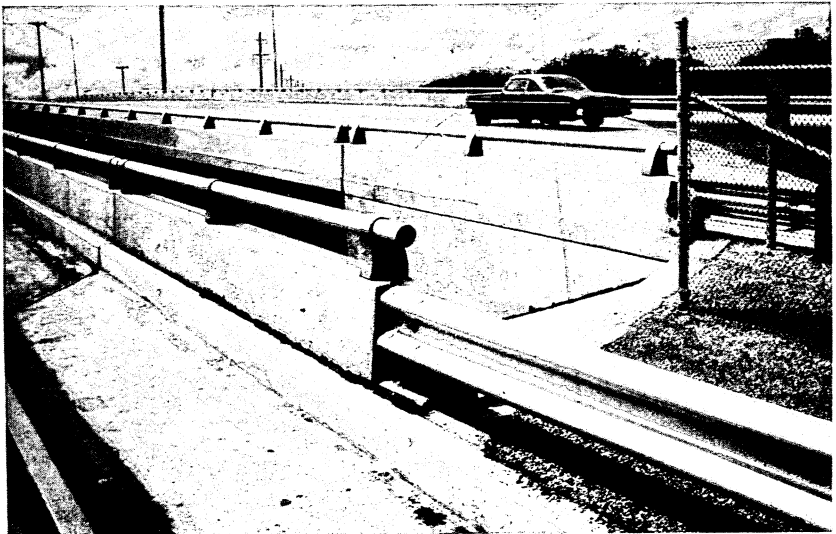
You do have, again, the curb at the head of the rail, with some disadvantage in performance. On this project, too, there is a hole at this point, which would not help too much if you happened to get a wheel up on it.

Mr. CONSTANDY. The concept here is desirable. We will see whether the details fulfill it. Is that true?

Mr. PRISK. True.



Here again approach to this same thing, a dual bridge, indicating the treatment on the median side where the rail is in fact anchored by a five-eighths-inch bolt to the concrete structure.



Mr. CONSTANDY. Would you consider that adequate?

Mr. PRISK. These apparently are not working out too well because this is not a sufficiently strong anchorage to forestall the contraction and expansion stresses that develop in the rail itself. Some of these, as we saw, pulled away or cracked the end of the concrete here.

Mr. CONSTANDY. There are several bridges on this project. For some reason, this is the only one treated in this fashion. The others were built as we have seen, with the guardrail not connected to the bridge. Perhaps we can move on.

Mr. GRAY. Just one moment, if I may. What purpose does the fence serve at all, in the center, except to obstruct the view?

Mr. PRISK. It prevents a little headlight glare. It has this disadvantage at this point of introducing that top rail.

Another use, of course, is pedestrians are prevented from promiscuously crossing the roadway if they get up on there.

Mr. GRAY. That would probably be considered the main purpose, would it not?

Mr. PRISK. I suspect so.

Mr. GRAY. All right, you may proceed.

Mr. PRISK. This particular structure that we found with these anchorage points on it, this gives the detail of what has been done here.



This is a half- or five-eighth-inch bolt, simply run through the concrete at one point. This is what you start to get, cracking developing, and some of these have pulled loose. Certainly it could not stand very much impact.

Mr. CONSTANDY. Mr. Skeels, you seem to have a reaction to this.

Mr. SKEELS My reaction was that they tried to do something but the solution is inadequate. To this—the size of this single bolt is wholly inadequate to develop the strength available in the guardrail. The tensile strength.

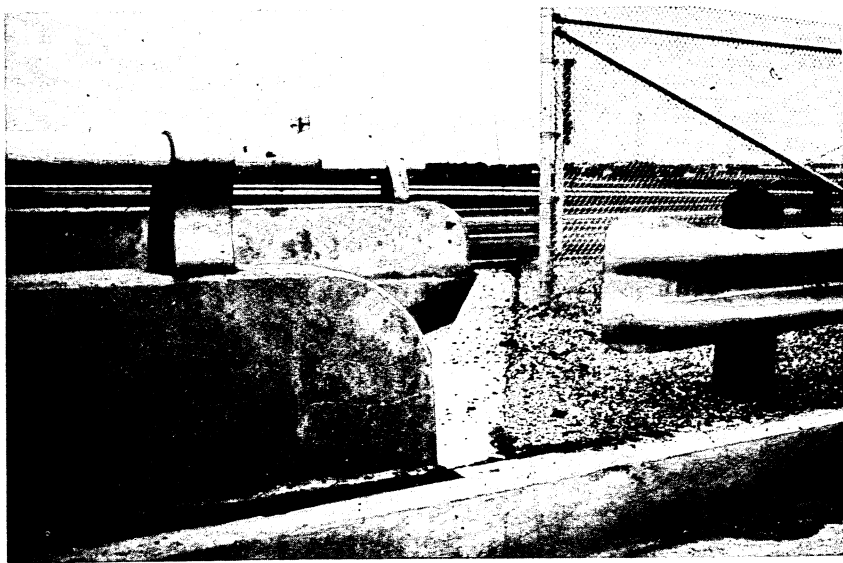
Mr. GRAY. Who designed this particular guardrail?

Mr. CONSTANDY. We don't know.

Mr. PRISK. Under the supervision of the Oklahoma Department of Highways.

Mr. GRAY. Probably someone in the district office, would you guess? District highway office instead of Oklahoma?

Mr. PRISK. Possibly so. It could have been done by a consultant. We just do not have that information.



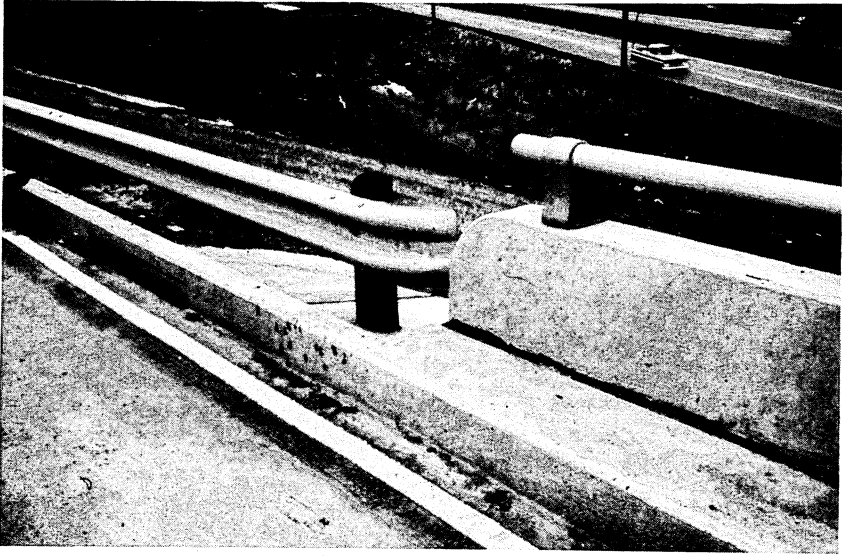
It is rather interesting on this same structure, that six of the eight possible points of contact of rail and structure have been fastened in the manner that we were just looking at in the previous slide. But two of them have not; on this side here is a place that is fastened and on this side it is not.

Mr. CONSTANDY. So the concept is three-quarters correct?

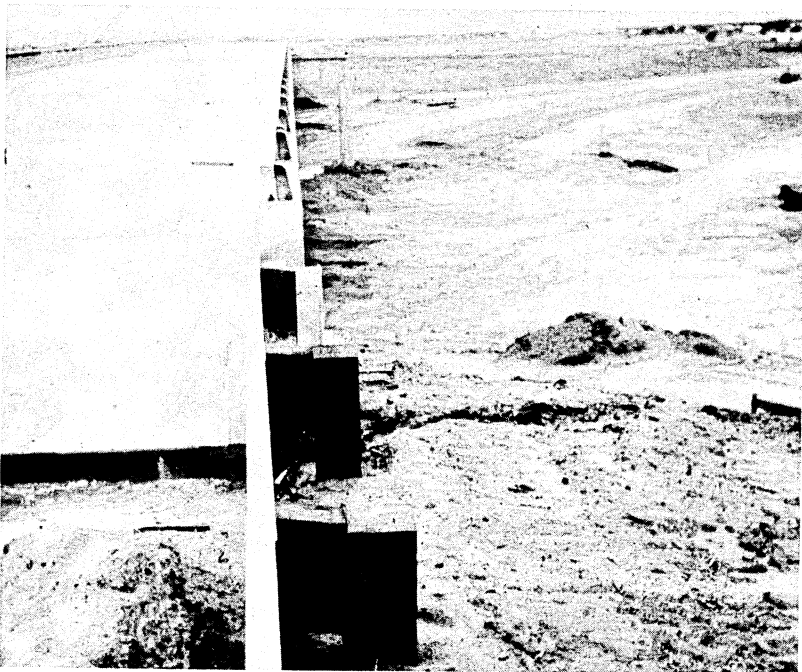
Mr. PRISK. So it is just a start.

You see here they have even drilled—I do not know that you can make it out but there are two holes through here, Mr. Skeels; maybe they intended to put two bolts through there and for some reason did not put a second one through. I think there is only one place you can put a bolt through, anyway.

This is the leaving side again of the part that is not fastened.



However, we move along to a new project, which is contiguous to the west from the section we were just looking at, which is 2 miles long, essentially in Oklahoma City. This is going on west from Oklahoma City. You see the blocked-out rail lined up, and again running to the structure.

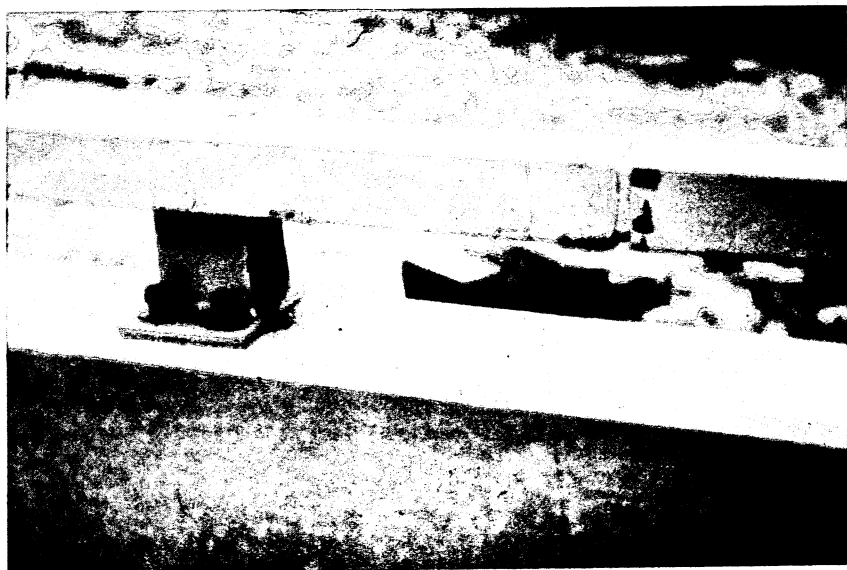


And here is the detail of that. The rail is blocked out. They use a steel post as an end post with a woodblock at this point; this gap is still with us [indicating].

Mr. CONSTANDY. The new work has the same deficiency we have seen on the old.



Mr. PRISK. Yes. This is a detail of the New York box beam type of rail, the sleeve shown here in the joint. This is recognized as one of the better types of railing.





This is a very interesting picture, because in contrast with what we saw in Missouri a few minutes ago, where there was almost no rail in place, they are just starting to put the rail up ahead of some of the structures that have been open 6 or 8 months. Here they built the rail and finished it off before they even got a floor on the bridge. So this is 186° opposite, apparently, in their thinking.

There is no—I would point out, this bridge is under construction today; there is no connection at all between these. [Indicating.]

Mr. CRAMER. When was that picture taken, Mr. Prisk?

Mr. PRISK. Mid-April.

Mr. CRAMER. Mid-April?

Mr. PRISK. Mid-April.

Mr. CRAMER. Had you adopted these AASHO standards at that time?

Mr. PRISK. Just about at that time, yes. I think the States had not been advised by that time. It was a few weeks later.

Mr. CONSTANDY. The picture certainly suggests that two different groups of people design and construct the elements which are to work together and function together to afford safety to the motorist. The guardrail is installed and finished ready to be open to traffic and the parapet at the end of the bridge has not even been built yet.

Mr. CRAMER. Well, Mr. Prisk, I understand the AASHO design standards which you indicate were adopted about that time provide, on page 29, as follows:

To afford maximum protection and to develop the full strength, the rail—

Meaning the guardrails—

on the approaches to structures must be attached securely to the structure and provide a relatively smooth configuration on the traffic side.

This would be in violation of that regulation over AASHO standards at the present time; would it not?

Mr. PRISK. It would.

Mr. CRAMER. What force and effect do these design and practices relating to highway safety, AASHO report, February 1967, have?

Mr. PRISK. These become the policy of the Bureau of Public Roads endorsed by the Secretary of Transportation as far as Federal-aid work is concerned. The implication of the statement which you read would be carried out in future design practice.

Mr. CRAMER. If that project came to you today, would you approve it?

Mr. PRISK. Our division engineers, who have that approval authority, would not approve that type of project, in my opinion.

Mr. CRAMER. Have they been so directed?

Mr. PRISK. Yes, they have.

Mr. CRAMER. They have been directed that the AASHO standards, and in this instance relating to this problem, are mandatory as a condition for approval by the Bureau of Public Roads regional offices?

Mr. PRISK. Yes, sir.

Mr. CRAMER. Then can we expect in the future not to see this kind of construction; do you think?

Mr. PRISK. I would expect so.

Mr. CRAMER. Why did it take us so long to get to this point?

Mr. PRISK. I think there probably has been a lack of appreciation or identification of the problem.

Mr. CRAMER. Well, now, what are you going to do about this situation?

Mr. PRISK. This situation would receive treatment in the priority it deserves, I would say, within the capacities of the State highway departments.

Mr. CRAMER. What priority does it deserve?

Mr. PRISK. Well, I would say it deserved rather urgent priority.

Mr. CRAMER. As high priority as possible?

Mr. PRISK. Not necessarily the highest.

Mr. CRAMER. I think, frankly, the Congress and the Bureau of Public Roads and the executive branch are trying to put their priorities down.

Mr. MCCARTHY. Mr. Chairman.

Mr. CRAMER. Just a minute. May I continue, Mr. Chairman?

Mr. GRAY. Yes, Mr. Cramer.

Mr. CRAMER. We have got all kinds of pressure, all kinds of demands. The President has asked the Congress to set up a separate trust fund, and authorize the appropriation of \$160 million for fiscal 1968, and \$220 million for fiscal 1969, for beautification, to plant some of these trees along the right-of-way which will become a safety hazard, too. But I do not see any pressure; I do not see any great demand; I do not see any high priority; I do not see any equal priority as it relates to safety.

Now, Mr. Prisk, that is not your responsibility; I am not suggesting it is your responsibility to settle policy questions relating to priority. I do think, however, it is the responsibility of the Congress.

What bothers me is I personally feel that safety is entitled to a very high priority, even as compared to aesthetics and beautification. And I would hope that there could be generated some substantial interest in financing constructional aspects of safety.

The safety bill we passed last year, the Highway Safety Act of 1966, does not provide funds for construction money to build in safety features, does it, Mr. Prisk?

Mr. PRISK. No, sir.

Mr. CRAMER. So if a State wants to build in safety features, it has to take its regular Federal-aid construction money to do so; is that right?

Mr. PRISK. That is correct.

Mr. CRAMER. If it wants to go back and build in safety features, it has to take construction money to do it, right?

Mr. PRISK. That is right. That is why we are trying to get them changed.

Mr. CRAMER. We are offering the States up to 100-percent incentive payments to plant trees and flowers, to buy up lakes, to buy up beautiful rock formations off the highway, to buy up creek banks, to buy up beautiful agricultural vistas off the right-of-way. And I just wonder why in the world we are willing to provide Federal money for that purpose and said or suggested or proposed little help for safety purposes. And I asked the panel yesterday what their recommendation might be relating to providing an incentive, giving the proper priority, to safety. It seems to me saving lives is as important as saving trees and planting flowers.

I would like to ask the panel again—I understand we provide 100-percent money for overpasses for railroad lines, do we not? One hundred percent Federal money? Is that not right, Mr. Prisk?

Mr. PRISK. Yes.

Mr. CRAMER. We provide up to 100-percent Federal money for beautification and that is a high priority item. And I just wonder why there is not some discussion, why there are not some suggestions as to how we can provide an incentive to the States to get the safety job done, concentrate on safety and eliminate these death traps that have been built into the highways.

Does anybody on the panel have any suggestions or recommendations?

I see the problem; we have been looking at it for 2 or 3 weeks now, but what are we going to do about it?

Mr. PRISK. May I say, Mr. Cramer, that the first action of the new Director of Public Roads, Mr. Frank Turner, was to address a letter to the State highway department commissioners, and included in that he said this, and I would quote:

I consider that available Federal-aid highway funds can be put to no better or no more urgent use today than in the very prompt initiation of a broad program to increase the safety of public highways.

I think this indicates the attitude of the Bureau of Public Roads.

Mr. CRAMER. That is a fond expression of hope. But they are not given the financial incentive like they are given for beauty; are they?

Mr. PRISK. No, sir.

Mr. CRAMER. So I would like to address my question to the panel: Do you have any suggestions as to what the Federal function ought to be as related to safety?

Mr. WILSON. I think my opinion would be any highway department ought to have a balanced program of new construction and going back and fixing up the old highways.

As I stated yesterday, we took a good, hard look at the existing State highways. We found a number of things that were causing accidents. We decided that we could fix up about 1,700 of these with normal traffic engineering devices and traffic engineering tools. And I think that a program of this nature—

Mr. CRAMER. You are hard pressed, are you not, to put substantial money into safety when it has to compete with construction money; is that correct?

Mr. WILSON. It is difficult to—

Mr. CRAMER. You do not have that problem as it related to beautification; there is no competition there, is there?

Mr. WILSON. I am not familiar with beautification.

Mr. CRAMER. You get a separate appropriation for beauty.

Mr. WILSON. I understand you do.

Mr. CRAMER. Yes. So again I say I think we are putting our priorities down; esthetics and beauty with high priority, and safety with low priority.

Does anyone else on the panel have a comment relating to what might be done?

Mr. WILSON. I would like to make one further comment. When I reviewed the legislation involving highway safety and reviewed House Report 1700 on the Highway Safety Act of 1966 and found that there was actually in fact no construction money available to go back and fix up hotspots and locations that were having accidents, I as a highway engineer was somewhat disappointed in this.

Mr. CRAMER. Does anyone else have any suggestions?

Mr. Skeels?

Mr. SKEELS. I certainly agree with your objective, that some funds should be made available to fix up these now recognized deficiencies.

Briefly, for our proving ground road system, we did make money available. We went back over our obsolete road system and we built it much in this manner.

Mr. CRAMER. Mr. Huff?

Mr. HUFF. Mr. Cramer, I would like to say a highway becomes obsolete through impairment of capacity and safety. Often the two go together.

Now, in my department in Texas, we think we have been conscious of safety for several years; but for some 10 years we have been spending about one-third of our available research on safety projects. We have begun putting a great many of those to use. And as I stated yesterday, we spent considerable amounts of money on rehabilitating our 6,000- or 7,000-mile system, bringing it up to safety standards and better, more comfortable capacity standards.

Now I believe our administration, who I am not empowered to speak for what they might or might not like, but I believe my administration will say we always need more money to bring our highways up.

Mr. CRAMER. Can you justify having a separate fund for beauty and not having an equal fund for safety?

Mr. HUFF. I do not believe I can comment.

Mr. CRAMER. I mean construction aspects.

Mr. HUFF. I do not believe I can comment on that, sir.

Mr. CRAMER. Well, commonsense would indicate safety is as important as beauty; would it not?

Mr. HUFF. I do not think you can put any higher priority on any operation than our safety program.

Mr. CRAMER. I do not think so, either. Mr. Wilkes, would you care to comment?

Mr. WILKES. As an employee of the Bureau of Public Roads—
[Laughter.]

Mr. CRAMER. You can take the fifth amendment if you want to.

We will move to Mr. Ricker. [Laughter.]

Mr. CRAMER. The President is not here to answer the questions. Maybe what we need is a "Safety Bird." [Laughter.]

Mr. RICKER. Since the issuance of Mr. Turner's memorandum concerning the yellow book, we have had meetings with the Bureau's division engineer concerning the projects that are now advertised or have already been contracted, and he has told us that we must incorporate all of the features of that book in current projects even though they are underway. There will be a deadline sometime this fall when new plans must reflect those provisions.

In the ones now under construction or about to be let, he has authorized change orders to incorporate provisions of the yellow book.

Mr. CRAMER. What do we do about past construction?

Mr. RICKER. I think if you are going to really go back and do past construction, you are going to get into a lot of money.

Mr. CRAMER. Obviously. So what can we do about it? And that is all the more reason why the States possibly are not able to do it when they have to use construction money to accomplish it.

Mr. RICKER. That is correct.

Mr. CRAMER. Well, now, Mr. Prisk, I have just one other question.

You have been in charge of the safety office in the Bureau of Public Roads; is that correct?

Mr. PRISK. Second in charge, yes.

Mr. CRAMER. Well, second in command. There has been a reorganization under the Department of Transportation Act. How many people did you have under your supervision before the reorganization?

Mr. PRISK. Fifty-two.

Mr. CRAMER. How many do you have now?

Mr. PRISK. I don't have the figures, Mr. Cramer. I would have to obtain those for you. I would estimate about 20.

Mr. CRAMER. So you lost about 32 of the people that were working under you on the problem of safety as a result of the reorganization; is that right?

Mr. PRISK. This is approximately right. Yes.

Mr. CRAMER. How in the world are you going to be able to do your job? It is obvious not too much was being done before. You lost 32 people. How are you going to do it now?

Mr. PRISK. These positions will be refilled.

Mr. CRAMER. You expect to hire new people to replace those 32 you lost; is that right?

Mr. PRISK. Yes.

Mr. CRAMER. What happened to all your expertise and know-how and experience that went with them?

Mr. PRISK. A good many of the people who have left the organization are still in the Federal Highway Administration, the Highway Safety Bureau.

Mr. CRAMER. I understand that. But how are you going to run your shop without qualified, experienced people?

Mr. PRISK. I think the answer is obvious.

Mr. CRAMER. You are going to have a lot of trouble, are you not? This is one aspect of these hearings I was hoping we would get into, the question of what this reorganization has done as it relates to dismantling the Bureau of Public Roads. I think this is one of the clearest examples.

That is all I have.

Mr. GRAY. Mr. McCarthy of New York.

Mr. MCCARTHY. Thank you, Mr. Chairman.

Carrying on the theme in a slightly different tack than that presented by the distinguished gentleman from Florida, I would like to go back to Mr. Prisk's observation that these conditions were permitted to develop because of "lack of appreciation for or identification of the problem."

For the record, I would most like to make a couple of observations from my own experience in industry. The company I worked for for 13 years before coming here found itself in a similar situation. We had 58 plants all over the United States, and found our accident rates increasing, death rates, in our mines. And conditions were allowed to develop the same way, lack of appreciation for and identification of the problem. It was not any deliberate action on the part of management, priorities were in a different direction. But they inaugurated a safety program with safety director at the corporate level and safety supervisor at every plant, who fine-tooth-combed the whole plant to find hazards and install guardrails, bridges over machinery, and so forth. I think the analogy is very close.

When new plants were built, new mines developed, the safety director was part of the planning process, so safety was built into the new facility. Then they inaugurated a campaign to educate the workers. There were signs in every plant on safety all the time. Every employee had to wear safety glasses. They were, of course, competing for the Department of Interior's Mine and Safety Award, which was an annual event. We won those several years in a row. It was made a management responsibility; supervisor of safety overlooked these conditions in the plants and the mines, but the manager was responsible for any deaths, or accidents. And the result of this over a several year period, when they showed on a graph, it was just like this: precipitous decline in accidents throughout the whole organization, 58 plants, all over the United States.

It was simply a change from lack of appreciation, as you put it, and identification of the problem, to safety consciousness. And pinpointing the responsibility, building safety into the facility. And my distinguished friend from Florida, I think, misses a point here, that safety is not an extra frill.

I think safety is something that should be in every dollar that is invested in these roadways, so that when you are building these roads, you are building safety into the road, not something which you take on as a 10-percent extra.

So I just would like the record to show this experience of which I had firsthand knowledge. I think the analogy is apt—and I don't think there is any room here for recrimination. If there are going to be

recriminations about what was neglected in the past, then maybe some Members of Congress who have been around here for a few years and on this committee might be subject to the same.

So I think if we approach it in this constructive manner and create consciousness of safety, we would be off on the right foot.

Thank you, Mr. Chairman.

Mr. CRAMER. Now, Mr. Chairman—

Mr. GRAY. Mr. Cramer?

Mr. CRAMER. I trust no one implied from anything I said that I considered safety a frill. I do consider beauty a frill, and my position is that certainly safety ought to have higher priority than beauty. If anyone wants to challenge that, I would welcome them to do so.

Secondly, it has been my objective in these hearings to find out what we can do about financing safety needs.

Everyone knows Congress is interested in financing beauty. I want to create some interest in financing safety and, hopefully, maybe Congress will come up with a program to do so.

The other aspect of it is: I made a statement on the floor of the House and I repeat it here, that in my opinion the Bureau of Public Roads is being dismantled, dismembered, and disemboweled.

Now the gentleman from the Bureau has stated that he has lost 32 of his qualified, experienced, knowledgeable safety experts, in a division that has responsibility of overseeing and of making certain that safety is built into these highways. That is where the important phase of it comes. You can pass all the regulations you want to, but if the administrative agency that has to see that those safety regulations are carried out through construction does not have adequate personnel, is not given high enough priority, is dismembered, then this entire program of safety is being to that extent destroyed.

I, as a Member of Congress, cannot sit idly by with this evidence before us—we are now going into the third week of hearings—where deathtraps are built into the highways, and seeing the Bureau of Public Roads Safety Division dismantled, dismembered, and disemboweled, losing many of its knowledgeable personnel, where they are most needed, building safety in these highways.

If someone wants to take issue with me I would be delighted.

Mr. GRAY. Let me say I agree implicitly with the distinguished minority leader of the Public Works Committee, Mr. Cramer. But I think I might add one point, and that is that under the act itself, the States, starting with the division office or the district office in the State, going on up to the chief highway engineers, work up a recommendation, both for the alinement and the design of highways, prior to the time that the Bureau of Public Roads division engineer even looks at this.

So I think in addition to what the distinguished Member from Florida has said, we also need to have some better liaison with the States in order that when the idea for a design is advanced, that design in its initial stages should have safety features built in.

It is one thing to say, for example, here you have not done this right or done that right and go back and spend 300 percent to correct it, and it is another thing to work in the safety features at the inception of the planning stages of a highway.

So I would hope in addition to what we are developing here, what seems to be the responsibility of the Bureau of Public Roads and this committee, that we would also have some closer liaison with the States where these designs are initiated in the first place.

I don't know the best way to go about that, but I would say in addition to what the gentleman from Florida says we ought to have, either through AASHO or the various chief highway engineers, some liaison or some meetings here at the Washington level to go over these things, so that everyone will be in unison when these regulations are laid down.

Would the panel agree with that statement? Because we need liaison in addition to Bureau of Public Roads and providing incentive and providing the funds by the Congress? We also need a little better understanding between the States themselves.

Mr. PRISK. I think that is correct, Mr. Congressman. And the Bureau of Public Roads and the key officials of the State highway departments in the Midwestern States, about six or seven of them have met yesterday and the day before, considering this very matter: The application of the principles set forth in the yellow book. And this can be worked into the program in the best possible way.

Mr. GRAY. The gentleman from Florida is absolutely correct; we need to work up these regulations and get them out. But, for example, in the district highway office in my congressional district of Carbon-dale, I know occasionally they have recommended certain things after a public hearing was held, then when it got on up to the State office in Springfield, it was found to be too costly or some other factor and the whole thing was scrubbed.

So I think we have this problem that comes not only from the Washington level, but right on down to the very district highway offices of the States. You may proceed.

Mr. CRAMER. Mr. Chairman, we get right back to the question of money. I agree with what the chairman says. If we don't solve the money problem, we will not solve the problem as I see it.

We have bundles for beauty, but no incentive for safety. I think it is time we gave some consideration to funds for safety purposes.

Mr. GRAY. Yes, I agree with the gentleman. I was agreeing with the gentleman, Congress needs to provide the authorizations, the funds, and the Bureau of Public Roads direction. In order to complete this partnership, I think we have to go on down then to the local levels.

Mr. CONSTANDY. Mr. Chairman, inasmuch as reference has been made to the letter of Mr. Turner, dated May 19, 1967, signed by Mr. Lowell Bridwell, attaching the letter of Mr. Turner to the State highway departments, I ask leave to have it made exhibit No. 5 and printed in the record following the quote from Mr. Prisk.

Mr. GRAY. Yes. Without objection, this will be made exhibit No. 5. (Exhibit No. 5 follows:)

U.S. DEPARTMENT OF TRANSPORTATION,
FEDERAL HIGHWAY ADMINISTRATION,
BUREAU OF PUBLIC ROADS,
Washington, D.C., May 19, 1967.

Instructional Memorandum 21-11-67 30-01.

Subject: Safety provisions for roadside features and appurtenances.

The February 1967 Report of the Special AASHO Traffic Safety Committee—Highway Design and Operational Practices Related to Highway Safety—is approved by the Bureau of Public Roads for use on Federal-aid highways.

Enclosed is a copy of a letter I have sent to the top administrative officials of each State highway department offering our full cooperation and assistance in applying the findings of the report to the existing Federal-aid systems beginning as soon as possible in 1967 and continuing on a large scale for as long as is necessary to provide the highest possible level of roadway safety.

The February 1967 Report confirms the provisions of IM 21-6-66, and the policy therein established is reaffirmed concerning PS&E approvals for new projects and change orders on projects now under construction. *It is expected that the plans for all projects on high-speed highways yet to be advanced to contract will incorporate the features of added safety as are presented in the February 1967 Report.* Where a check of the plans for projects underway reveals that features of added safety were not incorporated in the approved plans, contractual change orders to modify the applicable features in a manner which will incorporate the safer design features or extra work orders to add the safer design features are to be issued by the State highway department whenever practicable. For application of the cited safety features, high-speed highways include all projects on the Interstate System and all projects on the remaining Federal-aid Primary and the Secondary Systems where the design speed is 50 mph or more. To the extent practicable and feasible, an approved order of safety design should be utilized on Primary and Secondary projects with a lesser design speed.

On completed Federal-aid highways each State highway department is asked to establish an active corrective program to apply the findings of the February 1967 Report. Public Roads requests that all features of geometric, structure dimension and roadside element design that can effect safety of the motorist who strays from the roadway be given careful consideration by the State. Each State should evaluate the seriousness of the existing condition as measured by the more safe conditions recommended by AASHO in the new report and prepare its program for corrective work on previously constructed highways on the several Federal-aid systems. The most serious existing conditions should be assigned highest priority for correction. Corrections should provide the safer condition to the degree as outlined by the AASHO Report, with careful attention to not overcorrect the situation, especially when large costs would be occasioned. Attention is to be given the details of all proposed corrective work to insure that the new work does not retain a latent hazard to the motorist. Public Roads Division Engineers are to take a broad and liberal viewpoint with regard to approving programs proposed by the State highway department for work of the types described in the February 1967 Report.

As pointed out in my letter to the State highway departments, many items of the corrective work are of a nature that can be readily and economically performed by State forces. To assist in the expeditious handling and completion of this undertaking, the following procedures are established for corrective projects:

Where proposed by the State, Public Roads hereby finds it to be in the public interest to accomplish this work by use of State forces.

Projects can cover sizable lengths of highway and may cover several or all types of roadside features. For example, a project might include relocation or adjustment of signs, installation or modification of guardrail, removal of and/or protection from the varied hazardous roadside elements, etc., on as long a section of highway as may be proposed by the State.

Projects are to be programmed and authorized in the usual manner.

Project plans can be minimal, sufficient to identify the work to be accomplished and the method of its accomplishment. Prior construction plans marked to identify the work to be performed would be adequate for this purpose.

The project cost can be established on the basis of an approved State's estimate made up from agreed unit prices for the elements involved. Final payment on the basis of actual costs also is satisfactory if such a method is preferred by the State.

Projects may be constructed under the contract method administered in the usual way.

Federal-aid participation will be the usual pro-rata amount applicable for the system involved.

In carrying out the work it is of paramount importance that all of the safety provisions for performing construction under traffic be rigidly observed lest more hazard is created than is being eliminated.

F. C. TURNER,

Director of Public Roads.

LOWELL K. BRIDWELL,

Federal Highway Administrator.

MAY 8, 1967.

DEAR _____: By means of this letter, I call to your attention the recently issued American Association of State Highway Officials report entitled "Highway Design and Operational Practices Related to Highway Safety". The Bureau of Public Roads concurs fully in the report's recommendations and conclusions and considers it to be one of the most important documents ever developed by the joint efforts of the Bureau of Public Roads and AASHO. We wish to assist every State highway department in applying its findings beginning as soon as possible in 1967 and continuing on a large scale for as long as is necessary to provide the highest possible level of roadway safety on the Federal-aid highway systems. We pledge to you such assistance as is necessary to allow the State highway departments to plan and program the use of Federal-aid funds to expedite the accomplishment of this objective.

The report makes particular recommendations dealing with roadside hazards, which constitute a major contribution to the annual traffic toll. Work items such as are discussed in Chapter III of the AASHO document under "Roadside Design and Appurtenances" may be minor at individual spots but large when viewed on the basis of a full route. The required corrective work is of a nature that it can generally be readily and economically performed by State forces. Therefore if so proposed by a State highway department, Public Roads will find that the corresponding Federal-aid projects for use of State forces to accomplish this work are in the public interest. In accordance with statutory controls you of course know that Federal-aid funds cannot participate in costs of work classified as maintenance. But there *can* be participation with Federal-aid primary, secondary and urban funds in work that classifies as reconstruction, or construction; and Federal-aid Interstate funds for additional construction on previously constructed projects on Interstate System highways, and it will therefore be our purpose to permit full regular Federal-aid participation in this program, which will accelerate achievement of work of the kinds outlined in Public Roads Instructional Memorandum 21-6-66, August 1, 1966, subject "Safety Provisions for Roadside Features and Appurtenances".

There should also be continuation and acceleration of a program for the types of improvements that are described in Public Roads Policy and Procedure Memorandum 21-16, January 18, 1966, subject "Highway Safety Improvement Projects", and extensively discussed in the cited AASHO document.

A conference on this subject was held on April 25-27 with the design engineers of Public Roads. They and the division engineers are being advised that they are to assist in all possible ways toward the development and implementation of Federal-aid projects to achieve in the shortest possible time increased safety for the users of the Federal-aid highways.

The Bureau is placing its full support and resources behind a concentrated major effort to implement the recommendations of the AASHO report and I earnestly solicit your own support in this joint effort. I therefore urge you as the Chief Administrative Officer of your State highway department to examine fully the recommendations of the AASHO report to determine from a safety viewpoint those features of existing highways which constitute hazards to highway users; and to establish an active corrective program along the lines which the report suggests.

I know of course that each of you has a staggering list of needed work, both with and without Federal-aid funds. However, I consider that available Federal-aid highway funds can be put to no better or more urgent use today than in the very prompt initiation of a broad program to increase the safety of public highways. Conscientious and special personal attention to such a program is not only our responsibility; but at the same time it is an opportunity to perform a humane public service, and to demonstrate once again that we as highway officials are concerned with objectives that transcend the mere movement of people and goods.

This is the first communication to you under my new title in the infant Department of Transportation. I know how busy you are and how many urgent priority items there are to claim your attention; I shall not be imposing on your time very often in this manner; but the overwhelming importance of this subject impels me to do so in this instance. We shall be sending through the normal channels such memoranda as appear necessary to aid in implementing this program; but I want you to know that our purpose will be to remove every possible hindrance to your being able to cooperate effectively in this important endeavor.

We expect to provide you with the most liberalized procedural tools that we can devise under the law. I solicit your own personal support and I know that you have the same dedicated interest in this matter that we have.

Sincerely yours,

F. C. TURNER,
Director of Public Roads.

Mr. CONSTANDY. If you would continue, Mr. Prisk, perhaps we could move on.

Mr. CRAMER. Would you reread that quote? That is the "fond hope" letter, is it not?

Mr. CONSTANDY. Actually the letter puts that phrase Mr. Prisk quoted perhaps in more perspective.

Mr. CRAMER. I would call it the "fond hope letter"; no money, but fond hope.

Mr. GRAY. The Turner letter?

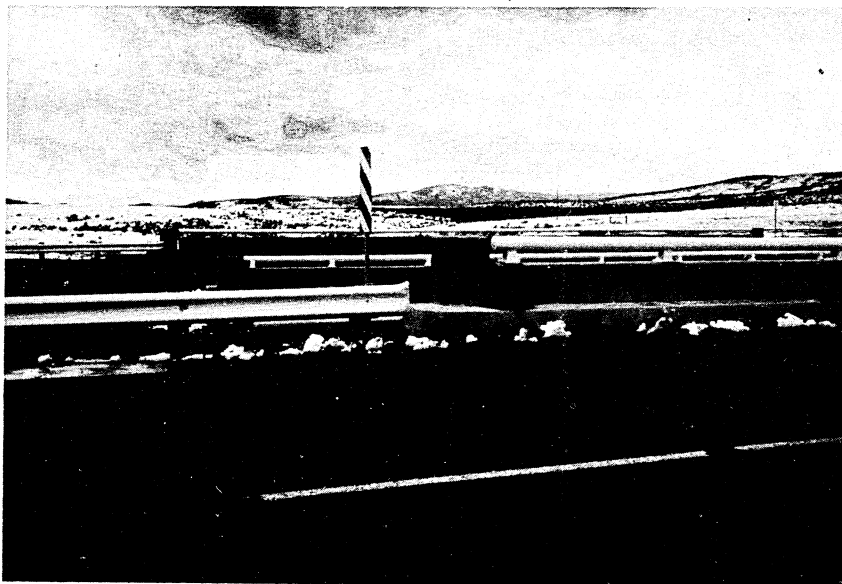
Mr. CONSTANDY. Yes.

Mr. PRISK. May I proceed?

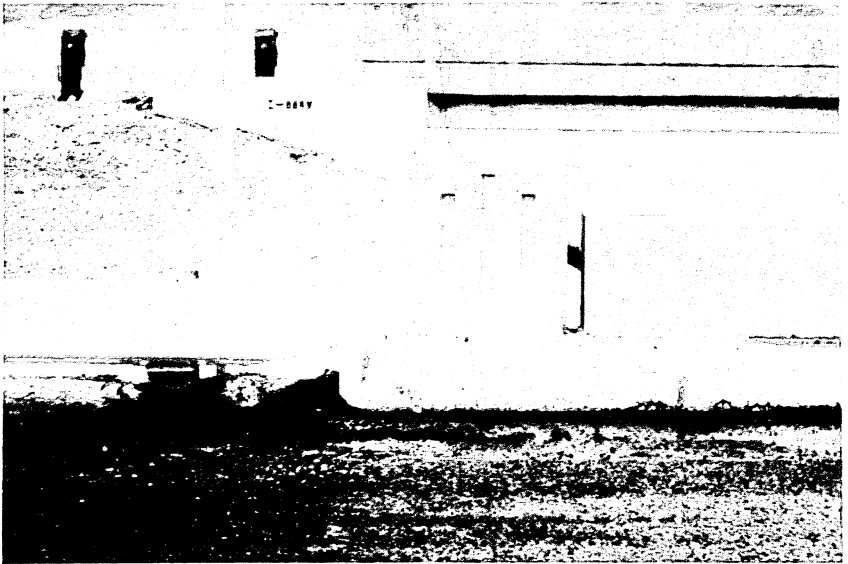
Mr. CONSTANDY. Yes.

Mr. GRAY. You may proceed.

Mr. PRISK. Now we move to another State. This is Nevada. And in this case we find the same situation we have been looking at treated in a slightly different way. This is an upright-type post; a heavy 6-inch rail here at the top on a concrete parapet. Nothing particularly different.



This is a closeup, same situation. The rail is rather low. Again we have twin bridges out here in a pretty rural country, very rural country. This is the only interchange within miles. And bridges are built separately, not paved over.



Here is a view along the structure, on the structure I should say, showing the safety walk at this point [indicating] which intrudes inside the rail, the line of the rail.

There is an asphalt curb along on this side [indicating]. You can see where these black and white stripes are.

Mr. MAY. You cannot tell from this photograph. You slide along this parapet to strike the end of that guardrail?

Mr. PRISK. You are moving this way and if you slid along this parapet, you would indeed strike the end of that guardrail.

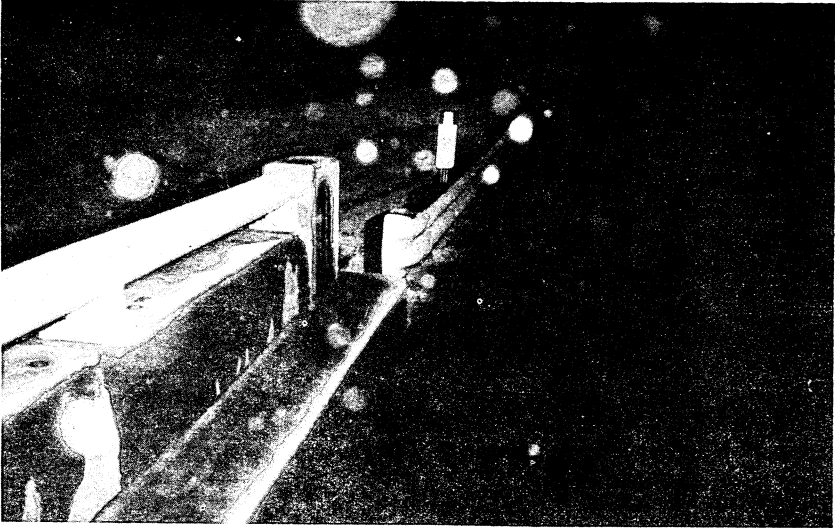


Mr. W. MAY. We can do better than that?

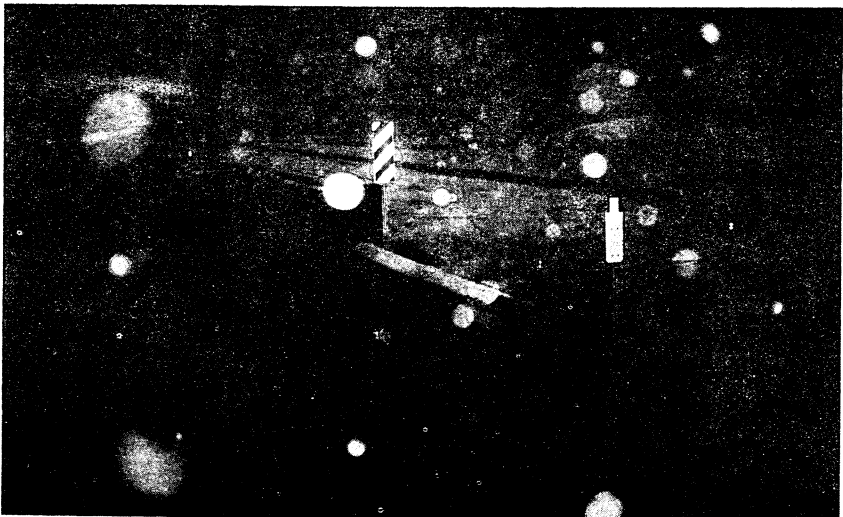
Mr. PRISK. I think so.

Another picture closer up of the condition that you referred to, Mr. May, is shown here; and there is the guardrail at the end fairly well matched up with the curb line.

If the car were sliding along the traffic face of the curb, instead of the parapet, we would be in pretty good shape. But along here, we would not. [Indicating.]

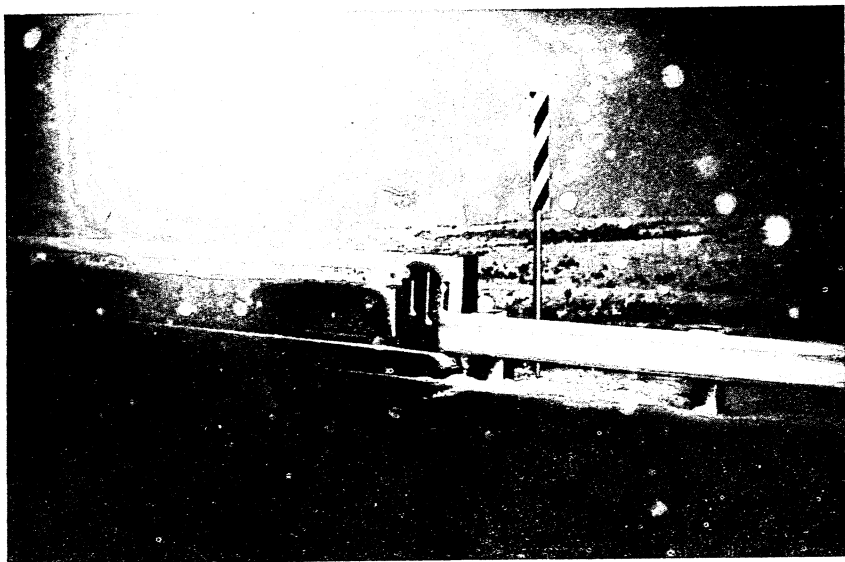


This is a view in a snowstorm of the end of a bridge here—I can barely make this out, but I am quite sure—yes, this is the end of the



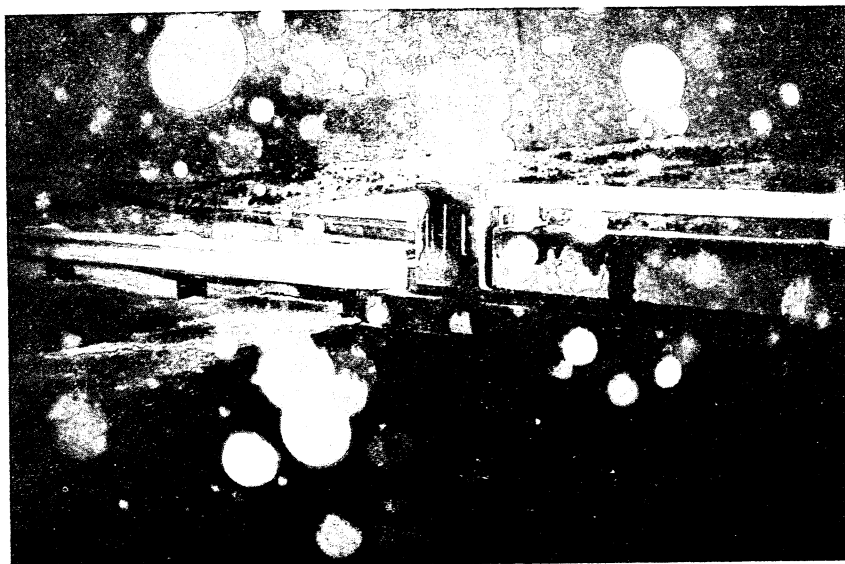
bridge; it is completely unprotected. Aside from this reflectorized marker, which with the black stripes down, Mr. Ricker said, means you keep on this side.

Another approach on that same bridge where there is a slight overlap, 6-foot, 3-inch post spacing used here indicating there is recogni-

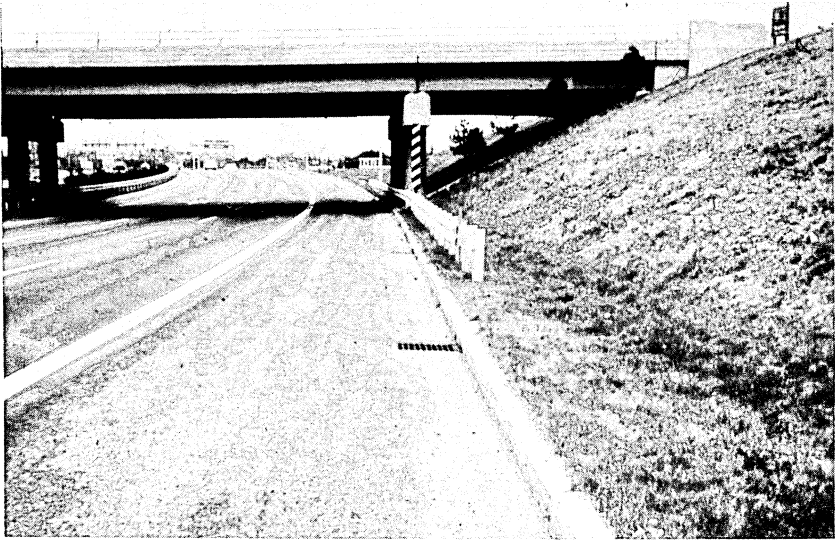


tion of the need for stronger rail support in this area. This again is a commendable step.

Not fully adequate. Similar situation.



Now we move to the Providence, R.I., area, and find this kind of a situation where guardrail improvements are still underway. Looking at the structure, you of course have here very evident side piers, a foot and a half or 2 feet behind the face of this curb, 10-foot shoulder.

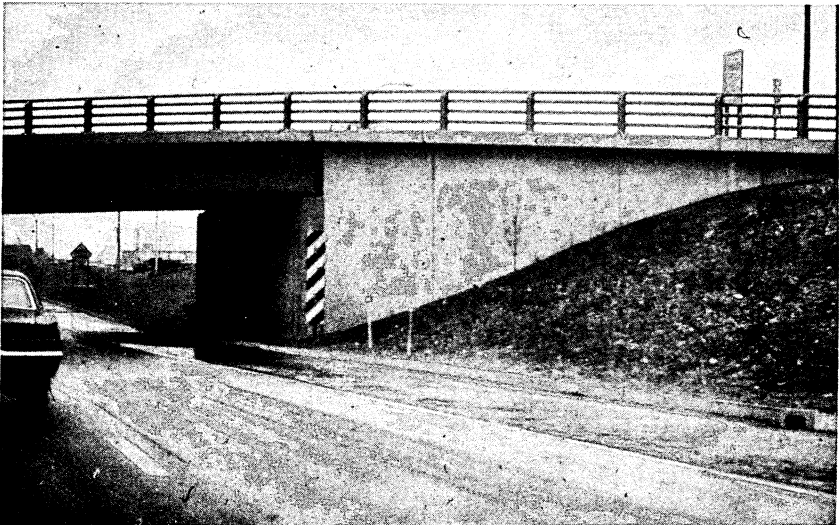


Move up closer, some of these structures are not guarded at all except with black and white striped panel board, such as appears in this picture. This is a pretty good target area. Of course, you do have this slope working for you to turn cars back onto the roadway if anyone got off at that point.

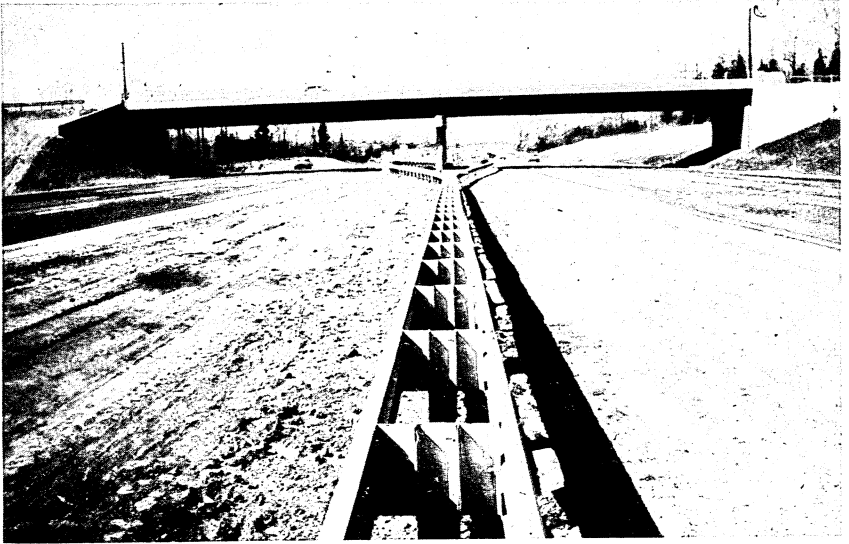
Mr. CONSTANDY. Mr. Prisk, that particular bridge was not on the particular project.

Mr. PRISK. I should have mentioned that.

Mr. CONSTANDY. We will see improvement on this project.

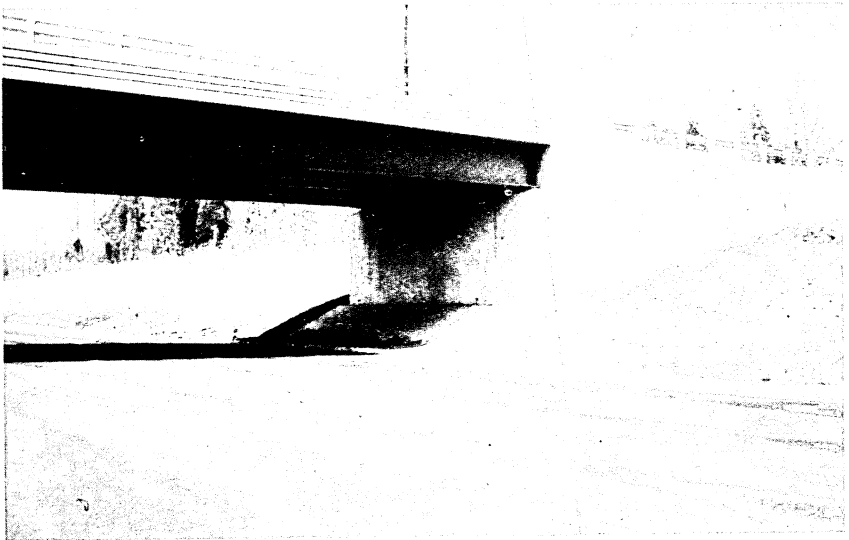


Mr. PRISK. Here is one that is on the project, and has a desirable feature of being an opened up span bridge where the abutment walls are partway up the slope, halfway up the slope here; provides additional lateral clearance and additional safety.



Mr. CONSTANDY. Mr. Prisk, this point you are making was illustrated on the panel appearing behind Mr. Skeels and Mr. Huff. I ask the chairman this be marked as exhibit No. 6.

Mr. GRAY. Without objection, it will be made exhibit 6.
(Exhibit No. 6 was marked.)



Mr. PRISK. This is a closeup of this recessed line of the abutment wall, this particular structure. This is paving underneath the bridge at this point.

Mr. RICKER. I would raise the question whether additional protection it still not needed for that vertical wall. Having observed accidents where a vehicle out of control will go up entirely over, this is still a hazard. Perhaps this can be protected by other means. You may not need to erect a guardrail, but planting of some small bushes and so on to protect that area would be desirable.

Mr. PRISK. With the rigid frame-type construction shown on one of these photos, one directly behind Mr. Huff—

Mr. CONSTANDY. The lower right-hand panel.

Mr. PRISK. The two-span rigid frame, that is possible of course, to completely eliminate that abutment wall.

This is, it might be said, a step in the right direction.

Mr. WILSON. Prior to 1963, we found that piers located next to shoulders and things of this nature here were being struck more often than we would like to have them struck, and instructions went out to our design sections in the bridge department in January 1963 to, in the future, design all structures similar to what is shown on the bottom right-hand side here, a two-span structure.

This can be done with a modest increase in cost. And since that time, our designs have had that feature.

This also included going back on the shelf and pulling out design plans that have been completed years in advance and changing these.

Mr. CONSTANDY. I am glad you said that, Mr. Wilson, because the initial reaction of a number of people we have talked to who have not had the experience your state has had, and who have not worked up the estimates, is that the better design would be rather costly. Your own experience in California has shown that has not been true.

Mr. WILSON. That is right. In fact, I could quote our chief bridge engineer, Mr. Elliot, in many cases where, if you can start a design from scratch from the very beginning and plan it on the basis of a two-span structure, there is no increase in cost.

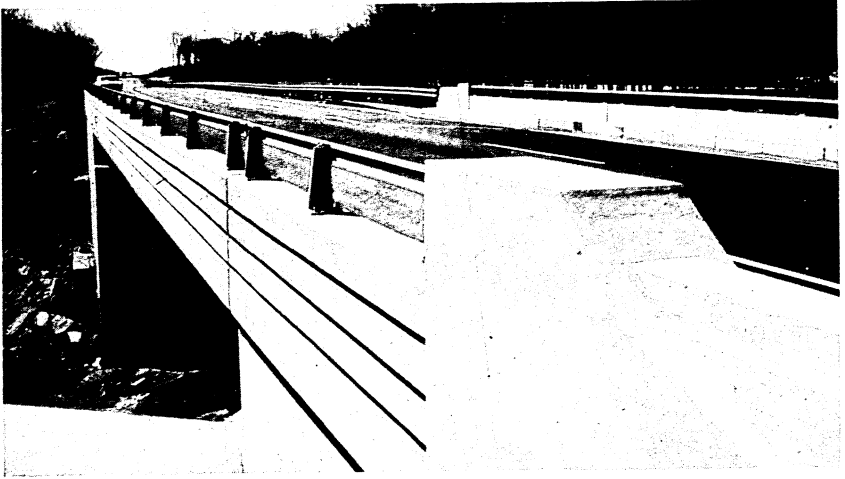
Mr. CONSTANDY. Mr. Skeels?

Mr. SKEELS. For three bridges recently constructed at the GM Proving Ground we adopted this approach and the increase in cost is negligible.

Mr. CONSTANDY. Thank you. Mr. Prisk?

Mr. PRISK. Continuing with another structure, you see the attention to architectural treatment on the bridge here, this is aluminum rail on top of a parapet. You see the curb design on the far side.

The parapet walls are of the same type that we have been looking at and one right here, of course, in the foreground. These are quite strong,



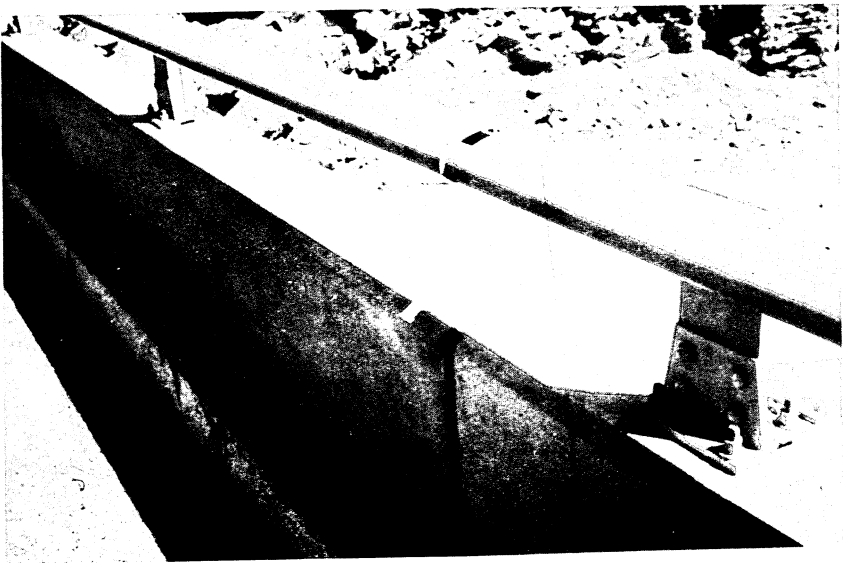
This is a detail of the rail showing an expansion joint.

Mr. CONSTANDY. This makes a good illustration, does it not, of that brush curb—is that what you call it, Mr. Wilson, in California, the one you made reference to earlier?

Mr. WILSON. I believe that is what I called it.

Mr. CONSTANDY. It would be similar to this?

Mr. WILSON. Yes. Exactly like that.



Mr. PRISK. Here is still another illustration of that curb down at the bottom, the brush curb. And upon crossing another structure showing the guardrail approach here. In this instance there has been no final anchorage yet of the post up here at the structure.

The curb is in front of the rail, again not too desirable.



Here is the closeup of that same situation showing that this has not yet been resolved. The intent here, as I recall its being explained to us by State officials, was that there would be a post driven right alongside of the end of this abutment wall and through a right angle. The rail would be fastened at that point. The steel post would be fastened into the end of the abutment wall—end of the bridge wall, or the parapet wall here in this case.



Mr. CONSTANDY. Mr. Wilkes.

Mr. WILKES. I have a comment on the brush curb. As you can see, it is a practice in many of the New England States to provide a granite curb on many of the freeways and they carry it across the bridges. Although you can't tell from the photograph, I am sure that is a granite curb. It serves not only as a rub rail for vehicles but also protects your structures from the snowplows as they clear the roadways in the wintertime.

Mr. CONSTANDY. That is granite, we have been told.

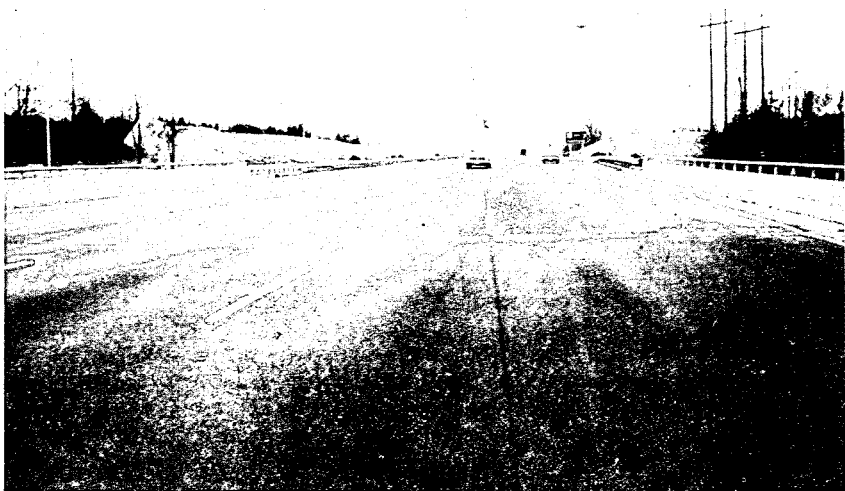
Mr. PRISK. Moving along here, we found this condition at one structure which is certainly a part of the cleanup illustrated on jobs that are still open to traffic and not fully completed as far as all the safety equipment on the highway is concerned. It is disturbing to find conditions like this on highways that carry large volumes of traffic. This one is I-95 in Rhode Island.



Still another section on I-95 showing full width bridge at this point; just in advance of a gore or decision point area up here where you see the sign [indicating].

There are light poles installed; this is fully illuminated, this urban section.

Mr. GRAY. Do you have any statistics at all to show down at the Bureau whether or not the accident rate is less where you have at least a three-lane bridge, say, as compared to a two-lane bridge? You have more room; you have less people running into the guardrail? Do you have any idea?



Mr. PRISK. I am afraid we don't have that. As far as highways are concerned, carrying the same volume, you are safer with three lanes than two lanes. Perhaps that would be obvious, but it has been borne out by studies, too.

Mr. GRAY. You don't have any statistics on that, whether or not if a bridge is much wider, you are less apt to have a collision with the railing?

Mr. CONSTANDY. The extra width would be carrying a full shoulder across the span?

Mr. GRAY. Yes. Well, not necessarily in that context. What I had reference to was, say, someone was driving down the road, the tire blows out, this is certainly an invitation to hit this guardrail. Say for example this is two-lane traffic here, but say you have three lanes compared to two, I was just wondering whether, if the bridges were wider, this might not alleviate some of the problem instead of having to go to the safety lane.

Mr. PRISK. This one-way traffic, all of this is all one way.

Mr. GRAY. So that would be at least three lane—or it looks like four.

Mr. PRISK. There are actually five lanes. There is one over here, here, here, and one coming in. [Indicating.]

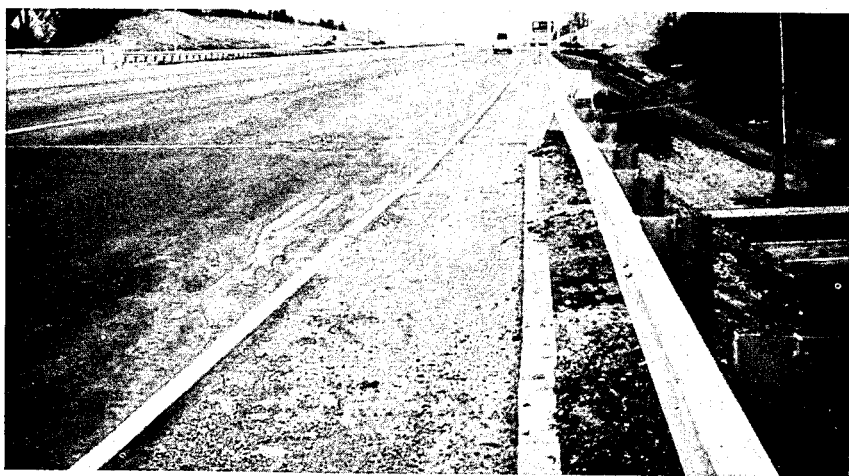
Mr. CONSTANDY. Four traffic plus shoulder.

I think it is true, Mr. Prisk, statistics show where there are full shoulders carried across the bridge there are fewer accidents on the bridge.

Mr. PRISK. That is right. You could reasonably infer from that three lanes would be safer than two.

Mr. GRAY. That is the point I was trying to make. Thank you very much.

Mr. PRISK. Here again is another view along the roadway approaching that same gore, or decision point up here.



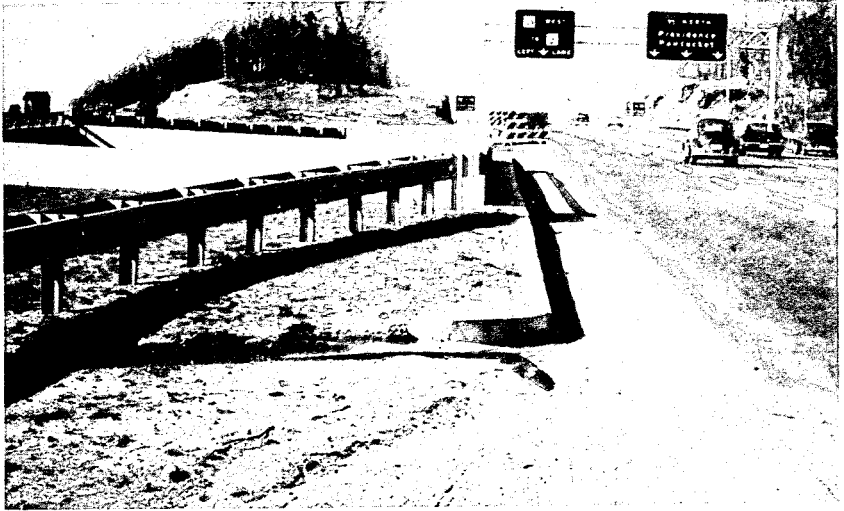
In this case there was a little cheating done on the bridge width, if I may call it that, because the deceleration lane began to take off and this is the edge line for the deceleration lane and the structure itself was not fitted to match the deceleration lane. It was simply carried straight ahead. I suppose there are reasons for that.

Here is the departure point beyond the end of the bridge at that same gore, which is to the left of the photograph. And you will see

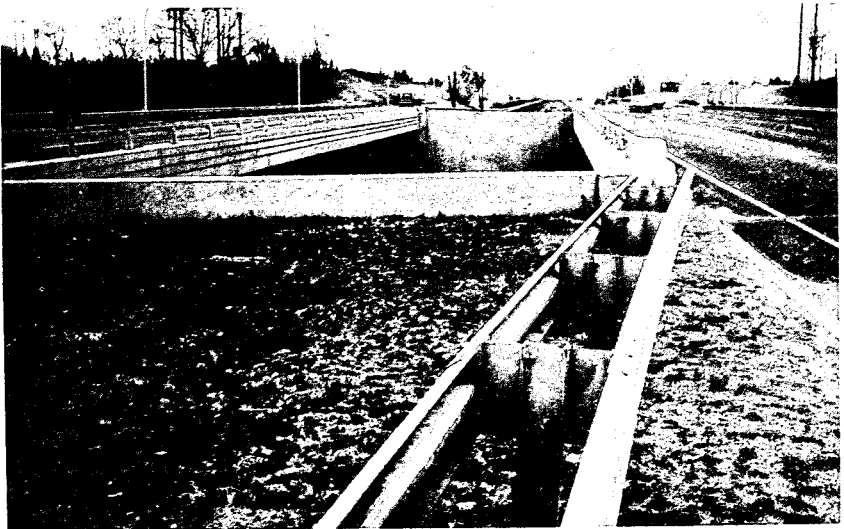


there is quite a space here behind the curb to the rail [indicating] and of course no attachment here.

This is a feature of the projects in Rhode Island, the tendency to carry this granite curb—in some cases this was a precast concrete curb. I am not sure which one this was, Mr. Wilkes, but they use both types up there—but this curb, instead of turning at this point and coming along the rail and coming into this paved gutter to run off the drainage, is carried down to this point and then off. This then becomes a hazard in itself on the approach to the structures.



Another one that might be pointed out with respect to the structure, this again is twin bridges and the solution here adopted is to build a wall across this open space. The function of that wall is hard to speculate on.



Mr. CONSTANDY. You will not go between the twin bridges.

Mr. PRISK. You can see here, or get an idea, what might happen if you hit the wall.

This is another closeup there showing how the rail has yet to be matched up to the end line of the bridge.

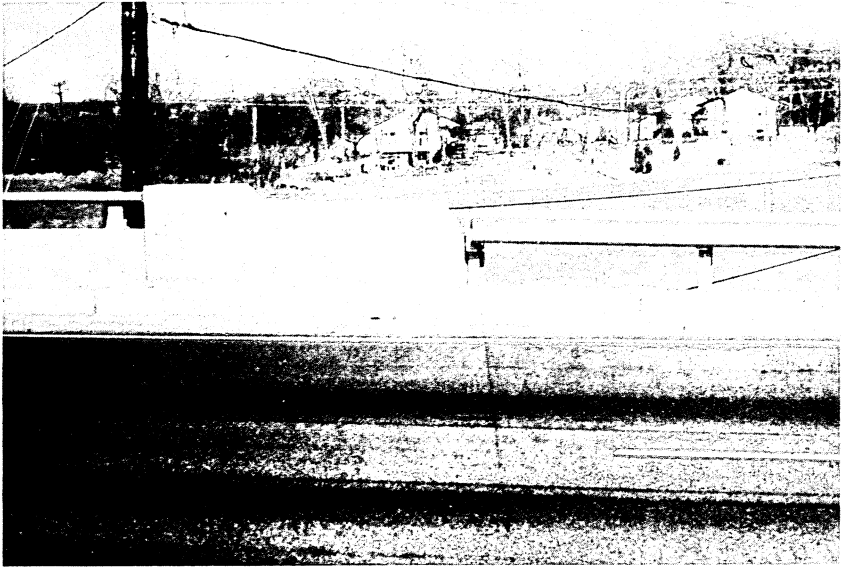


Another shot about the same thing.

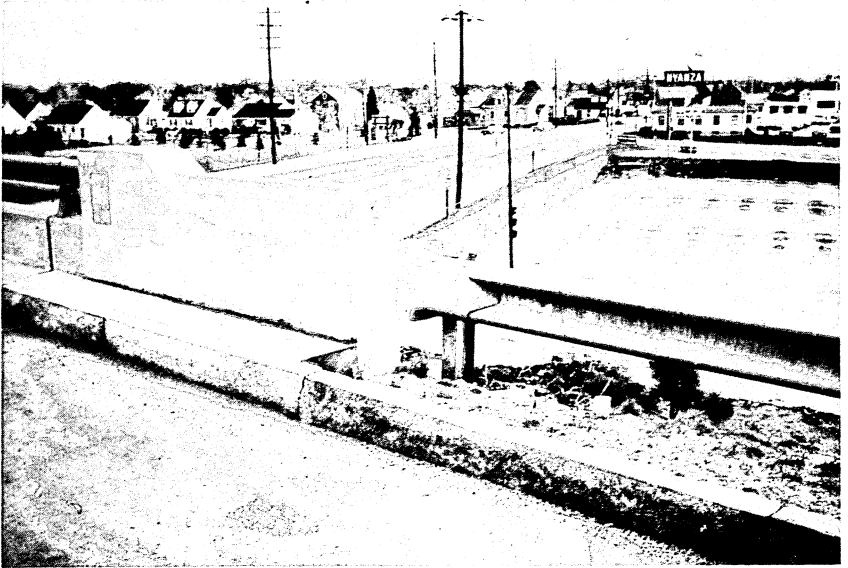
All of these points look pretty bad in the field as well as they do in the photographs.



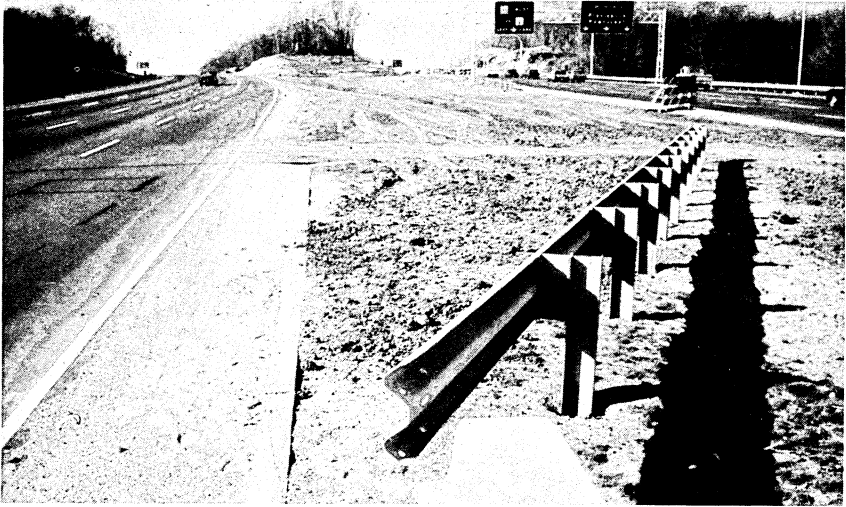
This is a case where that treatment that I mentioned, I believe, has been accomplished. There has been a type of anchorage into the end of the wall and post, driven right along side of the end wall of the parapet. This again provides support.



We see here one completely without any anchorage. This is overpassing a more local street.



This is another approach coming in from the median. This rail, of course, comes in at a rather abrupt angle, for one thing. But for the other thing, there is no determination fully as to just how this is going to function on the end here.



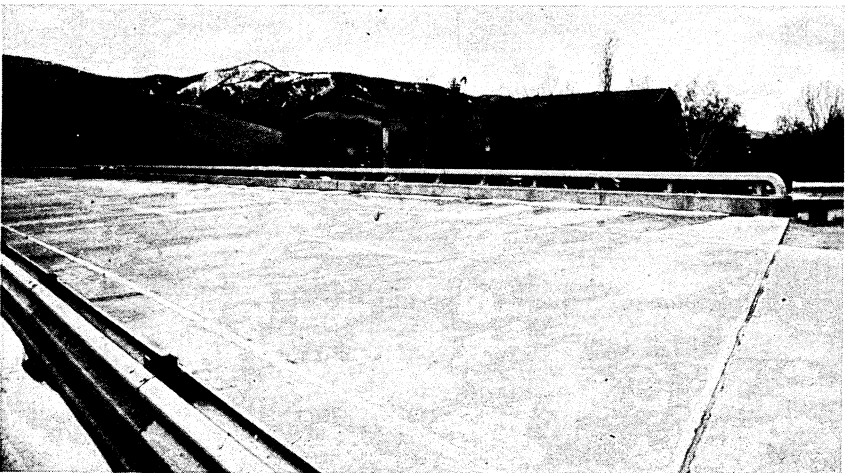
Mr. CONSTANDY. Could we reflect back on the criteria for the installation of guardrail for the median barrier, that the car can be permitted, after having struck it, to follow a course parallel with the traffic rather than be thrown back into the traffic?

A car utilizing that guardrail is going to be projected back into the traffic stream.

Mr. PRISK. This is very abrupt.

Again we have the curb that I mentioned previously in still another installation.

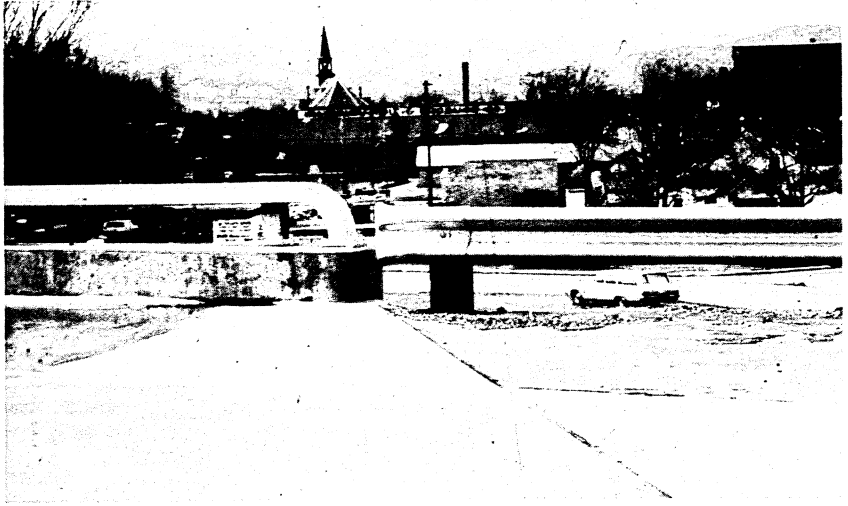
Now we move to Montana, and this is the situation just outside of Missoula.



I think one of the things that caught my eye here was the fact that the rail was so low; the total height of this rail was about 26 inches going across the bridge. This is very, very low for a structure rail.

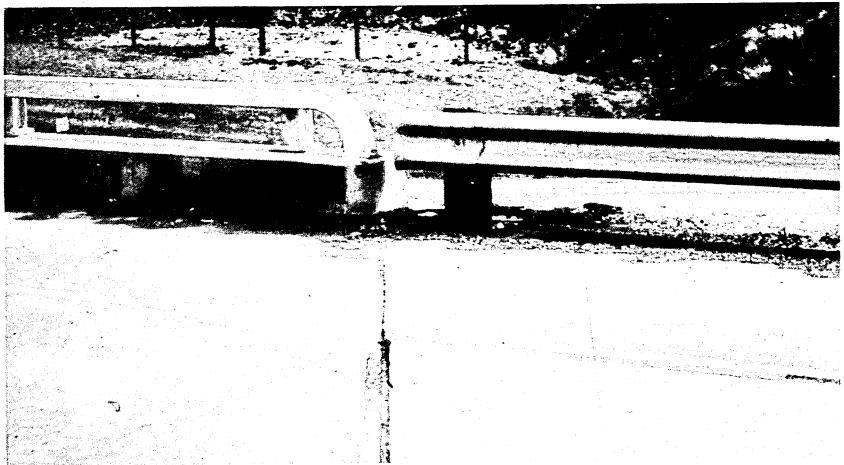
The median rail you see here is carried on steel posts while it is on the structure.

And this is the situation at the end of the bridge. Square wooden post driven as close as feasible, I presume, to the end of that concrete parapet wall.

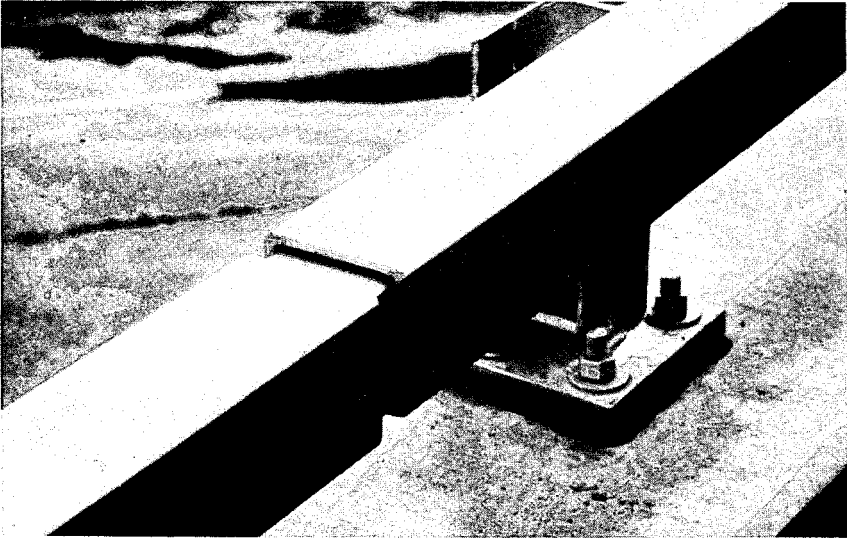


You see here, the vertical dimension of this W-beam guardrail is about 12 inches so you can get some judgement as to the height here. This is a shade under 12 inches here, and this is just a little bit higher than the top of that rail.

A good many things of this sort were seen in all of our nine State projects where you get indications of people striking rails. This one was marked up, tire marks, indicating some rubbing at that point.

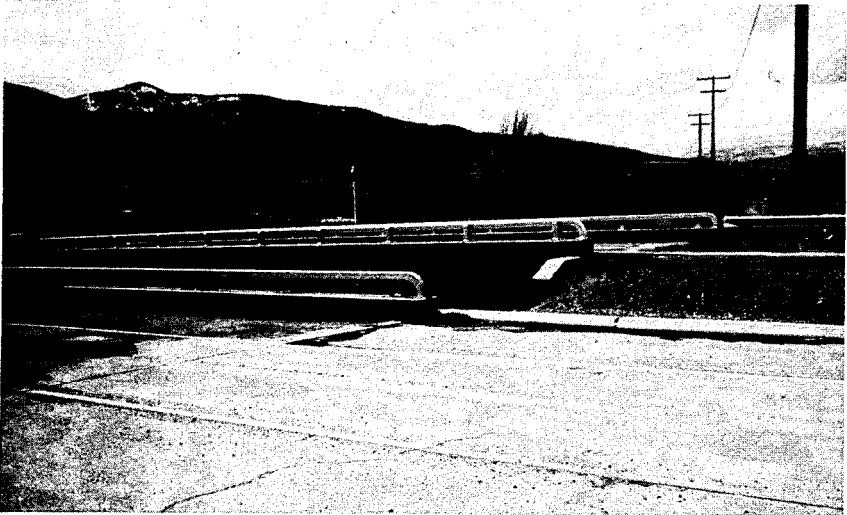


This is the New York box-beam-type rail on a bridge showing the sleeve on the inside. This is regarded as a very satisfactory type of rail. But used that low, there is some question as to whether it functions as well as it would at a greater height.



In Montana, as in other places they have their twin bridges, and some of these are very close, as this one is.

Their roadways are carried at different elevations. This one is an entrance roadway over on this side and these are the main lanes that you see in the foreground.



Mr. CONSTANDY. Exit roadway?

Mr. PRISK. Excuse me, exit roadway. Right.

The grades, I think, still could be accommodated. They are not too much different at the bridge crossing.

Mr. CONSTANDY. Mr. Wilkes, in this situation the twin bridges have been paved over on the main roadway. We have the peculiarity of the third bridge carrying the exit lane. I just was wondering whether it would be feasible, for instance, to pave the space between those two?

Mr. WILKES. Being the same additional cost, and normally on an exit ramp, it is an angle away from the main roadway so it would be a pretty strong taper if the bridge is any length at all. And of course, you would not have the exposure, normally you would not have the volume of traffic on an exit ramp that you would have on a through lane.

Mr. CONSTANDY. No. I suppose the greatest hazard here is the traffic, the heavy volume of traffic, on the main line and on its right side.

Mr. WILKES. That is correct.

I might also comment here, for example, turning down the ends of the metal rail.

Mr. CONSTANDY. Yes. As you suggested before.

Mr. WILKES. I think they have done an adequate job here.

I would expect that that dimension, instead of being 26 as Mr. Prisk suggested, is probably 27. Because that is what the standards require for traffic rail.

Mr. PRISK. I am not going to argue about an inch.

Mr. SKEELS. I have one comment to make on this rail, or two rather. First, I agree that it appears to be too low. It may meet the 27-inch requirement but I question this, whether or not this height is adequate. In fact, we have some information on rails of this height that have been mounted.

The second thing, the rail itself is back from the face of the concrete parapet underneath. It is installed back of it as it has to be, I guess, in this type of installation. And I question if a car strikes the concrete whether or not it ever strikes the rail at all until after it is in the process of rolling over. The rail ought to be—the face of the metal ought to line up vertically, at least, with the base of the concrete.

Mr. PRISK. Mr. Constandy, I wonder if we might ask Mr. Skeels at this point what the height of the rail is on the design they have developed at General Motors Proving Ground.

Mr. SKEELS. The height of the concrete portion of that is 32 inches to the top of the concrete. And the height of the steel rail that is installed on top of that, I can't quote you exactly but it is approximately another 14 to 15 inches. This makes a total height then of about 47 inches.

Mr. CONSTANDY. Why that high. Mr. Skeels?

Mr. SKEELS. Well, the concrete portion itself was made high enough to do the job with passenger cars. In other words, if you had nothing but passenger cars on the bridge, the concrete portion would prevent them from going over.

We felt with high center gravity trucks, this probably was not high enough, and they needed additional height, and so the metal rail is installed to take care of possible needs of truck-type vehicles.

Mr. CONSTANDY. Such should be reflected in highway designs.

Mr. SKEELS. Height, incidentally, the space between the concrete portion and the pipe rail, was determined by visibility purposes, to enable the drivers of automotive equipment to see out between.

Mr. CONSTANDY. That is always fascinating. I would hope the driver of the vehicle I am riding is watching the road. I do not know why the fascination to permit him to look elsewhere going over bridges.

Mr. SKEELS. It seems to me people like to look out and see what they are going over.

Mr. WILSON. While we are talking about subjects such as this, I would like to get a little traffic engineering in here. Besides, a rail should be functional, but there is a psychological effect of having too much openness in a rail.

We tried some experimentation having no wheel guard at all and putting two rails at various heights there and in our mountainous country traffic will shy away from that rail to the point where it is noticeable to traffic. It will go toward the centerline of the highway. I think from a traffic engineering standpoint, this might be undesirable, because it will mean that traffic will be passing or meeting at a closer distance.

Mr. CONSTANDY. You prefer that the driver of the vehicle not be able to see from the bridge?

Mr. WILSON. He should have a secure feeling and apparently this openness does not give him this secure feeling.

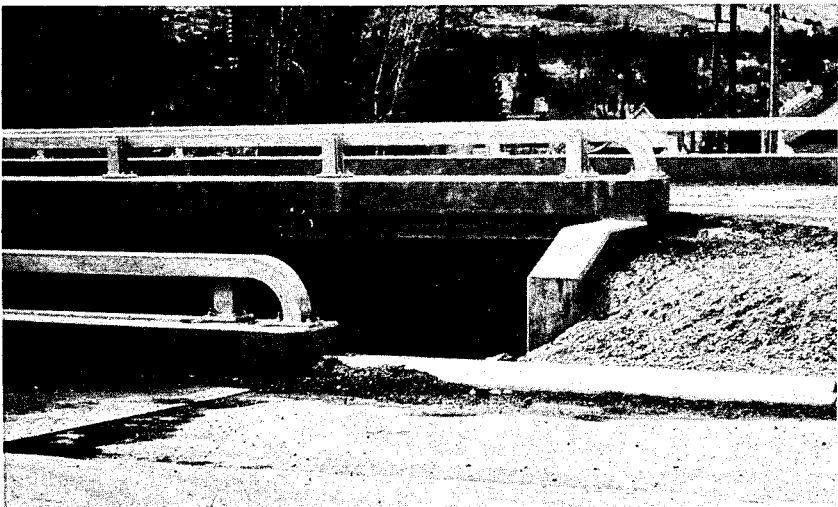
Mr. CONSTANDY. I think we have all experienced that, incidentally. I don't think it is uncommon.

The other point, Mr. Skeels, you mentioned about the need to have your bridge railing higher for trucks; there are some 15 million trucks on America's highways and of course they are not all high center-gravity vehicles, but a good percentage of them are. I wonder if these rails we are looking at are high enough to afford the same degree of protection to the truck traffic.

Mr. SKEELS. That is the statement I made, I do not think this is high enough even though it meets specifications.

Mr. CONSTANDY. Thank you. Mr. Prisk?

Mr. PRISK. Yes. This is simply a closer shot of the same location.

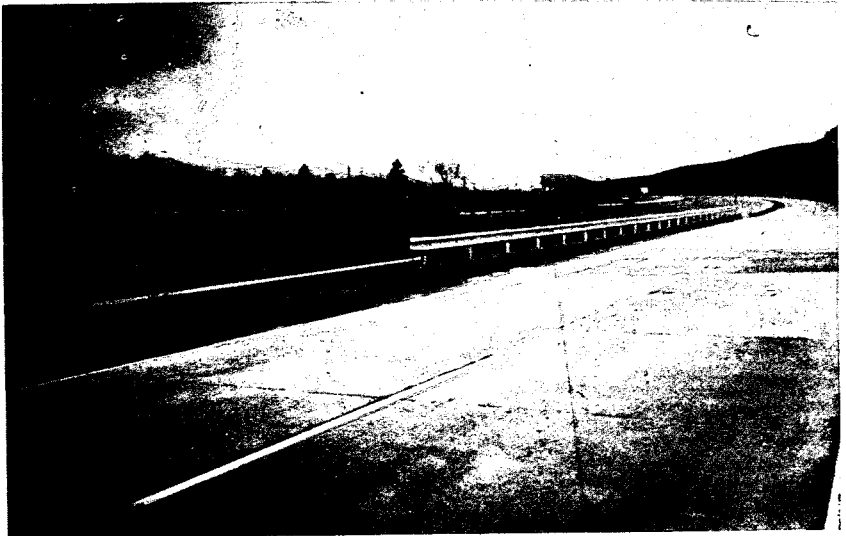


Moving along west from Missoula, this is an approach to a structure showing the guardrail installation.



This is a bridge rather different in design. I think this is unique in that it employs the same unit of design on the structure as is employed on the approach. You see that this rail again, taking this at 24 to 25 inches where it was set, that this adds another 12 inches, roughly, to that, so that you are up 36 inches at least with that rail going across the structure, with a curb in front of it.

I think we have a closeup view of this same condition.



Here it is looking along the rail so that you can see lateral offset of the rail behind the curb, also the relative positions of the two.

There is support for the rail on the structure provided by the series of steel posts, I-beams that you see mounted, integral with the curb structure.

Mr. CONSTANDY. Mr. Skeels?



Mr. SKEELS. I just have one comment. It would appear that the posts that hold the W-type rail on the bridge are of a weaker-type post than the ones that hold the same rail where it is used as a guardrail.

Mr. CONSTANDY. The guardrail being wooden, I think, 8 by 8 and the bridge rail being steel I-beams.

Mr. SKEELS. Of course, I do not know the size of the I-beams but the normal I-beams that are used are about, oh, a fifth to a quarter as strong as that wood post.

Mr. CONSTANDY. Mr. Huff, I would expect this bridge would develop some comments from you inasmuch as it begins to be similar to the type you people in Texas have developed.

Mr. HUFF. I believe I have no comment on this bridge.

Mr. CONSTANDY. With your permission, you were kind enough to bring a couple of photographs, and I think it would be helpful to the committee to be able to look at them in contrast.

Show the next slide first, though.

Mr. PRISK. This is simply a view of the right side of the bridge. You were previously looking along the left side.

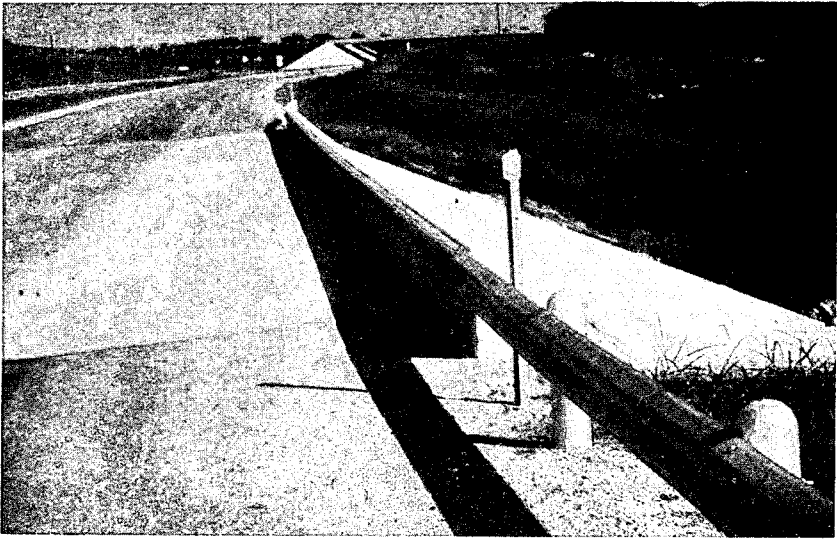
Mr. CONSTANDY. At this point then would you take that carousel along a few slides to those that Mr. Huff was kind enough to bring in.



Mr. HUFF. I would be happy to have the most caustic criticisms that I can get from my colleagues on this.

Mr. PRISK. This is Mr. Huff's design. I would suggest you go ahead and describe it, Mr. Huff.

Mr. HUFF. You will note the bridge has a full shoulder going across the bridge. The rail is continuous from the approach roadway across the bridge. One fault that we think we have on that, and I would be glad to hear other criticisms, probably where we attached



to the rail maybe it is a little too rigid and I believe we should have some kind of spring arrangement in there to give it a little bit of flexibility to match the flexibility on the approach roadway. I believe that is all the explanation it needs. It is there to see.

Mr. CONSTANDY. Before we go on to the next slide, I notice that your reflector at the end of the bridge is a single white reflector rather than what we have seen earlier with the three amber reflectors.

Would you put the next slide on, please?



This is more like the bridge that we have been viewing in Montana where you have the guardrail carried across the structure on I-beams. Is that not correct?

Mr. HUFF. That is my slide, is it not?

Mr. PRISK. Yes.

Mr. CONSTANDY. Certainly is.

Mr. HUFF. Of course, there is enough approach rail here to develop the full strength before you get to the bridge and if you get to the rail anywhere between there and the bridge or on the bridge, you should have enough strength to withstand it.

Now, I believe—I am not sure whether those posts are spaced 12-6 or 6-3. Our standard now is 6-3, on the entire length to develop vertical strength as well as lateral strength. Because if a car does run up on the rail, he needs a 6-foot 3 spacing in order to avoid pocket.

Mr. CONSTANDY. That is fine. I think this makes a very good contrast from the one we had before.

Mr. HUFF. Incidentally, one remark I might make, that does not have a block in it. We don't believe the block out would add a whole lot to the design.

Mr. CONSTANDY. Yes; we had that discussion. Let's go back to the bridge in Montana. If you had done this, you would have carried the same approach guard rail across the bridge.

Mr. Prisk?

Mr. PRISK. Yes. Moving on farther to the west, now, we see the treatment at this interchange structure.

You will note particularly the position of the side piers. I think there is 14 feet of clearance from the edge of pavement on the right-hand side.

Mr. CONSTANDY. As Mr. Wilkes mentioned yesterday on that same bridge, the cap on the piers is askew. I guess that concludes Montana.

Mr. PRISK. That is right.

Mr. GRAY. The Chair desires to announce that we have one very important piece of legislation on the floor this afternoon. Also we



have been in recess, because of the loss of a distinguished Member from California, Mr. Younger. It is the desire of both sides, the minority and majority, not to sit today during general debate because of the nature of the bill on the floor.

Therefore the committee wants to thank all of the witnesses for coming today, and we intend to adjourn over until 10 o'clock tomorrow. We will be delighted to resume the hearing at that time.

With that, the subcommittee stands adjourned.

(Whereupon, at 12:50 p.m., the subcommittee was recessed, to reconvene at 10 a.m., Thursday, June 22, 1967.)

HIGHWAY SAFETY, DESIGN AND OPERATIONS

Roadside Hazards

THURSDAY, JUNE 22, 1967

HOUSE OF REPRESENTATIVES,
SPECIAL SUBCOMMITTEE ON THE
FEDERAL-AID HIGHWAY PROGRAM OF THE
COMMITTEE ON PUBLIC WORKS,
Washington, D.C.

The subcommittee met, pursuant to adjournment, at 10:10 a.m., in room 2167, Rayburn Building, Hon. John A. Blatnik (chairman) presiding.

Present: Messrs. Blatnik, Clark, Cleveland, and Zion.

Staff present: Same as previous days.

Mr. CLARK. The Special Subcommittee on the Federal-Aid Highway Program will please come to order.

We resume public hearings on the design, operation, and efficiency of our highways, roads and streets. As we continue to review and analyze some of the most recently opened Interstate projects selected from around the country, we are privileged to have the benefit of the comments and observations of a panel of nationally recognized experts in the field of highway engineering.

The continued assistance of these gentlemen is greatly appreciated by the subcommittee.

Mr. CONSTANDY. Mr. Chairman, yesterday we were doing bridges in the nine States, and we had concluded with Montana. We have remaining with that subject, Ohio, Utah, and Georgia.

Mr. PRISK, if you could begin, we will see if we cannot complete the bridges and get on with signing.

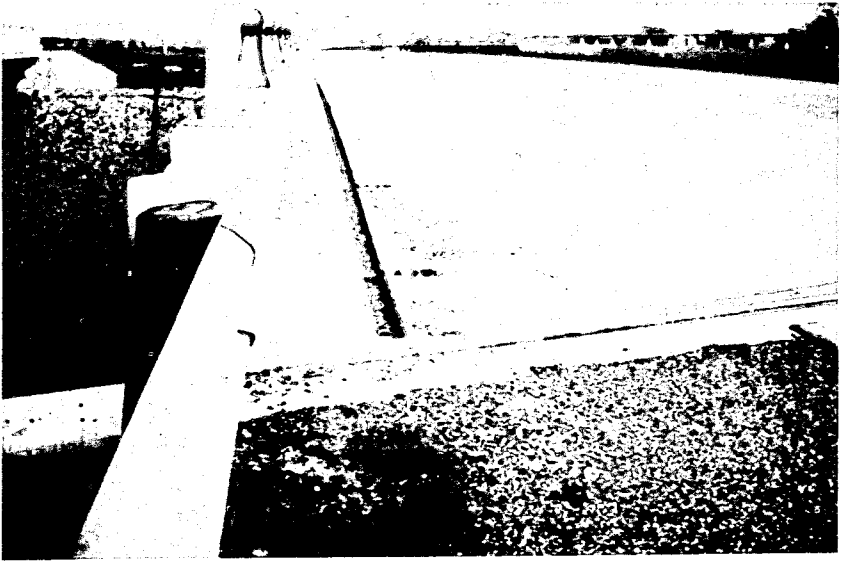
Mr. PRISK. Yes, Mr. Constandy.

Mr. Chairman and gentlemen of the committee, we begin today with Ohio, looking at bridges on Interstate 80-S.

This, you will see, is a full-width structure, again; one of two twin bridges on this particular route, typical of the design that we find. There is no anchorage of the approach rail here or there.

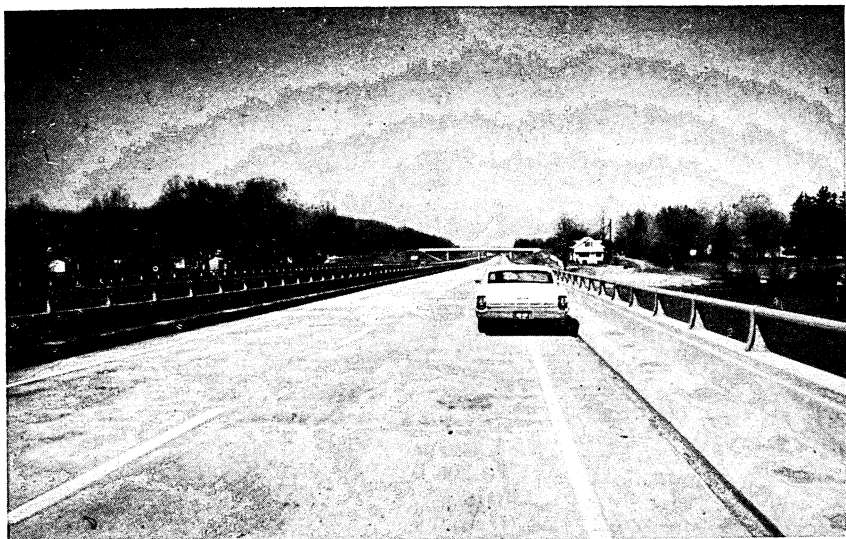


Here is a closeup on the left side, showing the detail there. It shows the open space available.

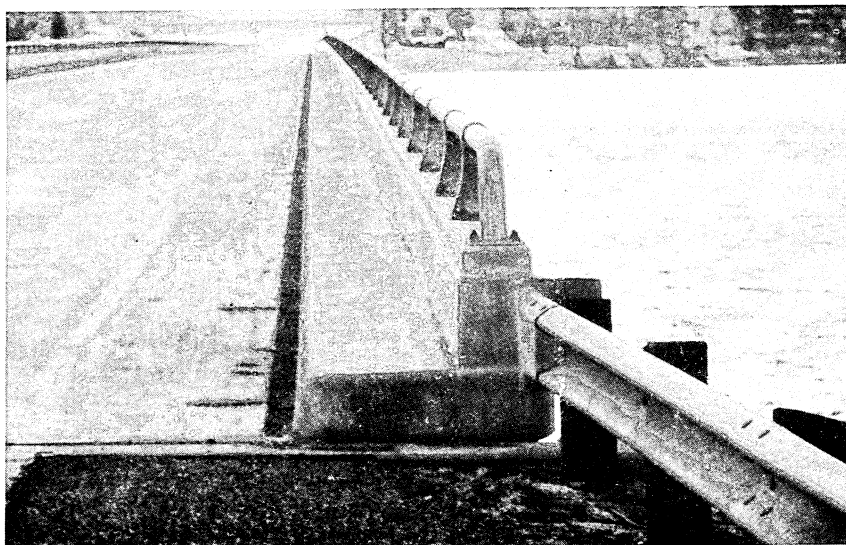


This is another structure on the same project, which is about seven-tenths of a mile long. This is a major bridge, and one of the longest in the State on the Interstate System.

From curb to curb there, you see they have provided for two lanes and about 21½ feet clearance on each side. A walk occupies the space between the face of the curb and the rail that you see.



Here on the right hand is the approach to that long bridge, and again the guardrail comes in with the benefit of close post spacing to stiffen up the rail at this point. It, nevertheless, is of a design that would give enough so that a car could impale on the end of the structure at this point.



Of course, there is beyond that the ever-present face of the curb, which rises vertically from the shoulder surface.

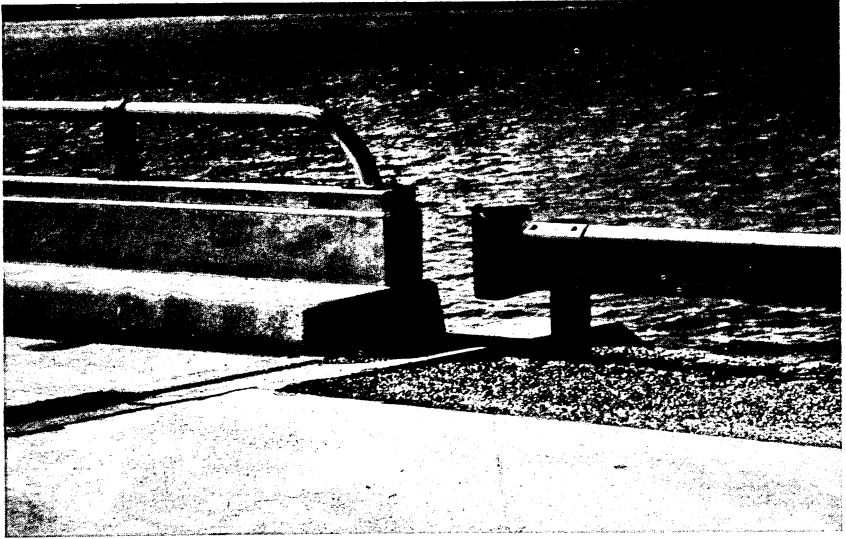
Mr. CONSTANDY. Mr. Prisk, that is typical of what we have seen in the preceding six States in regard to that detail of design, is it not?

Mr. PRISK. Very similar.

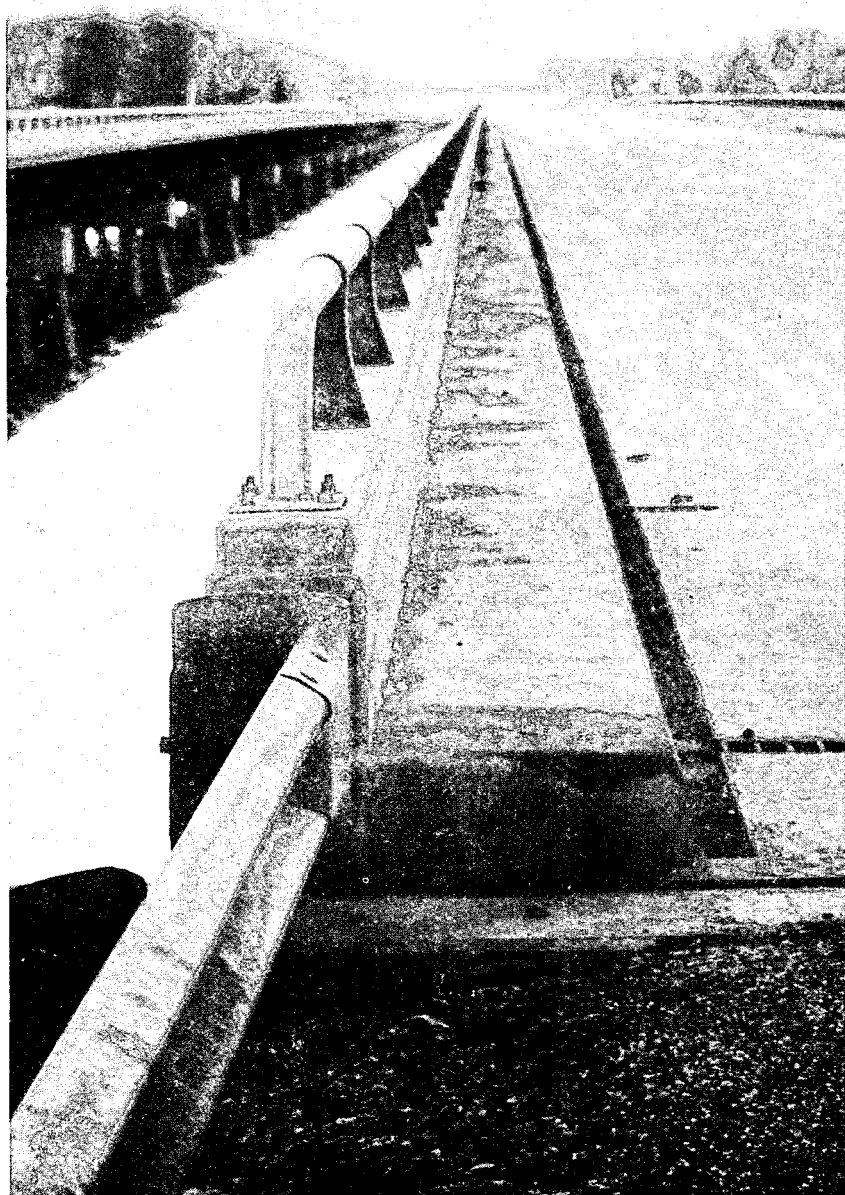
Mr. CONSTANDY. You would say it is wrong?

Mr. PRISK. This is not the safest design.

Here is a closeup of the same situation, showing the vertical face of the curb, which definitely would be a hazard continuing along the rail.

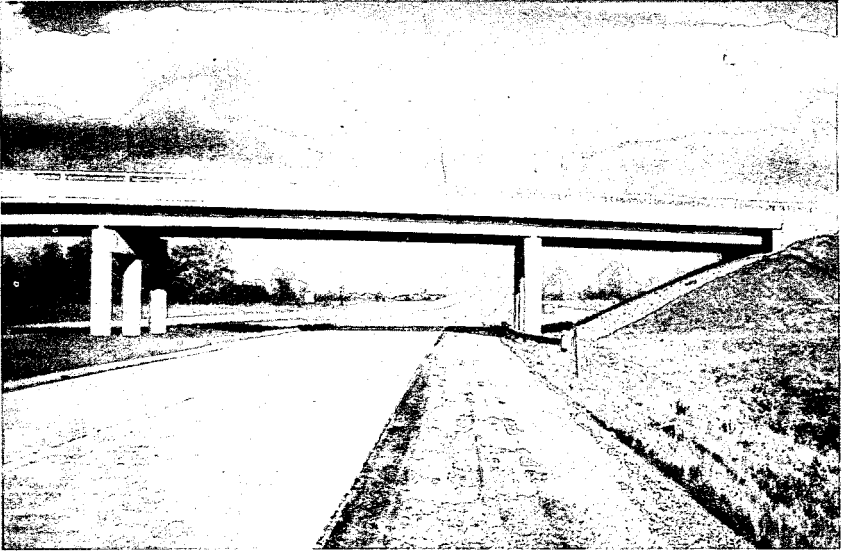


Here on the left side you of course have the same condition. I simply amplify my previous remarks.

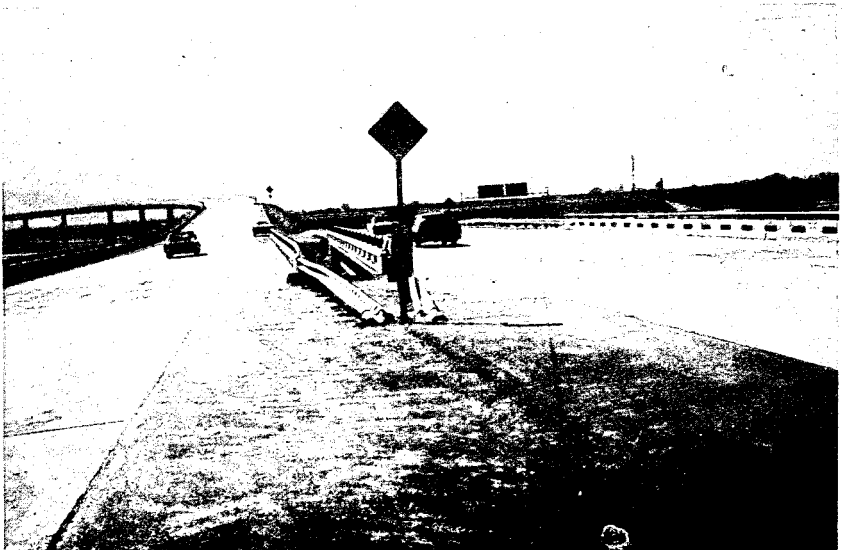


Coming now to the undercrossing, you find this structure on Ohio Interstate 80-S. The bridge piers are not shielded by railing of any sort, but they are offset a very considerable distance from the edge, and on the right side there is a rail flared back but not buried, which carries through the structure, giving protection against impact there.

That completes the Ohio sections.



We now move to Utah, in the vicinity of Salt Lake City, and find here a decision point. Motorists must decide to go up here or here, and this is a gore which is immediately ahead of two dual bridges, a very narrow separation. Let me show you how narrow.





Here it is looked at from the other end, looking back. It is probably no more than 8 or 10 feet clearance at this end, at the most; perhaps as little as five or six at the other end.

Mr. CONSTANDY. Mr. Wilkes, this would seem to be the ideal type of situation for closing that space and removing the hazards that exist as a result of the parapet on each bridge, and having that area traversable, would it not?

Mr. WILKES. I would agree with you, Mr. Constandy, that probably it would have been very similar in cost to build the bridge without this opening.

Mr. CONSTANDY. Being as close as they are, it might have cost even less to have done it the safer way?

Mr. WILKES. Possibly. That would, of course, have taken out this rail and parapet entirely and made a paved section across the open area.

Mr. CONSTANDY. Incidentally, that particular spot has the usual skid marks of vehicles in advance of the structure, but the area beyond is equally covered by skid marks from people who are yet undecided, after they pass the bridge, in which direction they want to go.

Beyond the structure it still is traversable for an appreciable area, and it is used as a crossover in that situation.

Safety would be considerably enhanced by the removal of those inside parapets and paving the space in between.

Mr. Wilson, did you want to say something?

Mr. WILSON. What you just mentioned could be a deficiency somewhere else. It could be a deficiency in signing or in signing messages.

However, I would agree with you, every effort should be made to make the gore area as flat and as traversable as possible.

Mr. CONSTANDY. Yes. We are deliberately omitting messages on signs in this hearing. At some later time we will be discussing signing and the messages that appear on the signs.

Mr. Prisk?

Mr. PRISK. Here now is still another twin bridge situation, where there is guardrail protection on the left side leading up to that division between the bridges. Still there is the same hazard, of course, that exists.



There is not quite as obvious a solution as the previous one, to pave over; yet it certainly is within range for consideration. Certainly it is much more desirable to have these areas as open and clear as possible.

Mr. CONSTANDY. In that particular instance you can see, although not too well, there are tracks across here, and you will see some denting in that buried part of the guardrail. In fact, a car did have an accident here. He drove over the guardrail and went on over into the other roadway, barely missing the bridge parapet on the end of the bridge.

This points up the possibility of a situation where you might have someone impacting on the end of the bridge in the opposing roadway. Mr. Huff.

Mr. HUFF. I think that points up one of the dangers of flaring the rail too much. Had the rail been longer, and extended farther down the road, parallel to the roadway, that might not have happened.

Mr. CLEVELAND. May I ask whose car that is? To whom does it belong?

Mr. CONSTANDY. It belonged to Hertz, but we rented it.

Mr. CLEVELAND. I wondered if that would be a hazard, too.

Mr. CONSTANDY. In connection with that, we calculated we walked something over a hundred miles, and it would have been much longer had we not taken a car.

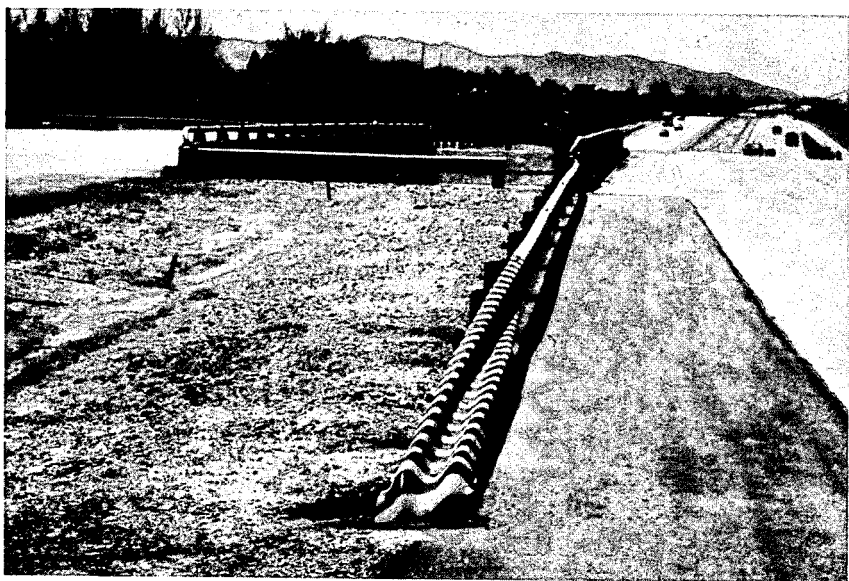
While you raise that point, we did have a problem. I think right there, Mr. Prisk, that is as far off the road as you can go and still get back on the highway. That median appears to be more sturdy than it

actually is. It is a very loose material, and I had the unhappy experience of getting stuck in it.

Mr. CLEVELAND. Actually, the car that would be broken down normally would pull off to the right; is that correct?

Mr. CONSTANDY. I believe that is true. In this particular instance there is an exit ramp on the right, and it seemed to be the least hazardous to put the car in a place protected by the parapets of the bridge, so any car that might go out of control had the chance of missing us because of the parapets.

Mr. PRISK. Proceeding now, looking at a bridge on Interstate 15, which is south of Salt Lake City, we find this condition. There is a little different treatment, because here a rail has been installed across in front of the open drop between the dual bridges, and in this case also, and remembering Mr. Huff's comment of a moment ago, this rail has not been flared but is buried. I think it could be said this rail is probably still all too short to do the job.



Mr. CONSTANDY. Mr. Skeels, what would your opinion be of the effectiveness of that guardrail, taking into consideration the length of it, and the fact that the automobile that might strike it is apt to be at a 90° angle in the face of it?

Mr. SKEELS. That one is rather useless as an effective guardrail. It does define the fact there is a hazard there, but, as far as deterring a car from going through it, practically any vehicle, at any speed whatsoever, would go through that rail.

I agree further that the length of the guardrail at this end of the bridge abutment is much, much too short. You have to have several hundred feet in there to effectively handle a car that may be out of control.

Mr. CONSTANDY. As Mr. Ricker brought up the other day, there is the undesirability of having the entire road lined with guardrail and, considering the spacing of the bridges on the roadway, you might have that if you install just sufficient length at the bridges and the approaches.

This further suggests the desirability of having paved open spaces between the two bridges. It introduces an element of cost; in other words, if this median did add some extra cost because of the width of the paving between the structures, you would want also to calculate the saving in the guardrail to properly protect the structure, and by the time you have done that you may find the cost of providing the safer facility, with the paved space between the bridges, is actually less.

Mr. ZION. Mr. Prisk, we were discussing on Tuesday the desirability of flaring plus burying the ends of this rail. Is this not another example of where a car could easily run up on the rail and perhaps be turned over into the highway?

Mr. PRISK. I think that is correct, and I think this is an alternate possibility that you need to consider with the use of this type of rail.

I think it is well to keep in mind, however, that running up here is unlikely to have the violent effect an exposed rail would have, say, if it were cut off at this point, and if you were to hit that squarely.

Mr. ZION. Would it not be more desirable to eliminate both possibilities by flaring and burying?

Mr. PRISK. In the previous view we had a picture of a section that was flared down here, and this does go down to a lower level elevation. There is a chance, unless this is quite long, that this again, with a car on the downgrade, could top that section of rail.

Mr. CONSTANDY. These are patchwork solutions, but ideally would it not have been preferable to pave the entire median between the twin structures?

Mr. PRISK. I think every one of my colleagues on the panel would agree that if this section were paved it would not be necessary to have this as low as it presently is, which is another feature in the dynamics of the accident.

Mr. SKEELS. I have another comment on the guardrail approaching the parapet there. If a car does go on this at the slope they have used, it is unlikely the car would be tipped over. We have run many tests, and rarely does a car tip over when it goes up a slope of this nature. However, due to the extreme shortness of this section, the car will keep going, and will be guided directly into the bridge parapet on the end. It cannot get off of it once it is on it. It will go on and hit whatever is at the end.

It does not look as if that would be very good.

Mr. ZION. This V-shaped median, as someone suggested in the past, there is a tendency, of course, to leave the highway, say it is going away from us here in the right lane, but gets into the V; there might be a tendency to throw it across into the approaching traffic on the other side.

Are you suggesting the desirability of having a raised median rather than a lower one, Mr. Skeels?

Mr. SKEELS. We all have seen many examples of tracks that do go directly across the median like this. As you go down, if the car is out of control, it tends to steer to the left, and after it starts up the other side it tends to steer to the right; so the effective path is merely raised.

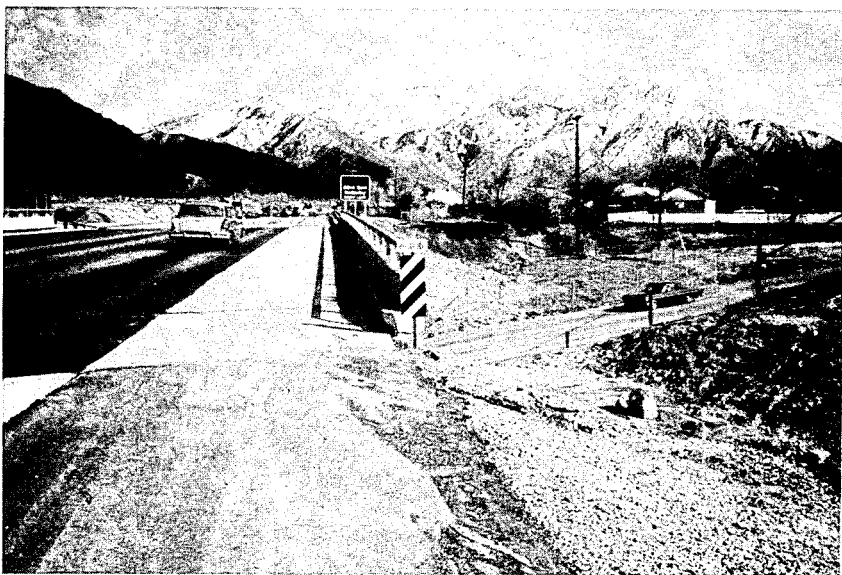
If you have a raised one, it does tend to steer back in the lane you came from; however, depending on the slope and the amount of rise that you can get, it would determine whether or not it would actually steer back into the correct lane before topping the rail.

If it topped the rise, then it would go down the other side, which would be much worse.

Mr. CONSTANDY. We will have a good example on one of the projects that is open in Ohio. Mr. Prisk?

Mr. PRISK. Let us move along here.

You have seen a picture of this before. I do not think we need to spend time on it, but this is that bridge on Interstate 80 at Salt Lake City where there is complete exposure of this end rail, the end of the parapet.



The possibility of a drop down here is of course nothing very healthy, either, but the full shoulder is carried across. Traffic normally would be moving in this lane, but any emergency use of the shoulder would very quickly get you into this parapet end.

Mr. CONSTANDY. Mr. Skeels?

Mr. SKEELS. I have just one comment on this. This bridge rail looks pretty good, and I do not think we should condemn the bridge designer for not matching the rail into it. Rather, it is failure, really, to recognize the highway as one system, the system consisting of the roads plus the structures, and the system has to be designed so that the vehicle can operate effectively on all portions of it.

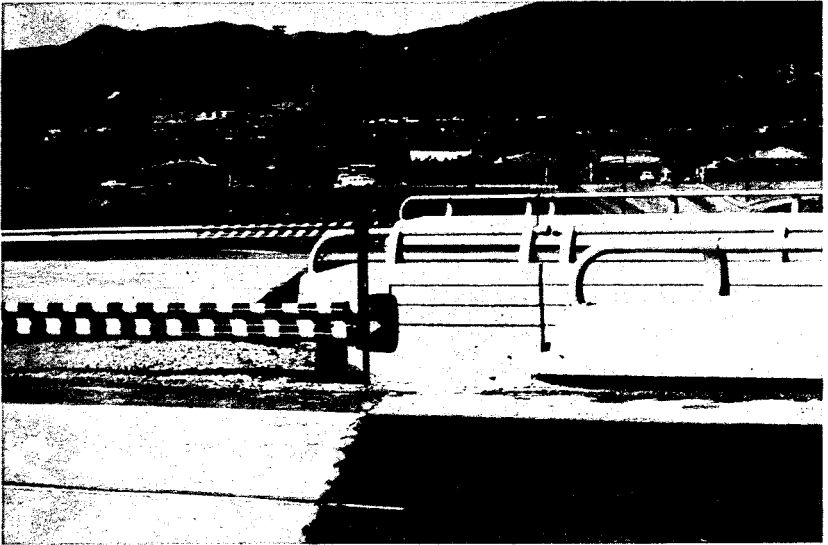
In other words, the guardrail and the bridge rail, and the shoulders—everything—have to be considered as they work together and connect together.

Mr. CONSTANDY. It points up the necessity of coordinating the design by the different groups involved. Mr. Prisk?

Mr. PRISK. Yes. Yes, very definitely.

Here again I will not spend any great time with this, because we have seen this open section, undesirably so, between the railing and the beginning of the structure. The opportunity is obviously here to pave over between the two bridges that are rather close together.

Mr. CONSTANDY. This is the eighth State in which we have seen this?



Mr. PRISK. That is true.

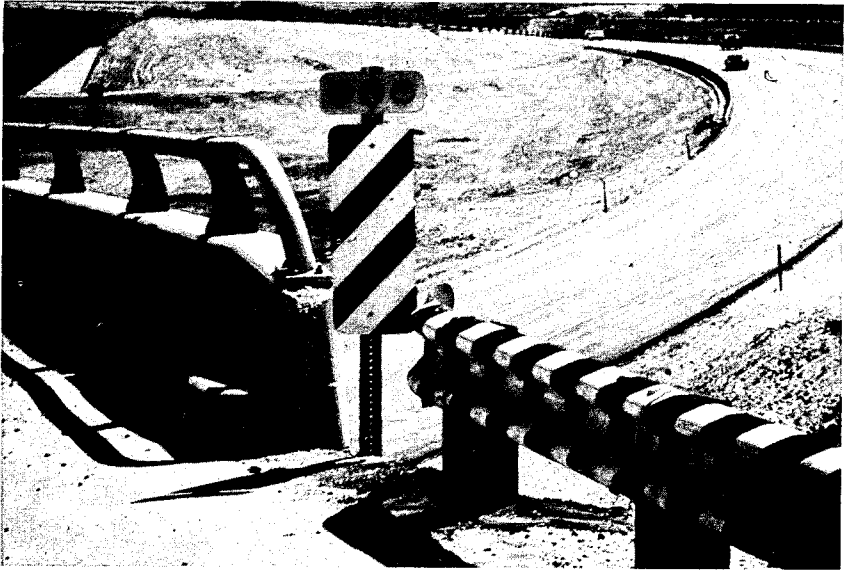
Mr. WILSON. May I make a comment? We should perhaps give the State here credit for utilizing the brush curb design that was developed from research performed in California, in which they undercut the curb. The theory is that that would catch the tire underneath the curb and help prevent the vehicle from rising up and going over the parapet.

Is that not correct, Mr. Wilkes?

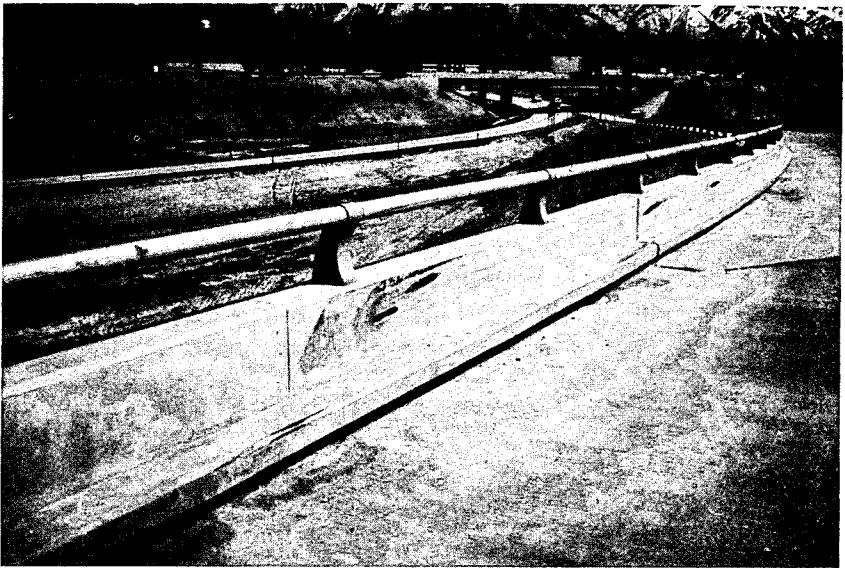
Mr. WILKES. I think you have expressed it very well, yes.

Mr. PRISK. May we move along to this bridge on Interstate 80.

There is evidence this has been struck in this area, with the chipping away in the concrete at that point, very similar to the other pictures we saw.



Here, too, is evidence that people do not always stay on the traveled way. This is a structure making a connection from Interstate 15 to Interstate 80, Salt Lake City being in this area.

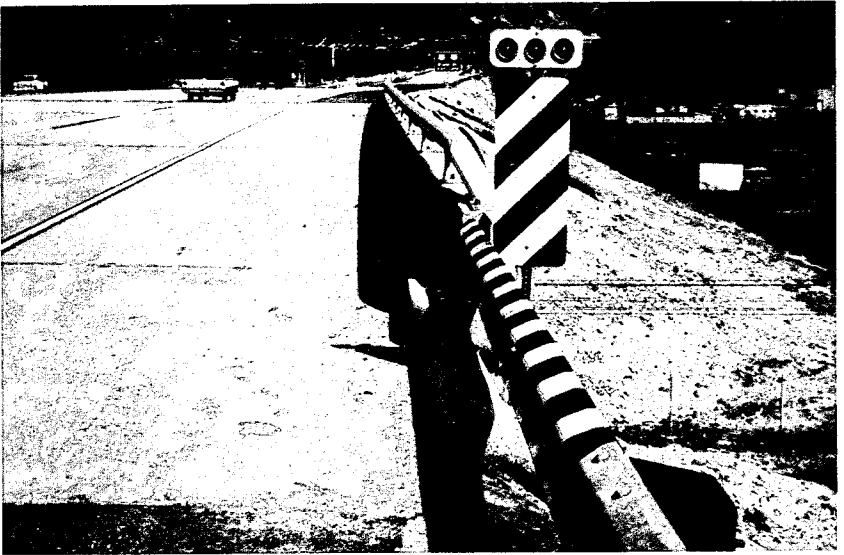


These tire marks very clearly show on this side, so there is enough shelf in this particular bridge, despite the undercut curb—which is a favorable design aspect of this structure—so that the wheel marks actually travel along here. Evidently the wheel is up high enough here, because these were rubber tracks.

Mr. CONSTANDY. Those tracks continue along the parapet, as a matter of fact, and there was evidence that the vehicle mounted the brush curb and stayed up on it through that curve, and hit the end of the guardrail at the other end of the bridge. It was kind of an unusual accident, but it shows this kind of thing can happen.

Mr. PRISK. This curb is wider than it is in desirable practice, somewhat wider.

Moving along again, here is an attempt to anchor the guardrail to the structure on Interstate 80.



This is a closeup picture of the same thing. One thing you notice here is about a half-inch of rail left to take the strain at such time as the force is applied. I am a little bit surprised this would be cut quite so thin. That could not withstand very much of a blow.

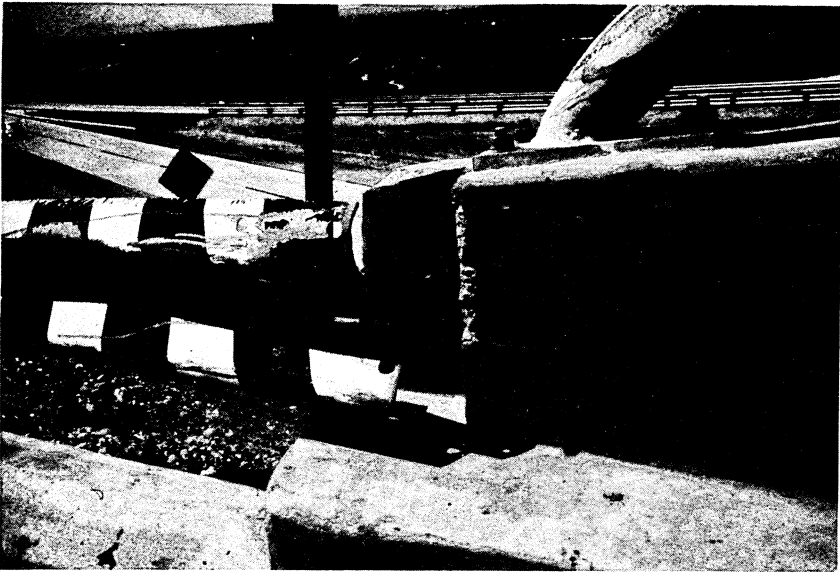


We have a picture here, now, of a structure where one of these was hit. This is a rail approaching on the left that I refer to.



There is a closeup of the damage to the curb. Evidently a car topped this curb and got up into this area, and also did a little minor damage to the bridge rail itself; but it was getting up fairly high. We have no details of the accident.





Mr. CONSTANDY. Perhaps, Mr. Wilkes, that is a good illustration of the point you brought up as an alternate to having that massive parapet at the end of the bridge, by flaring down the bridge railing as they have done here.

While the car or vehicle hit it, it was not impaled on it.

Mr. WILKES. I would agree.

Mr. PRISK. It makes a glancing blow out of an otherwise severe head-on contact.

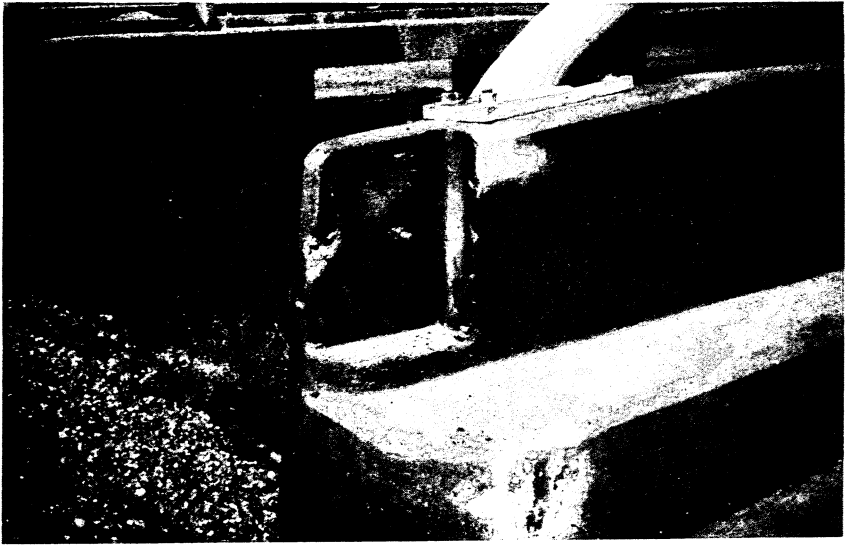
Here is another structure entirely, where a hit occurred. This broke away the concrete, either that or this pulled out as a result of temperature stresses on the rail.



Mr. CONSTANDY. I think, Mr. Prisk, there was other evidence of an accident, likewise, on that striped panel. I think on this one there had been an accident.

Mr. PRISK. All right. In any event, this is very similar to the previous condition. The design is exactly the same. The bolt is pulled out.

Here is the way this looks on one of the bridges where the rail is not in place. You can see the location of the bolt. Some of these are a little bent—it is expecting a great deal of one bolt.



Mr. CONSTANDY. Mr. Skeels?

Mr. SKEELS. I would just like to make a comment. This shows, really, a lack of appreciation on the designer's part of the tremendous forces that are involved in these typical impacts. The guardrail itself, as you recall, the sections are bolted together with four large bolts, two at the top and two at the bottom, with a minor mounting bolt in the center.

The guardrail will stand a tensile force of about 100,000 pounds. To bolt that rail to a bridge abutment with a single bolt, that looks to me as if it might fail at 5,000 pounds, indicates a misunderstanding of what one is trying to accomplish.

I do not think the designer really realized he was trying to fasten the rail to the bridge in order to obtain the tensile strength that the rail can deliver. In other words, I do not think his goal was properly spelled out to him.

Mr. CONSTANDY. The concept was good. It failed in detail.

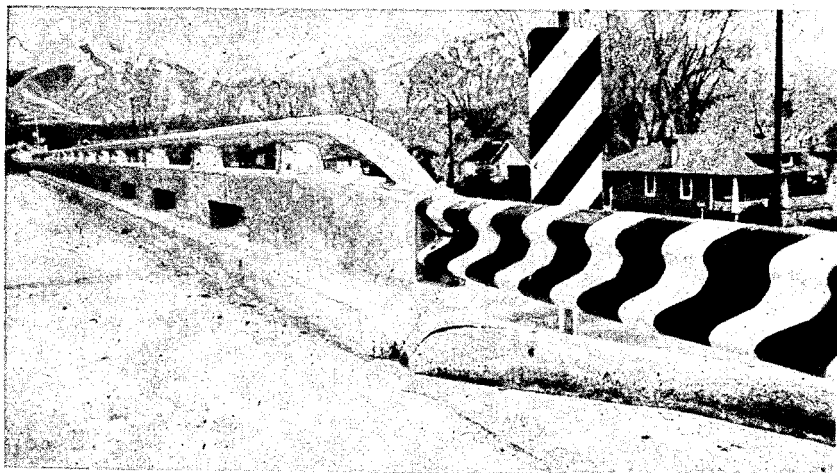
Mr. SKEELS. Yes, I think this is right.

Mr. CONSTANDY. Mr. Wilkes, you mentioned the other day the failure of appreciation of detail in design of some of these things. I wonder if you care to say something about it now?

Mr. WILKES. I am sure the designer of that connection was not aware of the horizontal force that would result from a vehicle struck against the rail, and did not realize it was intended this guardrail would

develop a cable type resistance to the vehicle hitting the rail, so there is a need for better understanding of how the rail is supposed to function in collision.

I agree with Mr. Skeels.

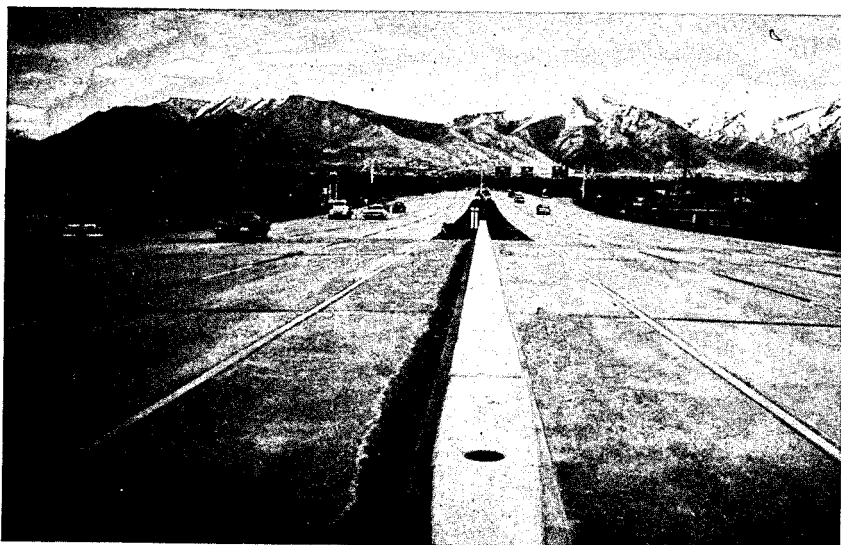


Mr. PRISK. You turn a few amateur photographers loose, and you do not get good pictures every time; but here is a case on another structure where there is a bolt that actually is sticking out. That is the end of the bolt, that little dark spot just before you come to the face of the parapet wall.

It is 3 or 4 inches; you could pull the rail back and forth.

Obviously this does not represent the best in practice or in application.

Let us look at another one.



This is a concrete parapet wall in the median. We saw the other day the way the guardrail treatment was applied, and you will remember that the metal W-beam rail is flared out at this point, and at the end of the concrete wall going this way, and also in the foreground, back here where the camera was, is the cable-type barrier.

This simply is an illustration of the design on the structure itself. You will see the narrow curb that projects from the wall of the median parapet.

Mr. RICKER. This is the twin bridges situation where it has been paved between.

Mr. CONSTANDY. Yes. On this particular stretch of highway, which is 5.7 miles, there is a series of bridges on the portions of the section closest to the intersection with Interstate 15. Not counting the first one we saw, they paved the space between the bridges, and, in addition, poured a concrete median barrier.

At points farther along the highway the treatment is different, the median is not paved, and the bridges are not paved between, either. Neither is there a median barrier, although the median appears to be the same width.

Mr. WILSON. One of the objectives of highway construction I think is to give the motorist a feeling that he is not even approaching a structure, and this can be accomplished by giving it full shoulder width and making all the approaching things as inconspicuous as possible.

But I did want to point out one thing here. In the moderate-length bridges we found it quite valuable, from the standpoint of delineation, to use a contrast treatment on the shoulders. You will notice here you come off the travelway, and you have a white travelway there, and when you reach the bridge you have a white shoulder.

We have found in the past that it has been desirable to coat that with some kind of material that is similar to the shoulder color, black lacquer or some type of asphalt compound that will give you a contrast treatment. This will help your delineation.

Mr. CONSTANDY. Thank you. **Mr. Skeels?**

Mr. SKEELS. I had one comment. I assume the median barrier on the bridge approach is the chain-link type?

Mr. PRISK. Yes.

Mr. SKEELS. Really, there is no excuse for changing that, as you go over the bridge. All you do is create the problem where the chain-link ends and the concrete begins. Either is fine, but there is no excuse for changing from one to the other.

Mr. CONSTANDY. It again suggests there is no coordination between the bridge designers and the roadway designers. **Mr. Prisk?**

Mr. PRISK. Looking now at an undercrossing, at the end of the shoulder again, it is without protection at this point. The median piers are protected.

Here you will see a median pier unprotected, and in this case the side pier is removed so that you are way back up here before you have any lateral obstruction at all.

Mr. CONSTANDY. So far that is very good? That is more desirable than a previous picture we saw?

Mr. PRISK. Definitely.



Mr. CONSTANDY. Could you go back to that slide 1 minute? Mr. Ricker?

Mr. RICKER. I was noting the pedestrian fence which I did not think would have to be that close to the path. It is somewhat of a hazard in itself.

Mr. CONSTANDY. This is on Interstate 15, incidentally.

The picture we saw before shows a structure where a fence comes down between the pier and the shoulder. On this structure they elim-



inated the side pier, but they created the hazard by placing the fence along the shoulder.

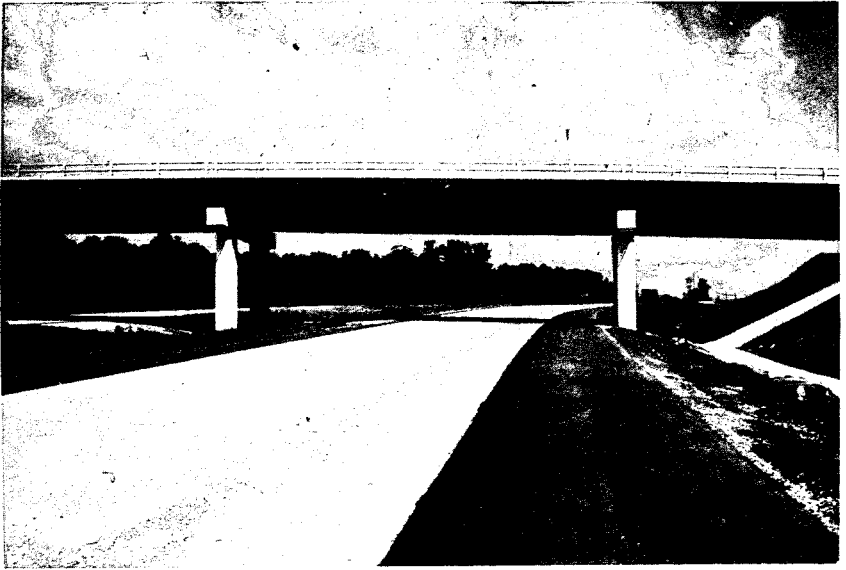
We could not figure out why. It seemed the fence would be as effective if it were continued along the right-of-way line and brought to a juncture with the bridge farther up that slope.

When you approach this—we were at some distance from it—we could not figure out what that thing was ahead. When you look at that fence end-on, it appears to be something in the road. You cannot see the side portion of it, so you cannot see the connecting piece of fence. You are conscious of something just off the shoulder.

So whatever advantage was obtained from the psychological effect of driving through an open-span bridge like that was lost by the existence of the fence.

Mr. RICKER. This again is apparently recognized by the placement of warning markers along the fence.

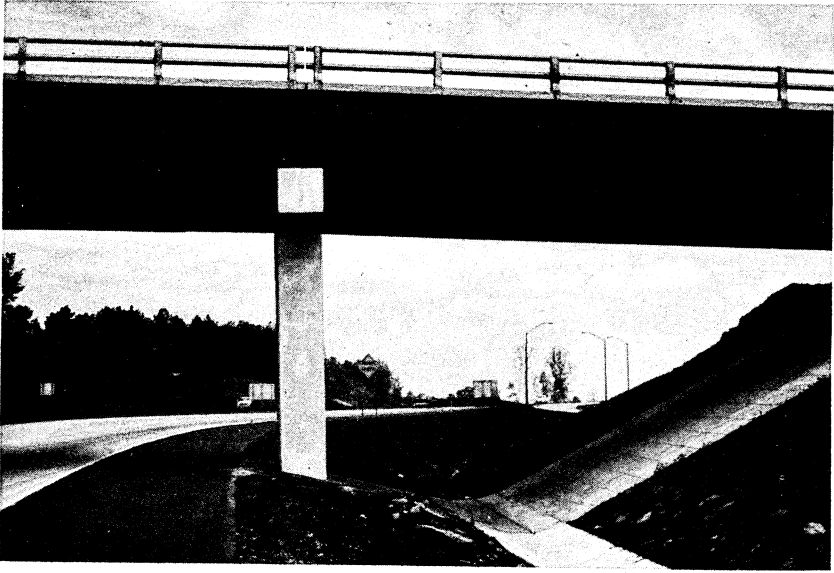
Mr. CONSTANDY. Yes; there are several of them. Mr. Prisk.



Mr. PRISK. Moving now to our next State, which is Georgia, we find undercrossing structures of this general type.

The side pier is in here, clearing the edge of pavement by 14 feet. There is no protection in terms of any rail installed here, nor is there on the center piers.

Here is a closeup of this same side pier, showing the detail and the magnitude of the mass that is there, in case you happen to run off the road at this point.



This is another undercrossing, where you have a series of piers carrying roadways overhead. This section here is paved for drainage purposes and to retain the slopes in the fashion in which they were built.



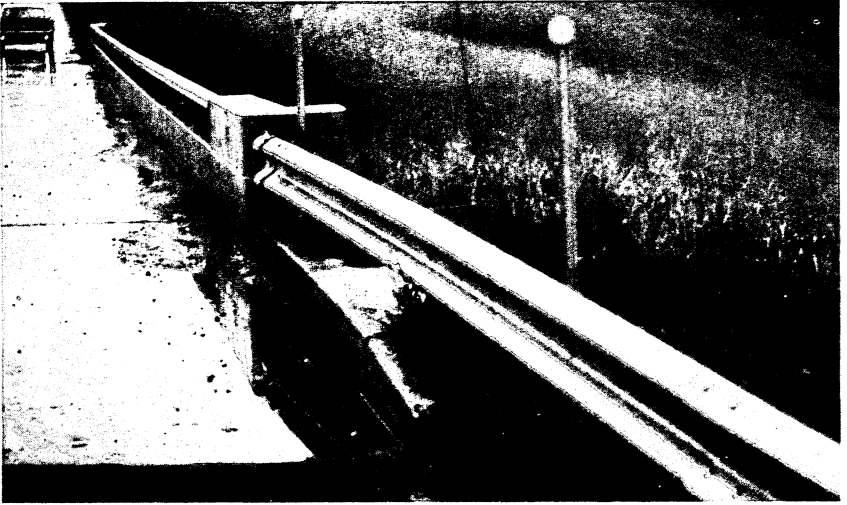
Also there is no protection, as you will see.

Here is an approach to a structure. I think it was remarked in a similar view we saw yesterday, the rail height on this particular structure appears to be quite low. This, as I recall, is only 27 inches high, not hardly any higher than the rail.

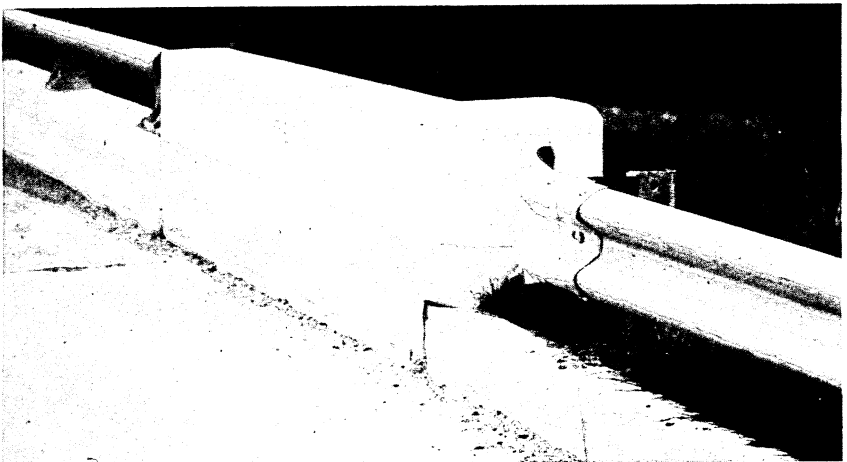
Those are the rear lights, of course, on that car proceeding away from the camera.

Mr. **CONSTANDY**. This now makes all nine States having the same design deficiency in the transition from the guardrail to the bridge rail?

Mr. **PRISK**. That is exactly correct.



Here is the closeup of one of the Georgia structures. You see there the relative height of that concrete block at the end of the bridge and the rail.



This is the detail of the type rail used on top of the parapet. This rises up vertically from the pavement edge or the shoulder.

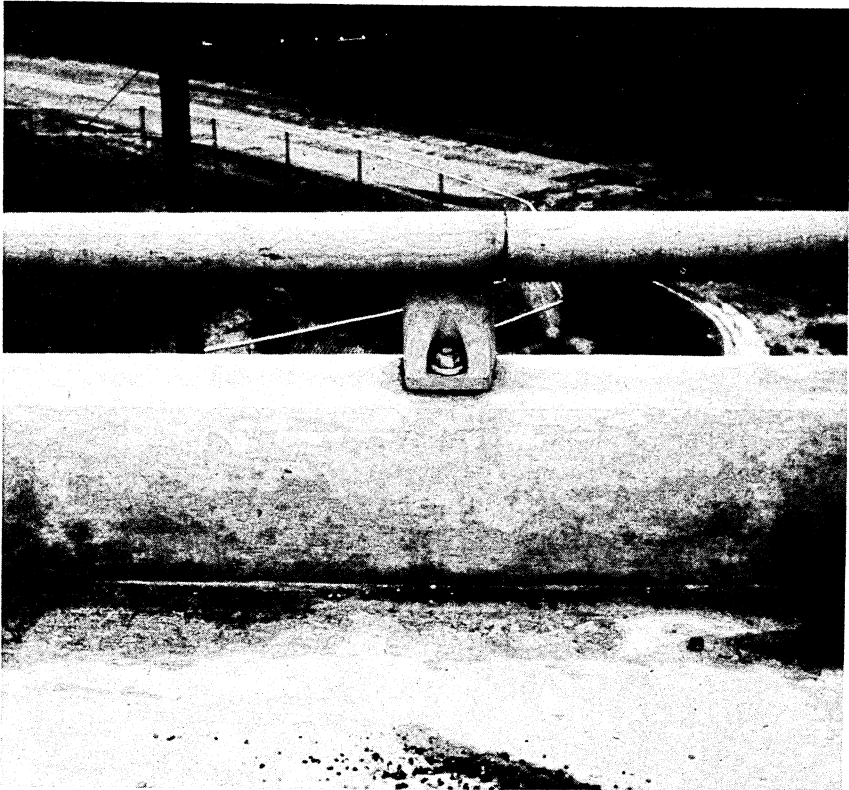
Mr. CONSTANDY. Would you say, Mr. Wilson, it would be more desirable to have that brush curb rather than the flat wall, as we see it?

Mr. WILSON. I am not sure I would be capable of answering that question. Where we use a brush-type curb, we would certainly have a higher concrete rail behind it, just in case it was mounted.

I think I would have to agree with what Mr. Skeels said yesterday, this looks like the rail was too low overall.

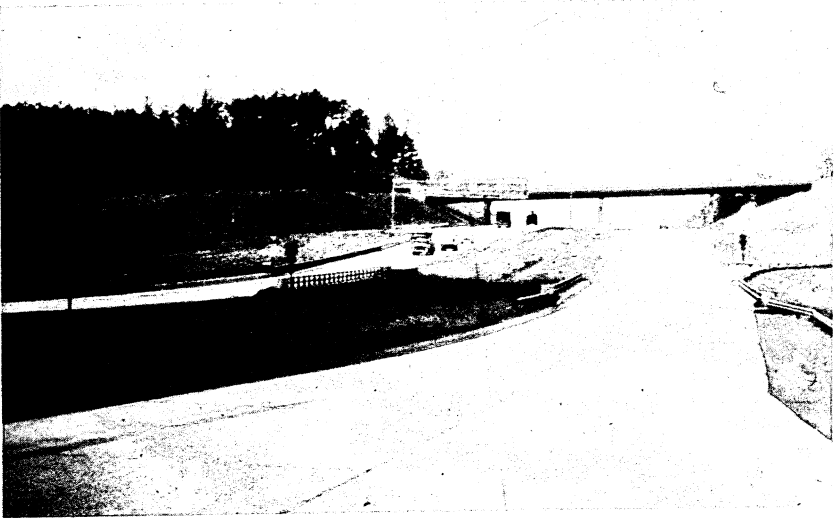
Mr. CONSTANDY. That is something that has to be borne in mind. If you intend to take advantage of the brush curb, you have to then take into account the height of the parapet overall.

Mr. WILSON. I don't think I am an authority on that, really, to comment.

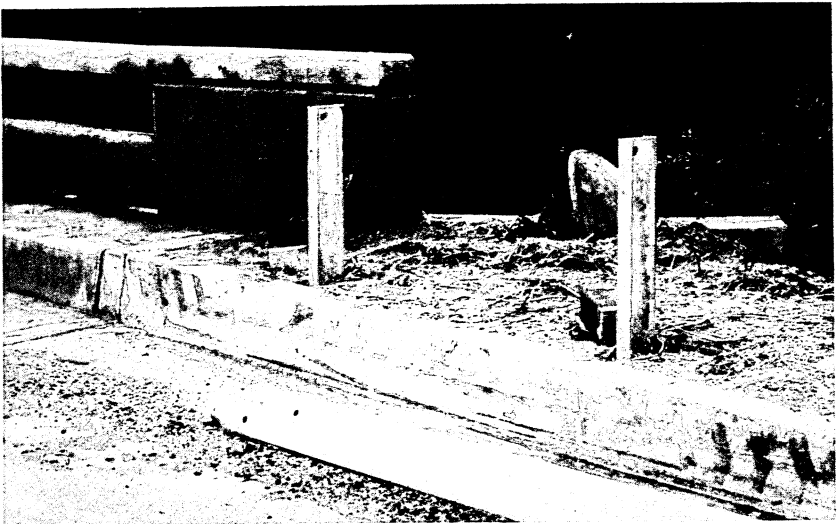


Mr. PRISK. Continuing, we find this condition at the end of the project in Georgia, where again you have dual bridges with very little guardrail protection at this point. This structure, which is at the end, this being a connection with Interstate 285, was built as a part of the old project. We were looking from the end of the work.

We have examined away from the project. That is the condition, perhaps the older condition, you might say.



Now we look at some new work in the same State. We find out that bridge ends are being treated this way. You recall seeing in our review of the guardrail practices that the State highway department is starting to use these blocked-out sections and Z posts; and here you see them again, approaching the structure.



This is the approach, moving from right to left on the photograph.

With this block installed in the base of the post, you will bring out the face of the rail pretty well to this curbline, so that aspect of it is perhaps something we can commend.

I think, still, this rail is a little lower than would be desirable. That is a 1965 structure, as you can see.

Mr. CONSTANDY. I think that completes the material we have on the bridges.

Now I would like to ask each of the members of the panel to comment overall on what you have seen from the nine States, the nine States being representative of completed Interstate sections open for traffic in late 1966 or 1967.

I would like to have your impressions and the satisfaction or dissatisfaction, generally, with what you have seen.

We realize there are a number of elements that were discussed that go into the features we have been talking about, but overall we would be curious to know whether you are somewhat dissatisfied or whether you are pleased with what the States have done, and what should be done in design and construction of the features we have seen.

Mr. Wilson, will you begin?

Mr. WILSON. I think it shows here, from what we have seen yesterday and today, that a modest cost increase in some of these features, such as decking over structures—and in some cases it may not even be an increase in cost—coming up with rigid structure two-span bridges in some cases, at no increase in cost, would certainly improve the safety features.

I think every member of the panel would agree that we have a lot of work to do in connection with tying the guardrail to the ends of the structures. This is something that apparently has not been solved.

Mr. CONSTANDY. None of the States did that correctly, is that true?

Mr. WILSON. I would not be satisfied with the way I have seen it done here.

Mr. CONSTANDY. Overall, were you satisfied or dissatisfied with what you have seen?

Mr. WILSON. As I have said, there are considerable deficiencies, and with modest increase in costs you could be getting a lot more safety out of it.

Mr. CONSTANDY. Thank you, Mr. Wilson. Mr. Skeels?

Mr. SKEELS. I certainly agree that all of the projects examined showed the same general types of deficiencies, and there are quite a number of them. We saw a number of attempts to improve the situation. There are lots of ideas on railing design. We even saw a few on the attachment of the guardrail to the bridge parapet.

These designs obviously were made by people well intended, who intended to do a good job. Most of them we criticize as not being a good job, or not being as good as we think the state of the art would allow.

I would certainly like to encourage the use of real full-scale tests to evaluate designers' ideas. I am a testing man, and I may be overemphasizing this angle. I realize many of the designers do not have facilities to conduct full-scale tests on their designs. If they do not, they should make use of designs that have been tested or evaluated and proven that they perform properly.

In this case, as in many others, intuitive design is not always proper. The design has to withstand a dynamic situation of a car impacting it at a considerable angle—I use the word “car”; I should use the word “vehicle”—and the designs do not always respond as the designer thought they would.

Hence, the only way to really appraise this is to run tests on them and evaluate designs. This approach should be encouraged, instead of allowing a designer to put in anything he thinks happens to look good.

Mr. CONSTANDY. Thank you. I think there is a great deal of merit to what you suggest in the testing of designs before incorporating into the projects. I think there might also be something to be said for the fact that there is already some knowledge which has been derived as a result of research done by several people in California, Texas, and yourself, to confine it to the group here.

But we repeatedly see there is a failure of appreciation of the significance of what has been learned from the research that has been done already. You do not see it being applied, even those things already known.

Mr. ZION. Mr. Skeels, we have no standards or criteria established by which these designs could be compared? No standards or criteria have been established?

Mr. SKEELS. I do not know exactly what you mean, I guess. We have evaluated them—

Mr. ZION. I thought your concept of testing was certainly a valuable one, but would it not be preferable to establish some sort of standard by which these things could be compared initially?

In other words, rather than having each State participate in its own design testing and establishing criteria, would it not be wise if we could make some federally recommended criteria for design?

Mr. SKEELS. It would be good to have a performance standard available, which they should meet. There obviously are many designs that would be adequate, but they all have the same function to perform. If a performance standard could be developed, this would be good. As far as I know, there is no performance standard for many of these items.

Mr. CONSTANDY. Is it not true they are in the process of being developed? Is this work not being done by the new agency in the promulgation of standards?

Mr. PRISK, is this not one of the things that will be done by the new safety agency?

Mr. PRISK. This is the responsibility assigned by the legislation passed by the Congress last year, to develop performance standards for safety in highway design; yes, sir.

Mr. CONSTANDY. They will begin to come out the first of July; is that not true?

Mr. PRISK. Initial standards will, yes.

Mr. CONSTANDY. Mr. Huff.

Mr. HUFF. My back vision is always 20/20. I do not have quite that good vision looking ahead.

I have listened with great interest to the discussions and views of the pictures of bridges during the last half day. As I have noted down here, they consist of bad connections of rails to bridge ends, massive

end piers, too close undercrossing piers, poor delineation, low bridge railing and high bridge railing, and unpaved, narrow medians.

I believe that we could all agree that some standards should be developed that would cure the evils caused by those things that we have seen.

I also believe that most of the things we have seen will meet our present AASHO standards, which, of course, were not written in enough detail to cover all of the things that we have seen.

It is my opinion—and I agree with one of the gentlemen to my right, who said that we should have a design system that will include the entire road, including the bridges—it should be a system that connects the rail from the bridge to the road, a system that carries the median continuously across the bridge, wherever practical or possible, you might say.

Such design standards, in my opinion, should be formulated through AASHO being composed of the member States.

It is my opinion from contacts I have had with design engineers from a great many of the States, they subscribe to the standards set forth in the new yellow book, and are willing to turn to them for the solution of many of the problems we have seen here on bridges and other things.

I would like also to comment on some of the things that perhaps were not expressed in the discussions here today and yesterday. One is the width of the bridge.

It has been noted we should run the shoulders entirely across the bridge. There is no mention made as to how wide the shoulders should be.

If there is an acceptance of the 10-foot shoulder on the right and the 6-foot shoulder on the left, on our highways that are carrying vehicles where 85 percent are driven at 70 to 75 miles an hour, it is my opinion those shoulders are not proving to be wide enough, particularly the one on the left-hand side of the road, which is, as all laymen know, carrying the fastest stream of traffic. We are making those 6 feet wide, whereas those on the right we make 10 feet wide.

Of course the shoulder has two purposes. One is to clear fast traffic, particularly the traffic that gets out of control. The other is for refuge for broken-down cars; that is the reason for putting it on the right.

I believe protection to fast traffic is becoming just as important, and perhaps even more important, than the traffic clearance on the right-hand side. How wide these ought to be, I must admit, I do not know.

The widths that were selected, I believe, were selected on the basis of the subjective ideas of the people in AASHO who developed the Interstate standards back in 1956, and I must say that I was on the working level of the group that selected those.

They appeared to be wide enough then, but with faster automobiles and more powerful automobiles, I think such things as shoulder width and all of these other things should be taken up immediately, and the minimum standards raised to take care of the conditions we have now, which may not even be comparable to what they will increase to in the next 15 to 20 years.

I also noted in the successive stages of the projects that have been built, they are making improvements, perhaps not fast enough, but

the rank and file of these States that were shown are making improvements.

Mr. CONSTANDY. Yes. I think that is something we should bear in mind, Mr. Huff, being very careful to recognize this in looking at old work.

When we went to the newer projects you could see there had been some upgrading in standards.

I think we might reflect on how long it has taken, and the fact that the improvement frequently still overlooked something that should have been obvious to someone who had a complete understanding of the problem before they made the change. Mr. Huff?

Mr. HUFF. I have one more comment I would like to make. I missed it.

I certainly agree with tests and research. Observation of roads under operation is very important in this matter. I think that each State should spend somewhat more than it is now spending on testing and research, which consists of, I might say, plant research or observation of installations on the highways themselves.

Mr. CONSTANDY. Thank you. Mr. Wilkes?

Mr. WILKES. My comments are as follows, Mr. Constandy. I think I could say without any reservation that all of those bridges shown in the photographs, although they appear to be deficient in certain respects, were designed in accordance with existing AASHO bridge specifications, and that the designer was principally concerned with the structural adequacy of the elements that he has included in his design.

Mr. CONSTANDY. In the design of a bridge that stands up?

Mr. WILKES. Correct.

Mr. CONSTANDY. I think that should be recognized. Actually the area that we are concerned with here is whether you have a bridge that will satisfy the needs of traffic, and whether we have done as much as is possible to be done to provide the greatest degree of safety to the persons using it.

Mr. WILKES. That is correct, and if there are deficiencies, we should recognize them as early as possible, and revise our bridge specifications.

The second is, many bridge engineers, being men of strong convictions, do not agree that safety walks are dangerous. On the contrary, they believe that the restricted-width bridges should have safety walks.

However, in the light of the strong recommendation made by the AASHO Special Safety Committee, the majority of all States have revised bridge specifications now under construction to the extent possible to eliminate the safety curbs. Almost without exception the States have agreed to eliminate the wide curbs from the future designs.

Mr. CONSTANDY. If I understood the first part of what you said, relative to the safety walk, the bridge engineers have strong convictions they are desirable, but the new requirement in the yellow book will demand elimination in most areas?

Mr. WILKES. That is correct. They feel this finding of the safety committee is still an opinion; that they have not seen the evidence that it does constitute a hazard, and neither can they supply evidence that they are, in reality, safety walks. They are bowing to the will of

the majority, as I say, almost without exception, and are eliminating the safety walks from future designs.

There is a third fact that disturbs me quite a bit. We saw in the picture unprotected exposed ends of the curbs and I really could not justify in my own mind leaving this curb exposed.

To a vehicle, that certainly results in a disabling accident if it should run onto this curb. The car would have no chance to recover at all; and this could be improved at very small expense, to provide an adequate transition, or a much better transition. Apparently we are still making the same mistakes.

The last remark is that apparently there was inadequate coordination between the bridge designers and the roadway designers to produce the safest highway that can be produced from our present knowledge.

Mr. CONSTANDY. Do you know, Mr. Wilkes, for how long the AASHO standard for the bridge railing was in effect, up until it was changed recently?

Mr. WILKES. No.

Mr. CONSTANDY. It was for some years, was it not?

Mr. WILKES. Yes. I would say there was no change in the railing specification for a period of more than 15 years, until 1964 when the heavier loading was reviewed and approved by the committee.

Mr. CONSTANDY. Up until 1964, would a bridge railing built pursuant to the AASHO standard contain a vehicle on a bridge?

Mr. WILKES. I would say in a majority of cases they did.

Mr. CONSTANDY. If it is built only to standard?

Mr. WILKES. Built to design; yes. Most of the rails that performed badly would not even meet the then-existing design standards.

Mr. CONSTANDY. Of AASHO?

Mr. WILKES. Of AASHO.

Mr. CONSTANDY. If the bridge railing were built to the pre-1964 AASHO standard, it would contain an automobile if struck?

Mr. WILKES. Let me say in most cases the rail performed in an acceptable manner.

Now, certainly there are many instances where the vehicle did go through the railing, so I will not claim 100 percent performance, but most of the time it did.

Mr. CONSTANDY. You know, of course, we have no professional competence on this staff in the engineering field; we do not purport to have.

However, I have had many conversations with bridge engineers—dozens of them—relative to design strength of the AASHO standard bridge railing prior to 1964.

It was my impression, as a result of these conversations, that if they had answered the question, the answer would be no, it would not contain an automobile.

Mr. WILKES. Let me say that, as a result of this Highway Research Board Special Report 81, certain angles of attack and speed of the vehicle were prescribed for a bridge rail or parapet test.

I would agree that the pre-1964 bridge specifications for rail design, according to those specifications, would not contain a vehicle at the speed and direction recommended for testing in this bulletin.

Mr. CONSTANDY. That is apt to be a large percentage of the vehicles striking the bridge rail?

Mr. WILKES. No; I do not think all vehicles hit a bridge rail at a 20° angle at 60 miles an hour.

Mr. CONSTANDY. No, I would not suggest that, either.

We will get into this in somewhat more detail later in the hearing, because I think it is significant. Many States built bridge railings in excess of standards set as a minimum by the AASHO policy.

Mr. WILKES. I would agree.

Mr. CONSTANDY. We have to recognize there that the State has the latitude to exceed the minimums as set by the AASHO standards, does it not?

Mr. WILKES. Yes; it does.

Mr. CONSTANDY. In many cases States have done so?

Mr. WILKES. Yes; they have.

Mr. CONSTANDY. So, if we reflect on the projects which we have seen here in the nine States, the fact may be that they have been built, in the elements which have been analyzed, to the AASHO standards and still not be adequate, but the State is not precluded from going above those standards in providing a facility which would be adequate from a safety standpoint?

Mr. WILKES. That is correct.

Mr. CONSTANDY. Mr. Ricker.

Mr. RICKER. Several different organizations, particularly in the State of New York, have made extensive crash tests of bridge rails. Movies of these tests have been shown in several meetings, such as the Highway Research Board. To those of us who have seen the movies, there is only one conclusion: That we never want to hit a bridge rail.

There are just spectacular crashes, including such things as the motor flying out of the vehicle and over into the far side of the rail.

I think we might consider a little bit that the nature of limited-access highways is enough that it greatly increases the number of structures on a particular section of road. If you have a land-access highway, about the only time there is a bridge is when you are crossing a river, but a limited-access highway has many, many more structures, and this is perhaps why they are becoming increasingly important in accident involvement, and increasingly important that they be designed safely.

On the matter of connecting the guardrails into the parapets, I have been personally advocating a better design of this for some 10 years, based on direct observation of accidents and so on. I am all in favor of it, and I think they must be connected, and well connected.

One other observation. We may wonder why people run into bridge piers. I am speaking of the piers supporting the overhead structure, which may be only two feet wide. This looks like a small spot to hit. Certainly when it is drawn out on a plan, or from an aerial view, you wonder why anybody goes out of his way to run into them.

Actually, in appearance to a vehicle, they are 14 feet wide, if you have only 2 feet of concrete; because if the vehicle touches them anywhere, it is a head-on crash.

Likewise, you can compute they are about 400 feet long. If a vehicle wanders over the median anywhere within 400 feet, it is almost certain

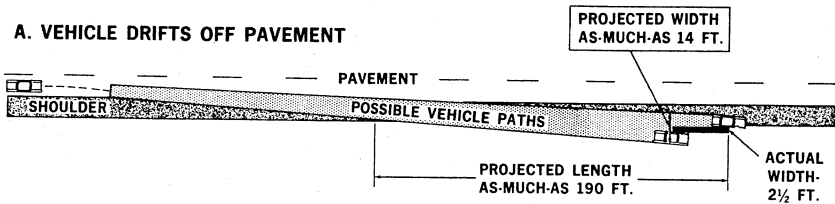
to hit the bridge pier. This is why they are suddenly so much more important than they used to be.

Mr. CONSTANDY. That is a very good observation.

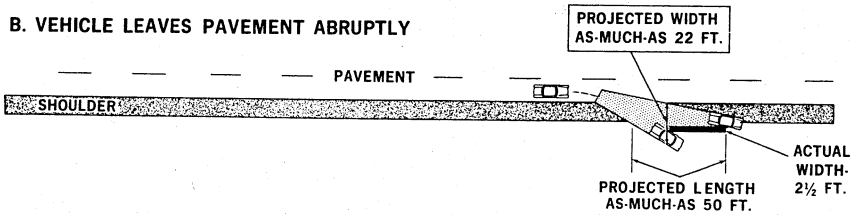
A chart illustrating the foregoing points is inserted in the record at this point:)

POTENTIAL HAZARDS OF TYPICAL ROADSIDE PIERS
~ PROJECTED VERSUS ACTUAL DIMENSIONS

A. VEHICLE DRIFTS OFF PAVEMENT



B. VEHICLE LEAVES PAVEMENT ABRUPTLY



What was your overall impression of the work you have seen on the nine projects we looked at, Mr. Ricker?

Mr. RICKER. I am afraid we have never really faced up to this matter of connections at the end of the bridge. Some people have advocated safety walks, some say eliminate the safety walks. Some say connect the guardrail in directly to the parapet, and so on.

There is no existing standard. I do not think that we can fault individual designers for not complying with the standards that exist. I think we do recognize there is a need for a connection, and we had better hurry up and get a good one.

Mr. CONSTANDY. Thank you. Mr. Prisk, I think we can now turn our attention to lighting. We have had, out of the nine States, only four which have lighting. The other five do not. The four which do have are Rhode Island, Georgia, Montana, and Oklahoma.

Perhaps, Mr. Prisk, you might begin our discussion on lighting.

Mr. PRISK. As you mentioned, Mr. Constandy, not all of the nine projects did have lighting installations. I think the matter of the lighting of a controlled access facility is perhaps still an unsettled matter, because there are bodies of information that suggest the importance of lighting in some situations, and in other cases indicate that on these newer highways where there are fewer obstructions, fewer opportunities to depart from a prescribed alinement, fewer opportunities to meet anyone at an intersection than under the normal city street conditions, that lighting is probably not as necessary and that headlights will do the job adequately. However, in those cases where lighting has been a feature of the projects we have been looking at, we have examined

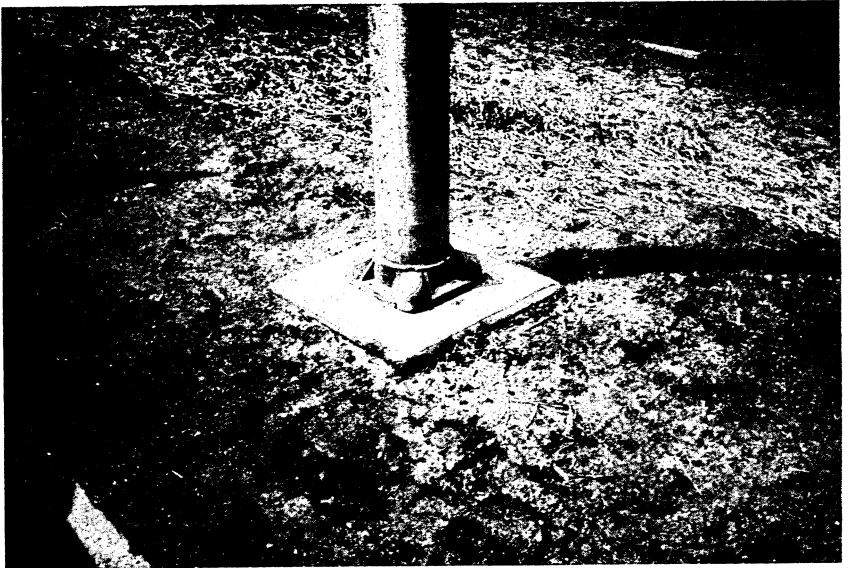
that aspect of design since it does relate to the general subject area of design efficiency and operation of the Interstate System.

Take a look at some of these observations now.

Here in Rhode Island, you first see a multilane facility installation of a fully lighted section where the luminaires are set 2 feet beyond the edge of the 10-foot shoulder making them 12 feet from this white line that you see here. This is common throughout the length of this project. They appear both on the left and on the right as you will see.



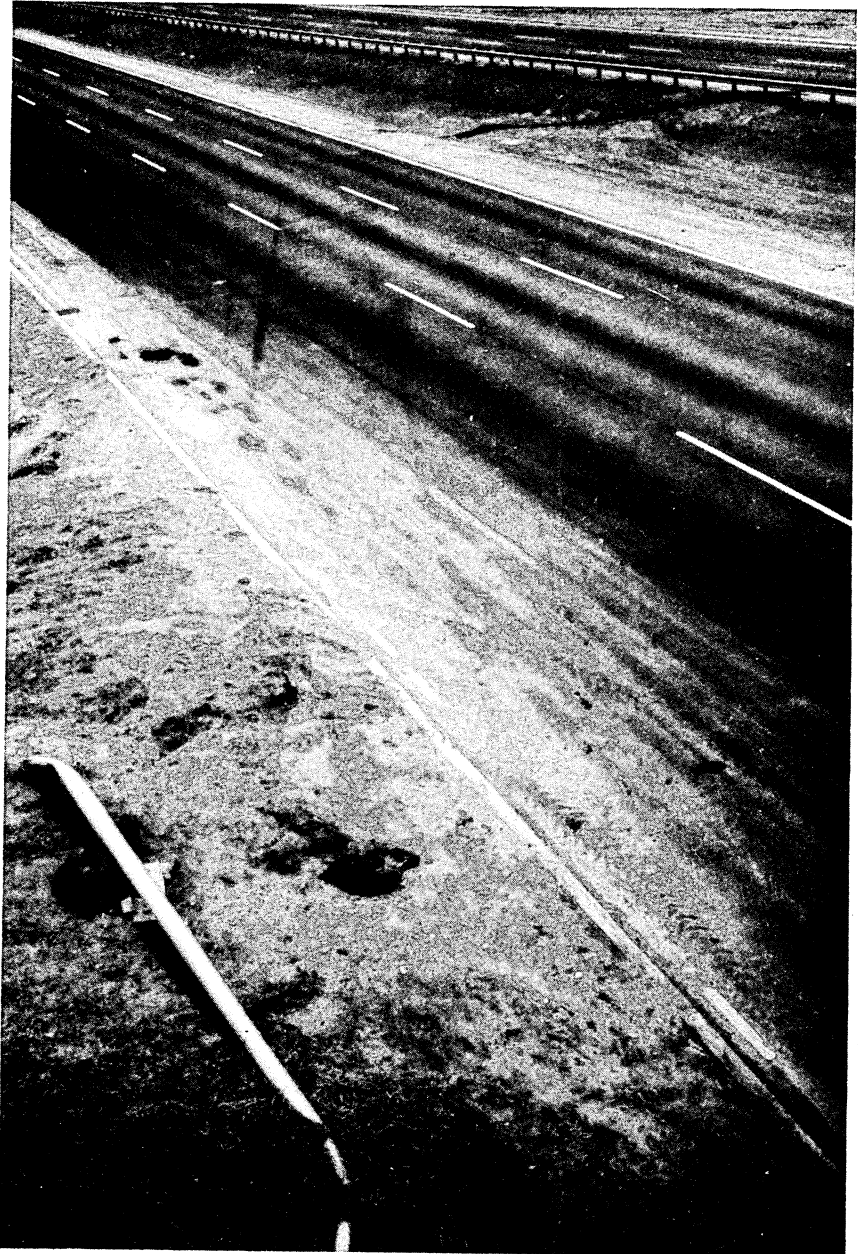
These poles are constructed so at their base they appear this way.



This is an aluminum pole and this is cast aluminum around the base here. This is concrete, built—desirably so— flush with the surrounding level of the ground.

So that is the Rhode Island installation we are looking at now.

These poles are rather frequently knocked down because of their nearness to the pavement. And this is one knocked down that we saw. This is the base at this point, out here [indicating], just 2 feet off the roadway. This is the position of the pole as it came to rest.



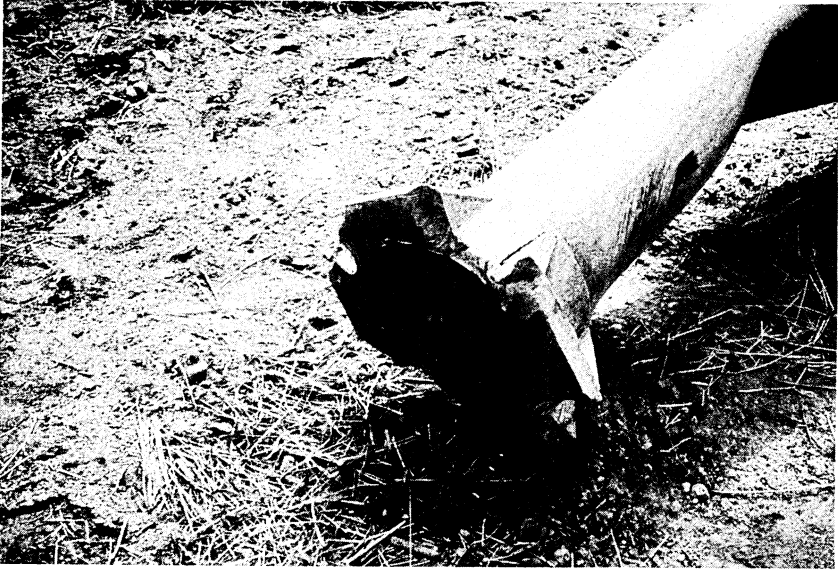
You can see the remains of the base. This is so constructed and wired that the pole breaks away at the base. Here are remnants of these little clip sections that go on the bottom. And the wiring is such that there is an automatic disconnect when the pole is knocked down.



Here is a closeup of the pole after it was hit, presumably an impact about bumper height, as you can see. And the pole is broken away here at the base.



Still another picture of that same pole.



Here is another location. In fact, during the evening that we stayed over there in Providence, this pole went down. We saw it working the night before and down in the morning when we first came out. So this is a very fresh situation, the car that went across the roadway here—you can see the skid marks after he hit the pole.



Pursuing this a little bit further with the authorities in Providence since that time, we were unable to find any accident report was filed for this pole knocked down at all. In other words, the driver apparently survived this breakaway-type pole accident with only damage to his vehicle and went on his way.

Here again is a closeup of that particular installation, the one most recently broken.

Mr. CONSTANDY. That picture shows something else, does it not, Mr. Prisk, the manner in which it is provided that the high-voltage lines will not cause an additional hazard by being broken. Could you explain that?



Mr. PRISK. Yes, I had mentioned that on the earlier slide, Mr. Constandy, that there was an automatic disconnect. These ends here and here pull away from the wiring inside the pole so that when it goes down, there is an automatic disconnect of the power, no opportunity for fires to develop or any short circuits in the line or even interruption of service to the other lighting units.

Mr. CONSTANDY. Mr. Ricker.

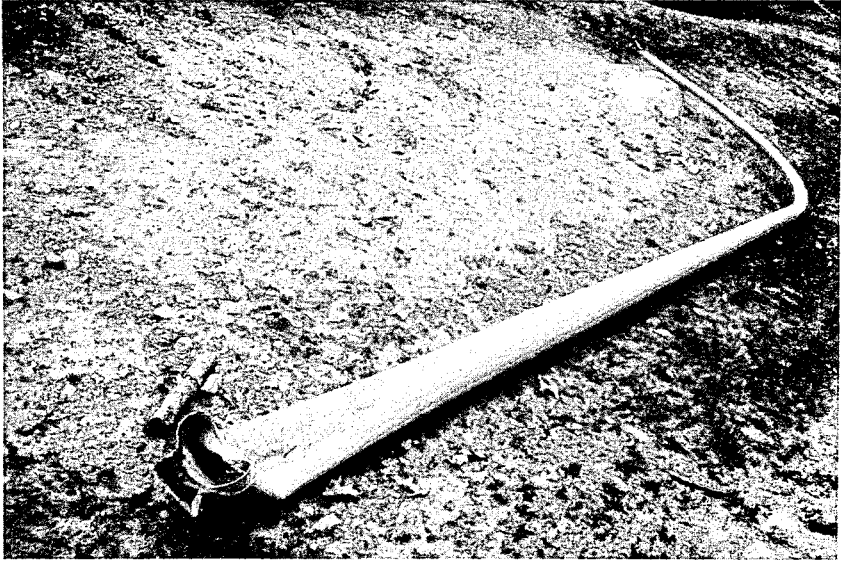
Mr. RICKER. You might note that that concrete base is about 2 inches out of the ground. That should be about the maximum, particularly when you consider erosion that may take place later on. Not having seen the pictures, I do not know whether you have some others that are higher. But I suspect that 2 inches is about the most that should be allowed to protrude.

Mr. CONSTANDY. Thank you.

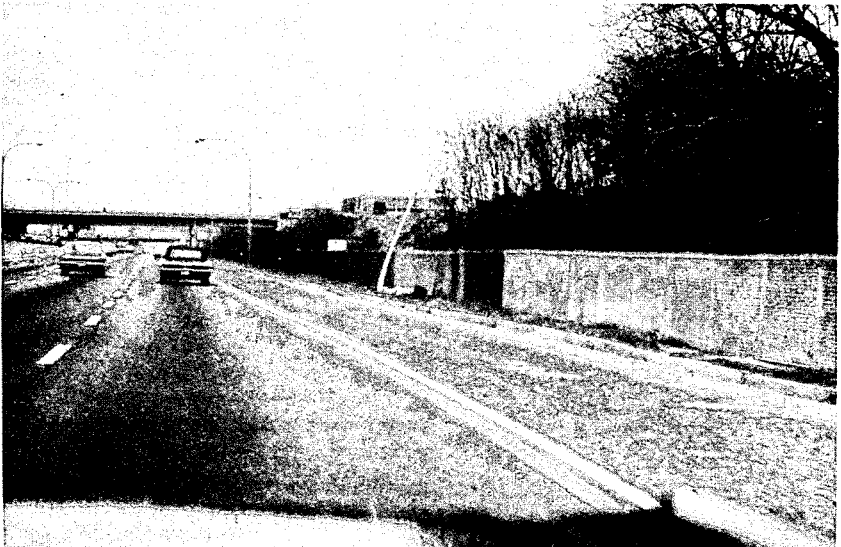
Mr. PRISK. Very good observation. Glad to have it, of course. Most of these I would say are limited to within 2 inches.

This is that pole knocked down showing the extent of damage there. Bending the lower part of this aluminum pole.

Of course, the luminaire itself, the glassware, is broken as it comes down.



Here is another one—this is off the project but still on Interstate 95—indicating a pole knocked down. It is rather interesting to us that in the very short distance that we are looking at here, we saw four or five light poles actually laying along the roadside as this one appears.



There is information available in other areas of the country that supports the desirability of having poles more than 2 feet off the edge of the paved surface.

In Chicago, on their expressway systems, there have been studies, paragon made of the rate of knocked down light poles on the basis of miles of travel, and we find that moving the poles from 4 to 8 feet away from the edge of the pavement will cut the light pole knockdowns by about two-thirds.



Here is an installation of the same type of pole behind the guardrail, the rail of course being put in here for this embankment.

Now, down here, let's take a closer look (slide) and at this same location you will find wood poles that are put up, and they are inside the rail.

Mr. CONSTANDY. They are not breakaway, are they?

Mr. PRISK. These are wood poles that are not intended to break away; no, sir. I might say this is on a spur to Interstate 95; it immediately adjoins the project, feeding the project, as a matter of fact.

Mr. CONSTANDY. This is apparently a temporary installation until that spur is extended; the lights are mounted on the wooden pole. Would you call them telephone poles?

Mr. PRISK. Yes. Utility poles.

Mr. CONSTANDY. Inside the guardrail. Here again we have somebody doing something wrong. While the State is to be commended for their efforts elsewhere, where they install breakaway light poles, whoever installed these wasn't thinking the same way as the man was who made the decision to use the safe breakaway light poles. This is an unnecessary hazard.

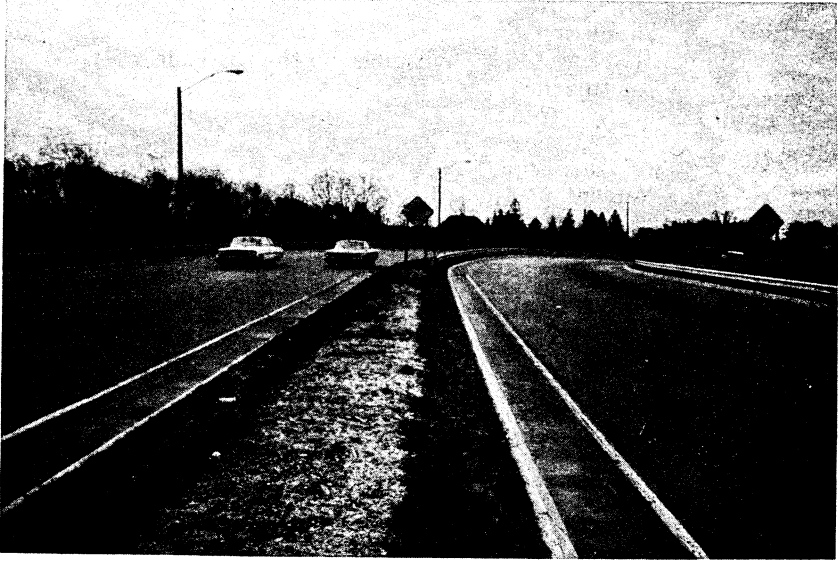
Mr. RICKER. Is it possible the wooden poles were installed by a jurisdiction other than lighting?

Mr. PRISK. It is altogether possible. It could have been a local jurisdiction.

Mr. CONSTANDY. Conflicting jurisdictions is another subject we will get into later in these hearings. It is one that comes up.

Of course, the motorist striking it is concerned only with his well-being, but that does present a problem and we will explore it further as the hearings develop.

Mr. PRISK. Here are some other pictures, in the same State again.



In this instance the pole is mounted in the median barrier showing how nicely this can be fitted in with concrete base essentially flush with the paved median barrier, and protected here by the guardrail.



Here is one over here, you see is exposed. The normal roadside condition is an exposed pole.

Mr. SKEELS. This is in a gore.

Mr. WILSON. I would like to comment on that last pole Mr. Prisk pointed out. It is on the outside of a curve. We found that this is not a good place to put a light standard or really anything else that might be hit. These could be just as well placed on the inside of places like this.

Mr. PRISK. Thank you.

As we move along, we find an obstacle, on the roadside, of this magnitude. I show you this picture first.

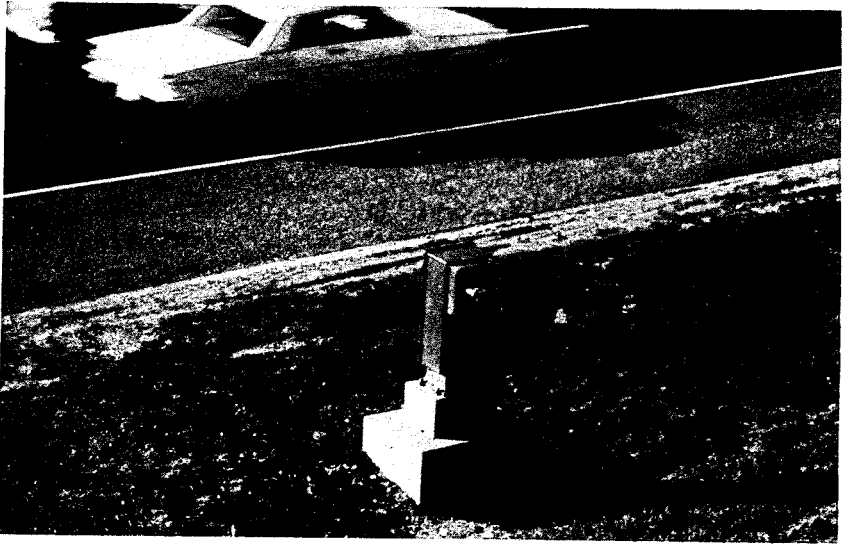
And then I show you this view of the same thing to give you an idea of where it is and its relevant size. This is the control system for the lighting that we are just looking at, and just dropped in here on a section of the tangent portion of I-95, all too close to the roadway. There is a slope, where this picture was taken, which rises up here and is clear perhaps within the right-of-way for possibly another 40 feet from that location. It could have been moved up the bank.

The only consideration I can understand for this location is that it is a little easier to get here and read the meter or service the equipment inside of the box.

Mr. CONSTANDY. It is unfortunate. Those two things were the only features which spoil an otherwise very good installation of lighting, the existence of that control box and the unfortunate existence of the two light poles inside the guardrail.

Mr. PRISK. That is true.





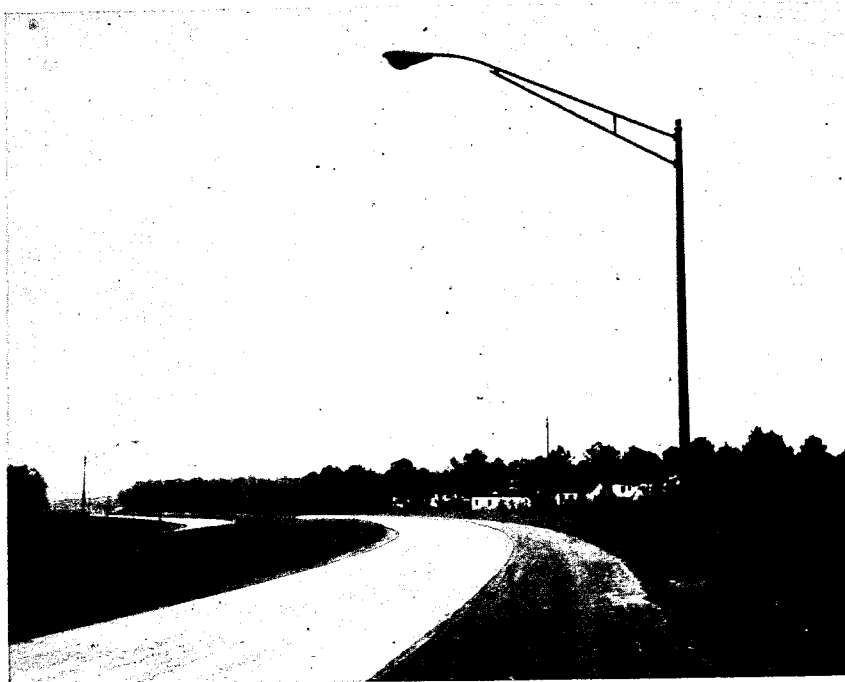
Experience with the control box system which they have has been relatively good.

Now we are in Georgia, back to the section that is near Atlanta, where light poles are installed at this distance [indicating] which will measure just about a foot to the edge of the transformer base.

This is not an aluminum or otherwise frangible base. This is a steel pole all the way.



Here are some of the things that Mr. Wilson mentioned, the same narrow clearance to the edge of pavement, and 1 or 1½ feet, possibly 2 feet at the very most, showing off the edge of that pavement the unprotected posts or base.



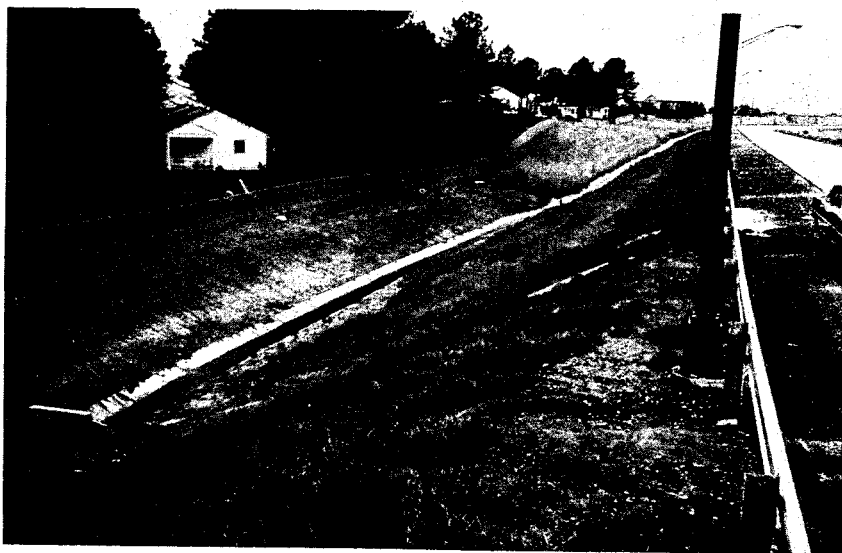
Here is one upon the parapet wall of the bridge which does afford the protection by the structure that is there.



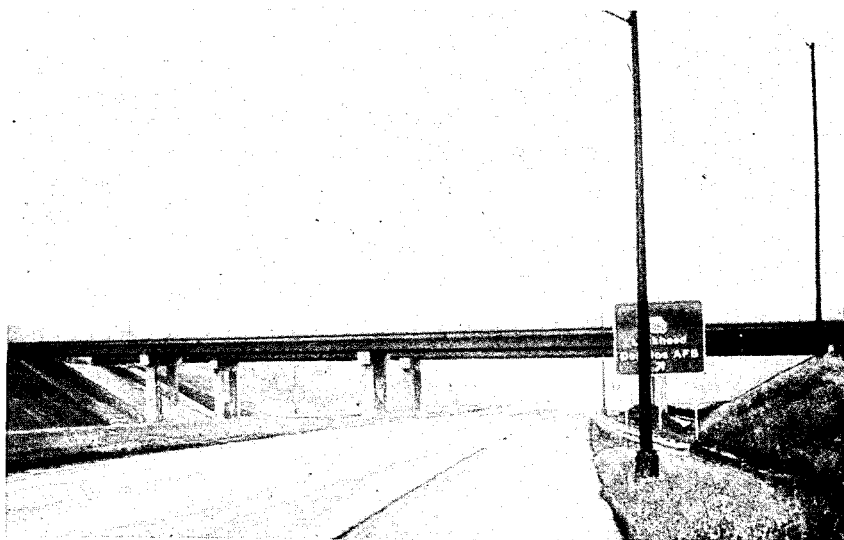
Here is one closeup showing installation behind the guardrail.

Mr. CONSTANDY. That is just by chance, is it not, Mr. Prisk? The guardrail is close to the bridge.

Mr. PRISK. The guardrail is not put in there in any sense to protect the pole. As we saw, the other random poles came outside the guardrail. This rail is in here on account of the embankment and the drainage system here.



Here now is the approach to the Dobbins Air Force Base north of Atlanta, and you will see the pole installation here, too. The guardrail beyond it is in to protect this sign and leading up toward the undercrossing structure. The light pole is exposed.



Mr. RICKER. Excuse me.

Mr. PRISK. Yes.

Mr. CONSTANDY. Mr. Ricker?

Mr. RICKER. This picture illustrates another problem, although it is only a picture that could be taken from a different angle. Oftentimes the light poles block out the proper view of the sign and they must be placed in relationship to each other or else one pole after another will block a sign so you cannot read it at all.

That would be another reason for moving the light pole back so as to get a clear view of that sign.

Mr. CONSTANDY. Thank you.

Mr. PRISK. Very good point.

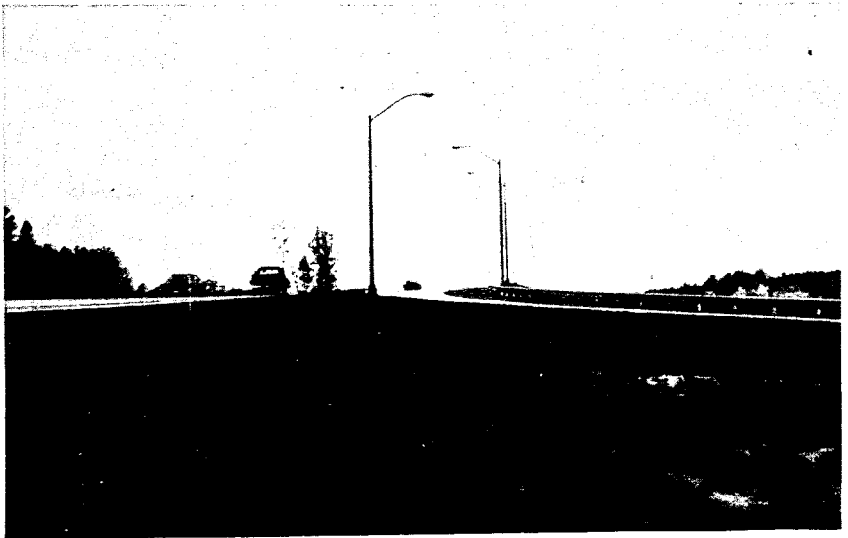
This is a typical installation. You will find at the entrance ramps on the project where there is the one pole put up here very close to the junction of the entrance ramp and the through roadway, and two poles put beyond that along the acceleration lane. This pole, of course, ends up being on the outside of the curve.

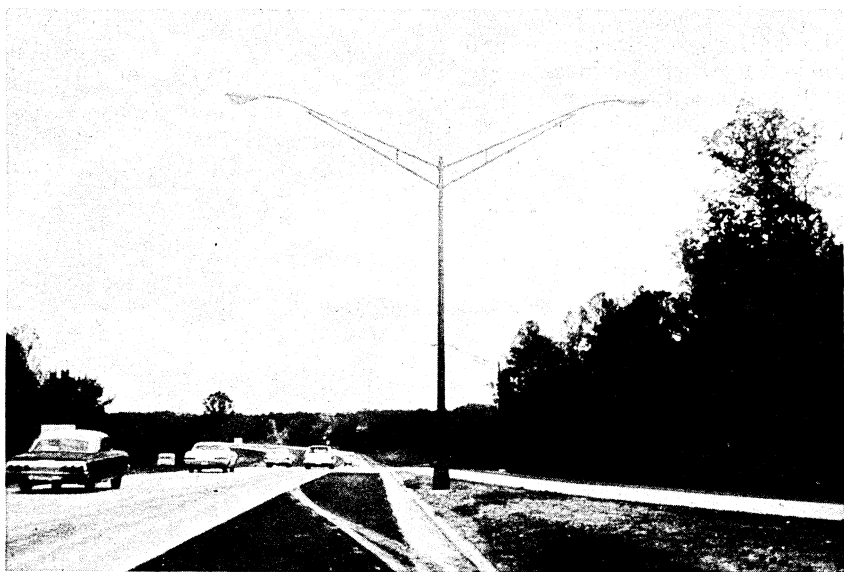
There are two here.

Mr. HUFF. Mr. Prisk, you mentioned horizontal dimensions on the light standard. What generally are the vertical dimensions, height above the road, and so forth?

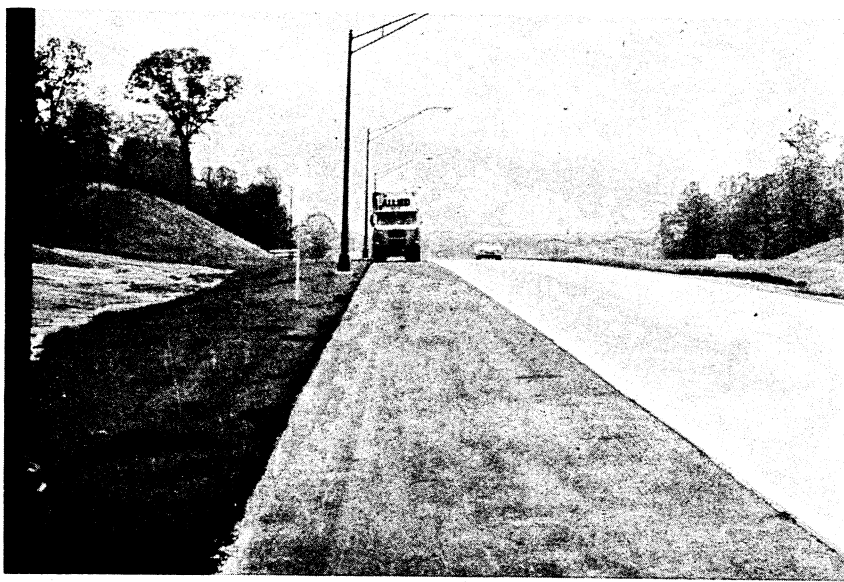
Mr. PRISK. These, I believe—I looked at the plans on these—I would only have to recall that these are about 35 feet above the roadway. Fairly high.

This is what you find in the urban section, entrance ramp coming in here and in this case a double luminaire mounting. This is in contrast to the previous picture where it is a single light over the roadway.





Here, as a truck stops, you can see something of the horizontal dimensions that we are talking about; the clearances from the side of the truck to these poles is so little that you might think that picture was staged. But that man just stopped there and we happened to get a picture of him.



This is brand new work off the project. This is identified with the south expressway running out to the airport. Came in past this and picked up these pictures at that time. So today, even though this is still under construction, this is what we have for light pole placement on that project, which is part of the Interstate System, also.



Here is another part of the same new work showing, rather interestingly, a deliberate placement of rail rather well back from the nose or gore decision point, which is about where the camera is, but interestingly enough leaving the light pole in here in an exposed position in relation to this rail that is going to be built around through here.



Mr. ZION. That is apparently not a breakaway type of pole either.

Mr. PRISK. No.

Mr. ZION. Is that a concrete foundation it is sitting on?

Mr. PRISK. Yes, sir, it is a concrete foundation.

Mr. ZION. Does this not cost more than the aluminum breakaway-type poles you were showing previously?

Mr. PRISK. They are competitive in most cases.

Mr. ZION. Again would this not indicate a need for establishing some Federal criteria for light poles as well as for placement of guard-rails, and tying them to bridges in highway construction?

Mr. PRISK. I think that it would deserve commensurate consideration along with these other items that you mention as far as the performance standards are concerned, yes.

I do not think that you need to limit materials to aluminum or steel. You can accomplish performance with either material. I do not condemn one or the other.

Mr. ZION. Certainly we are not fighting the concrete people, but certainly this is one of the danger elements that could be reduced in erecting light poles; do you not agree?

Mr. PRISK. If you are talking about that base, I fully agree, yes.

Mr. CONSTANDY. Congressman, you raise an interesting point, if you will allow a comment about the need for Federal standards to regulate some of this.

We will look at light poles and some of the other elements. You can have discussion and differences of opinion on whether it is feasible to remove the shoulder piers on bridges, whether it is feasible to carry shoulders across bridges that are a given length. You can get into some meaty arguments, I am sure, with people who may even have some proof for their point of view.

This, however, is a relatively simple thing. A light pole can either be put up to be frangible and save the motorist, or it can be put up in a very rigid fashion and the result would be likely to kill the motorist.

We have had testimony about light standards on the Capital beltway, on the Maryland section, which repeatedly, not infrequently, cause severe injury or death.

It is a simple election: You can either put one up that will withstand the impact of the automobile, or you can put one up which will give the motorist who strikes it half a chance to survive. There is no great argument here.

There is available a wide variety of types of light bases and poles. You can have an aluminum pole with an aluminum frangible base that is either mounted on a transformer base or the type you have seen here in Rhode Island. You can have a steel pole, steel base; it can be breakaway. You can have a slip-base pole—there is a wide variety to choose from. The prices are relatively competitive. It comes down to a simple thing: When you install the light pole you intend to give the driver of the automobile a chance to survive or you do not.

Highway departments should be able to decide this without AASHO standards being set, or threat of penalties for not abiding by standards set by the Federal Government. Here is an area, it just strikes me, that could be improved by highway departments without regulation, so that a light pole, if struck, will yield. I think it is distinctive in that respect. Mr. Huff?

Mr. HUFF. I would like to say that technology of highway lighting has advanced probably more rapidly than anything in our safety field.

Up until not many years ago, the general practice was to use illumination poles about 30 feet in height. One problem attendant to the low elevation was that you had to put the poles up near the edge of the road in order to light the highway. That is in particular where you had to light three or four lanes.

Now, that created the collision problems, which I believe have been found in all the States, of people running into light poles. That has proved in the past to be one of the most hazardous things we have had.

So to cure that, the highway engineers, in conjunction, of course, with the electrical people, have developed new lighting standards up to 45 and 50 feet high, No. 1, that will enable you to move farther away from the road. It will also enable you to use fewer poles than you had to in the beginning, and it will enable you to have fewer knockdowns, of course.

Incidentally, when you knock one of those down, it does cost money to put it back up and you want to have as few knockdowns as you can and as few replacements as you can.

The only problem that has come up is that many, many of the lighting projects are maintained by local jurisdictions. Sometimes it is difficult to get a local jurisdiction to purchase equipment or mainte-

nance equipment tall enough that will go up and reach these 50-foot height lamps. And that is one of the problems that most of us have been working on; we have been using frangible bases here for, oh, nearly ten years. We are well satisfied with them. So far as I know we have not had a fatal accident running into a frangible base, whereas we have had many fatal accidents on the old rigid-type base of which we are moving to replace all that we have.

Mr. ZION. Would this not suggest that we make these regulations sufficiently flexible that we do not become wedded to a specific distance from the roadway? For example, rather than establishing 4 feet, 8 feet, 10 feet, and so forth, in a situation such as this, by moving the light pole back a mere 4 or 5 feet, you would have it behind the guardrail and thus not accessible to an automobile that inadvertently left the paved surface.

Mr. HUFF. In my opinion, sir, the frangible base should be there whether it is in front of the guardrail or behind it.

Mr. ZION. Sorry, I did not understand you.

Mr. HUFF. In my opinion, the frangible base should be installed whether it is in front of the guardrail or behind it. The extra cost would be negligible, if any.

Mr. ZION. Oh, yes, certainly. I agree to that.

Mr. HUFF. I agree with you we should not have rigid standards as to just how far it should be away from the road; I agree with you on that.

Mr. ZION. That was the point.

Mr. CONSTANDY. And the point Mr. Huff made was very good. The fewer targets you can have on the roadway the safer the driver is going to be. The farther they are from the travelled way, the less likelihood there is of striking them. They certainly are two valid considerations.

To go back to the other end of the poles, the rigidly mounted base does kill people. It is killing people daily in this country. And the States that have seen the wisdom of putting in something else—New Jersey, as an example has replaced many thousands of their light poles with breakaway, one type or another; they have had no fatalities. In Rhode Island they had had no fatalities. One witness was telling us how pleased he was with that type of installation, the breakaway light pole. They are not killing people. Yet in looking at some of the new work in the United States—this one, as an example; we will see another—you find the most recently completed project with a feature which could be changed with relatively little difficulty. They are open to traffic, people are using the highways and you can rest assured people are going to be killed when they strike these light poles.

Is there anybody who would suggest any reason whatsoever for there not being a standard that the light poles on the Interstate System be breakaway type? Is there any reason at all to argue against that? Is there any justification?

Mr. HUFF. I say there is no justification. It ought to be on all systems, whether Interstate or not. Any time you build one, it should be frangible, in my opinion.

Mr. CONSTANDY. Yes. Very valid point.

Mr. PRISK. The Texas Highway Department, Mr. Constandy, has recently completed a report of the effectiveness of the breakaway light

poles and the relative ease with which existing fixed installations can be converted to breakaway. Bureau of Public Roads has picked up this report and circulated it to all the highway departments for that information.

Mr. CONSTANDY. Yes. I think we have a slide here that will follow which will show how this lethal thing we see in the picture before us can be converted to a type which will minimize the impact when struck.

I am a great believer in the laws of probability. If something can happen, it is going to happen if it is given enough exposure.

When you are talking about a highway which has traffic volumes that ran 100,000 and 140,000 and 150,00 cars a day, it doesn't take long until you get up into the numbers where the laws of probability will come into play, somebody will strike the light pole. They will survive or not, depending on the foresight of the highway department in installing the facility that will give him half a chance when it happens.

Would you go on, Mr. Prisk?

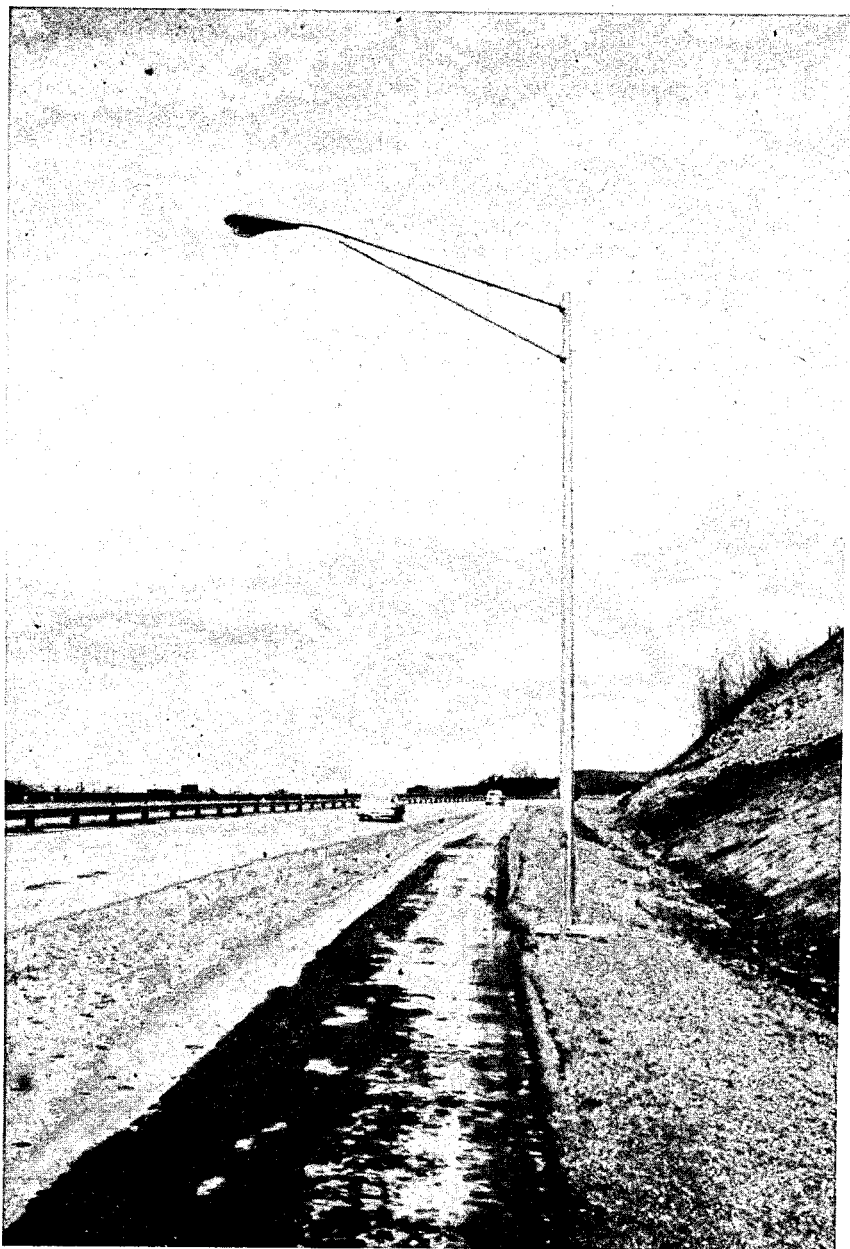
Mr. PRISK. Yes.

Here now, this is rather disturbing, because this is an old project, and look at the position of the light poles here. They are, in fact, farther off the roadway traveled surface at this location. This is a curb section rather closer to Atlanta than the subject projects we looked at; nevertheless it is not too comparable [slide] with this situation, also close to the city of Atlanta and much newer.

Here we are on an older project with poles farther away and therefore less hazardous than some of the work being built today.



Shifting now to the scene out in Montana, here is a single shot of a light pole installation there. Here again we have a rigid fixed pole, steel pole, mounted in a concrete base, 4 or 5 feet deep, right here at the road edge, with barely 11- or 11.5-foot clearance from the edge of the traveled way. This is a nice light pole installation from an appear-



ance standpoint, but it can be a very severe hazard for anyone who drives off the roadway.

Mr. CONSTANDY. It could kill you, to be less polite?

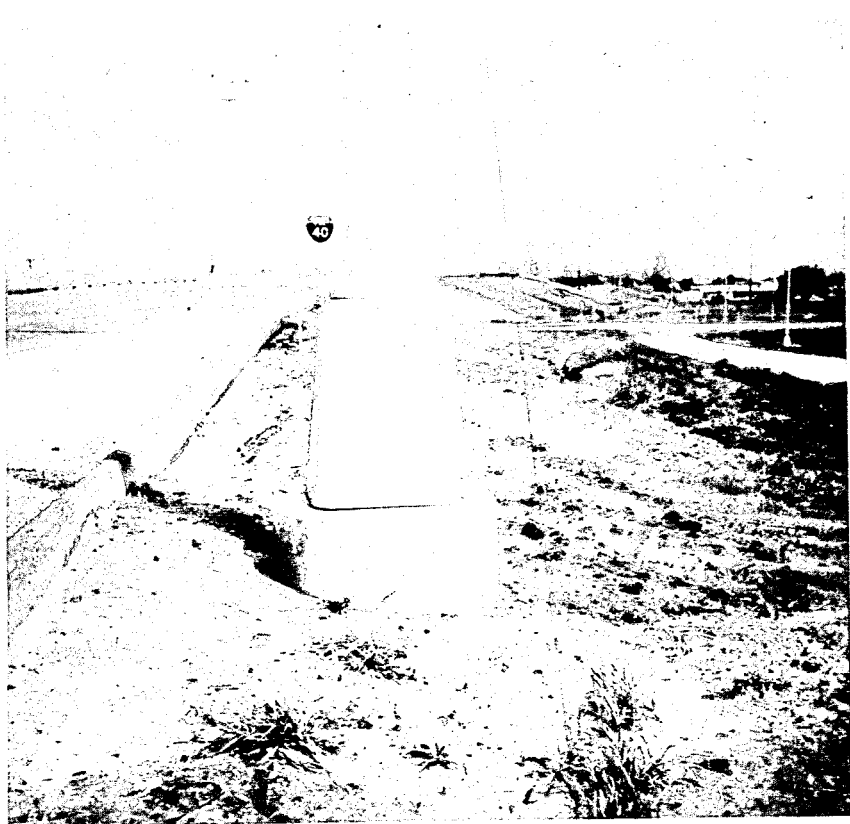
Mr. PRISK. Right.

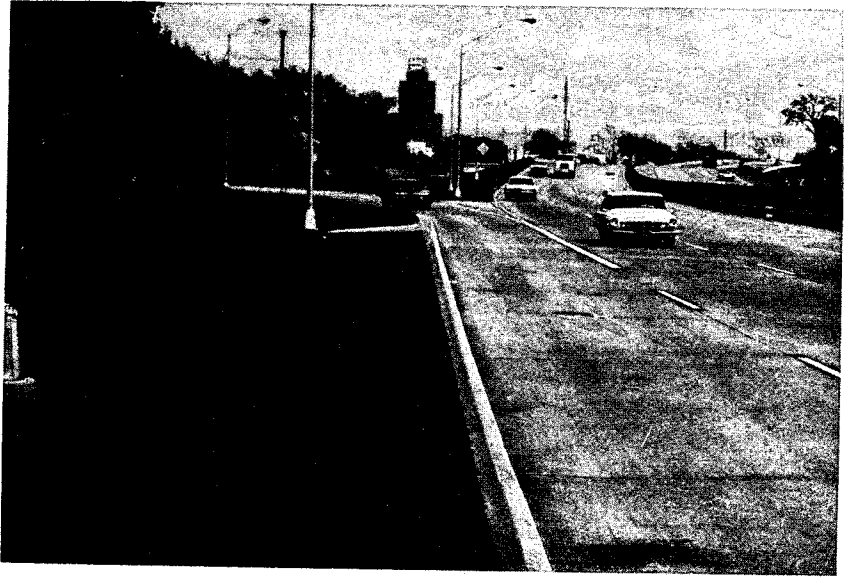
Here now is an installation in Oklahoma City. This is a frangible base and this is one of the ironies that you run into—I hope you don't run into it—but it is one of the ironies of the situation.

A steel pole, frangible base, and a nonfrangible footing underneath it. So that if you can get into this one, which is also 2 feet away from the edge of your paved surface, you have to contend with 8 or 10 inches of concrete.

Most cars underneath, for the record, will clear about 5 inches of concrete. Eight or 10 inches is too much.

This, too, is in Oklahoma City. We will see the breakaway or frangible base section poles here all the way along. Parts of the installation we will see later are a little bit different. Here is one, here [indicating].

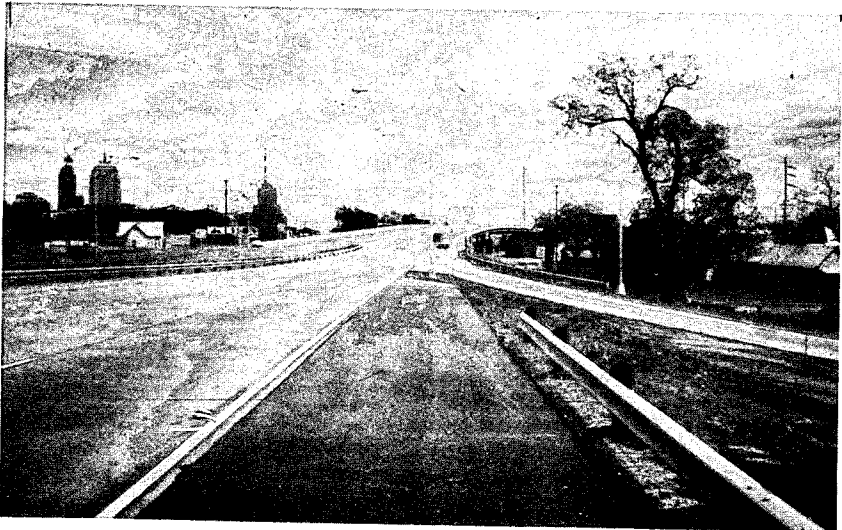




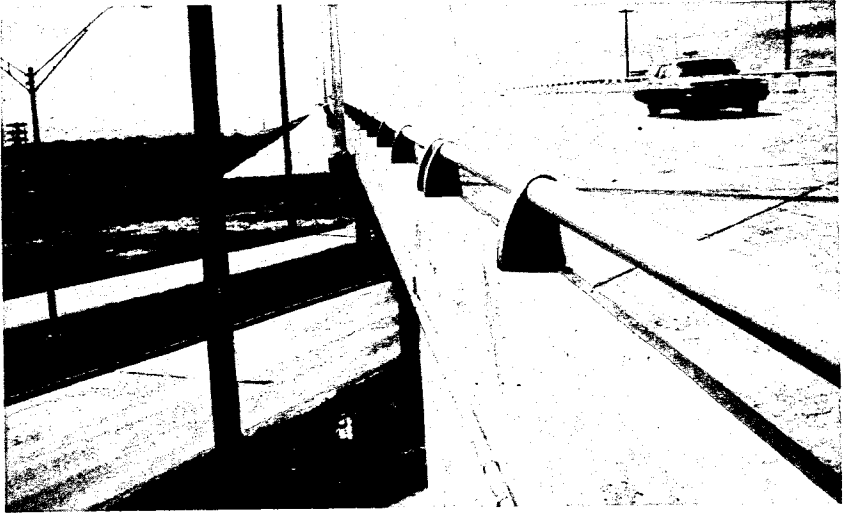
This is something we will be discussing a little later as we get to consideration of shoulders and curbs, but here the shoulder is cut off in order to permit this advanced roadway to come onto the main line, and the light pole is mounted at the end of the shoulder. You cannot continue through there without having to take down that light pole. Frangible or not, I think most of us would rather not hit it.

Mr. CONSTANDY. I think in the preceding view you had a similar situation, did you not?

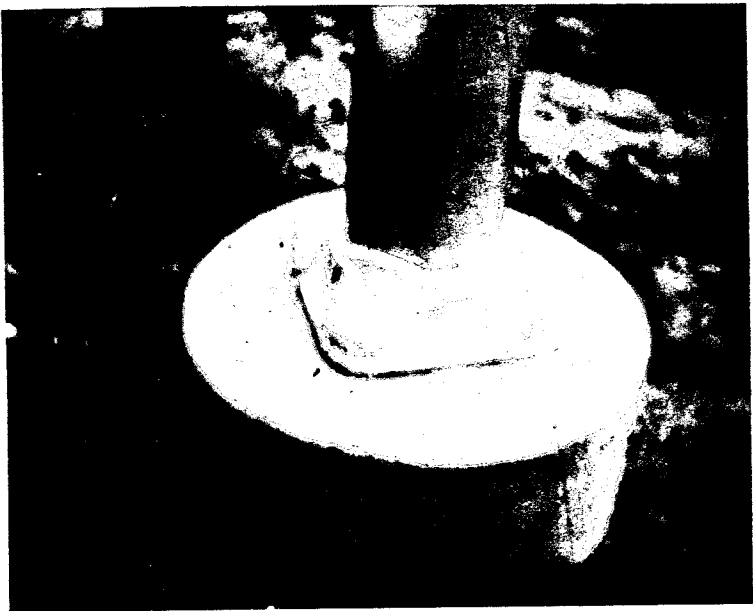
Mr. PRISK. Yes.



Here, too, is something that can be commended. In addition to the frangible pole, here the structure has been altered so as to permit the light pole to be erected completely away from the roadway and behind the bridge rail itself.



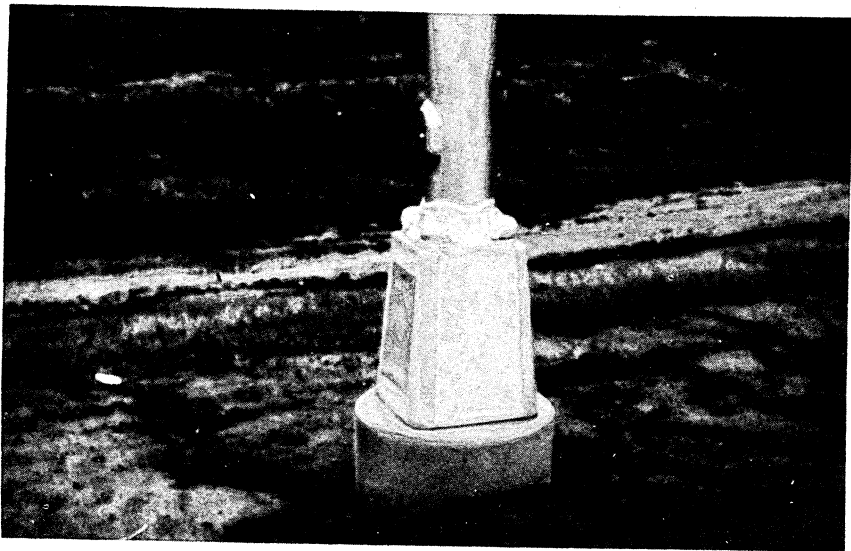
This is a steel pole of the type that was prescribed on this Oklahoma project. All of these frangible base installations that we saw were introduced as a result of field change while the project was being constructed. And here again this is a project just opened at the end of last year. This is a steel base pole on a concrete footing.



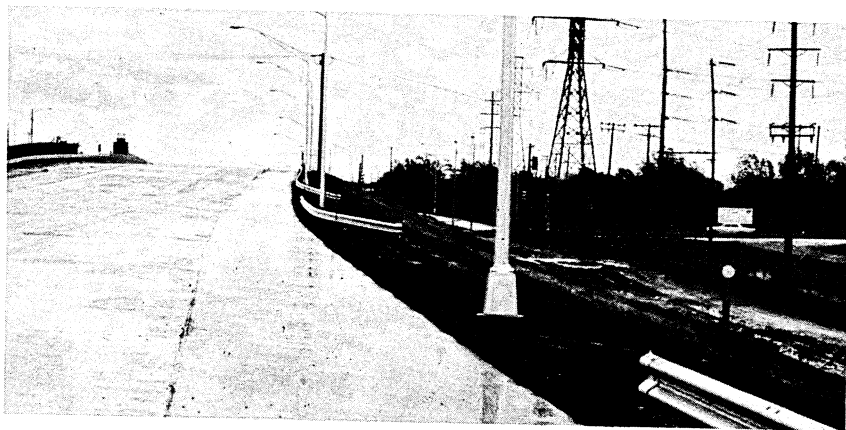
Mr. CONSTANDY. So it is possible, then, late in the project, to make a field change and correct what otherwise would have been a hazardous deficiency?

Mr. PRISK. This was done, that is true, to the credit of the State and the Bureau of Public Roads, whoever it was who initiated the change.

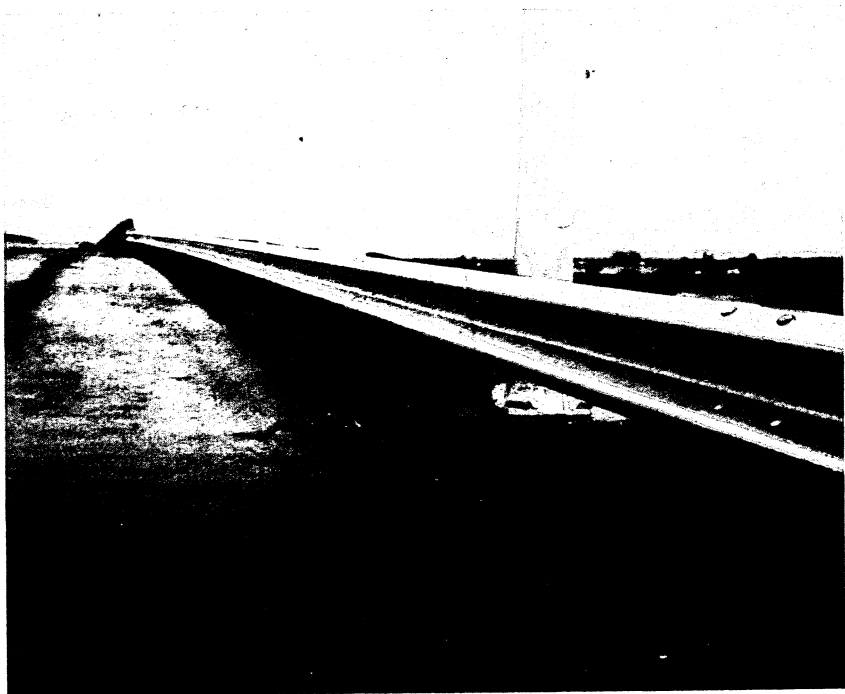
By contrast with the steel pole, of course, this is the newer break-away-type base. You will see the footing so high, however, as to create a hazard of its own, particularly in this sort of soil that adjoins the paved shoulder.



In this project, the field change was limited to taking care of these poles that are not behind guardrails. This pole [indicating] in other words, would be a normal pole with a normal base, steel base, and mounted in the concrete as usual, where I showed you the closeup. Here is the exposed pole which does have the frangible base.



And this is the other complementing condition, steel pole, steel base all the way down behind the rail, slight exposure of the footing.



Now moving to Ohio, and taking a quick look at I-71, which is not the project that we selected but the one recently completed, we find poles mounted again very close to the edge of the pavement.



In some instances they are protected by short sections of rail that they put in for other reasons.

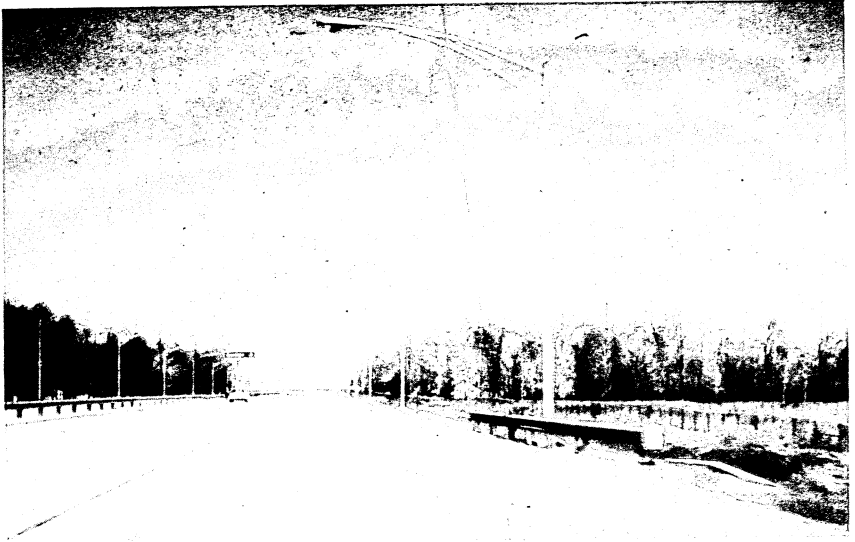
Here, there is a headwall drainage under the roadway, and the pole is located at that point. Another one up here is exposed.

Mr. CONSTANDY. Is that a breakaway-type pole, Mr. Prisk?

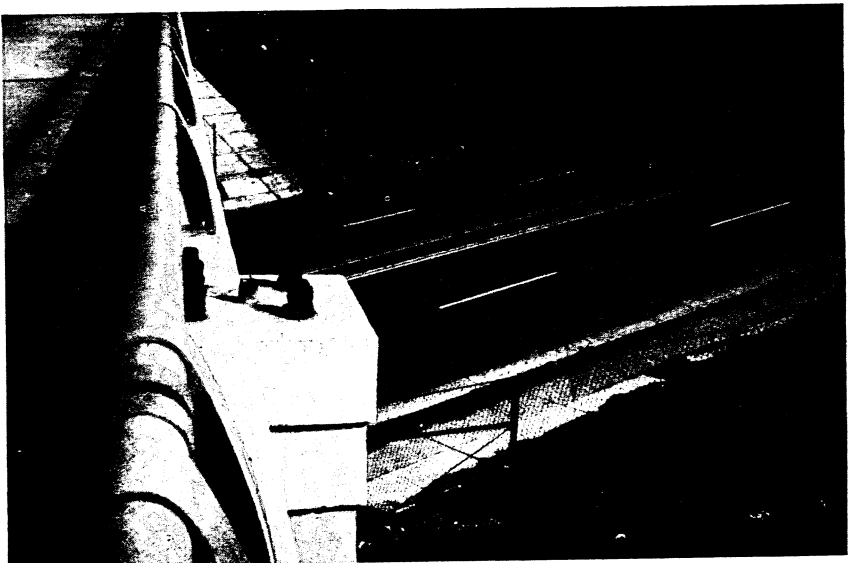
Mr. PRISK. This is a breakaway-type pole.

Mr. CONSTANDY. The one in Ohio?

Mr. PRISK. Yes.



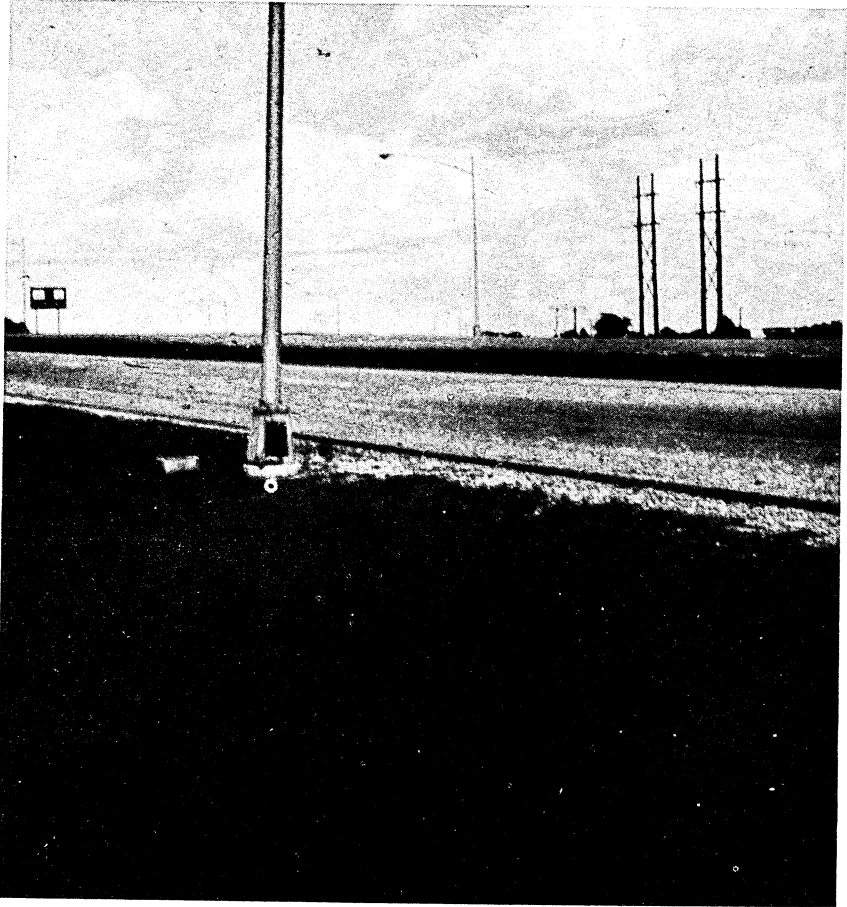
Here is the evidence in Salt Lake City of provision for putting in future lighting, indicating someone was thinking well ahead to the day when you might want to undertake something as we saw had been already done. In other words, putting a light pole outside the structure.



This is the Texas installation.

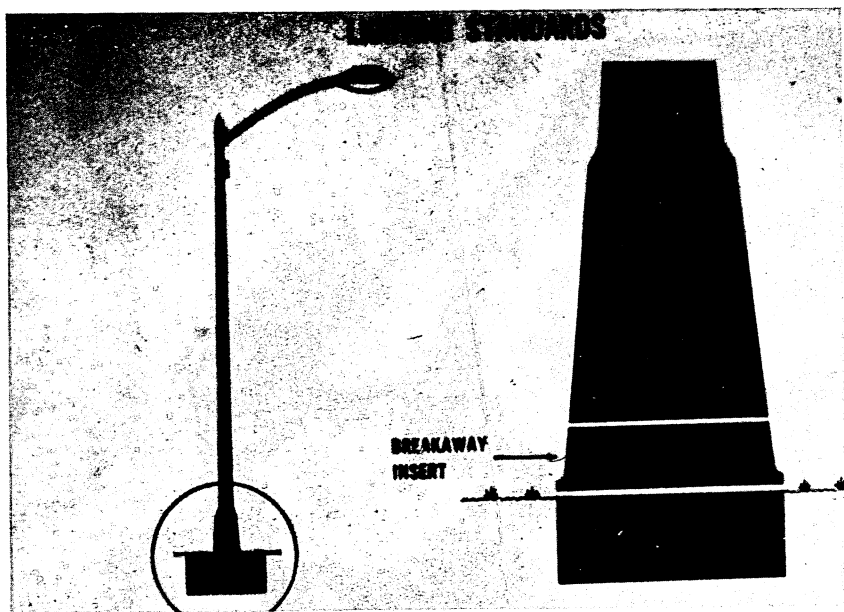
Mr. CONSTANDY. Yes. We were grateful to Mr. Huff again for having brought some slides with him.

Mr. PRISK. We would run out of slides, I am sure, if we didn't have these. I would be very happy to have Mr. Huff talk about this, if he will.



Mr. HUFF. I do not know what else you have. Suppose you proceed, if you will, Charlie.

Mr. PRISK. Well, we have a few in here. This is the way it appears, general appearance.



This is a slide simply to illustrate the very ingenious way that they have begun to convert their system of previous poles that had steel bases and are steel all the way, to include this minor section here that can be introduced in the support system at the base of the pole.

The next slide I think shows this even better. This is the breakaway section down here. This is frangible. It is steel, will not give. But upon impact with this surface, this section tears out and the pole falls harmlessly over the top of the car.

Mr. CONSTANDY. Is that a relatively inexpensive modification, Mr. Huff?

Mr. HUFF. We installed some of those with maintenance forces for about \$25 apiece. That is material and labor both. On the contract jobs that we have let, it cost a little bit more.

Mr. CONSTANDY. So it is well within reach for the amount of safety that is being bought.

Mr. HUFF. Yes, of course. We ran considerable numbers of tests, Texas Transportation Institute did, prior to putting these into operation. We also installed some to observe. We had, oh, two or three accidents. They were safe accidents, no damage except the pole had to be put back up and nobody was injured in the accidents.

Mr. PRISK. This is one of the things that you can convert at relatively low cost. Some of these other adjustments we talked about are more expensive.

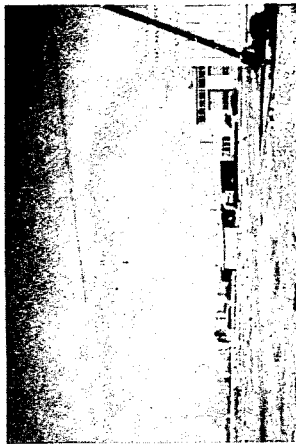
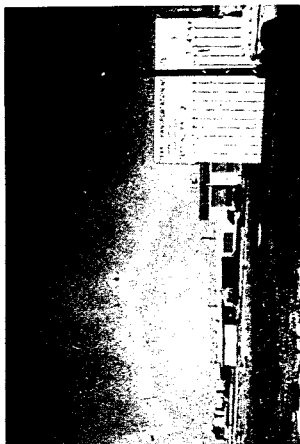
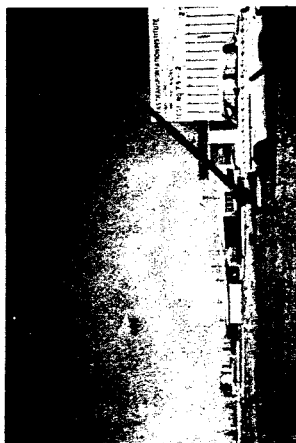
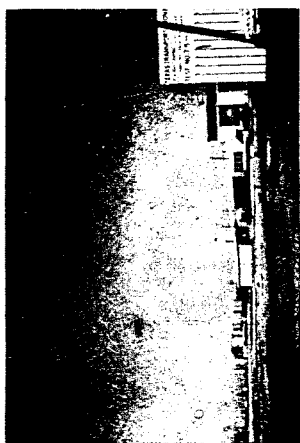
Mr. CONSTANDY. If you could run back through these we would have the effect of a movie. It depicts an automobile striking that type of light

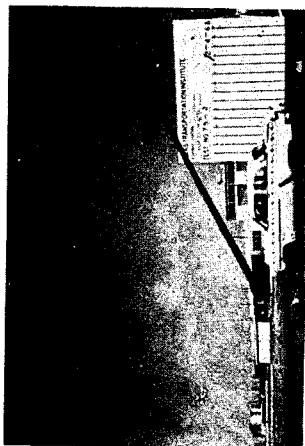
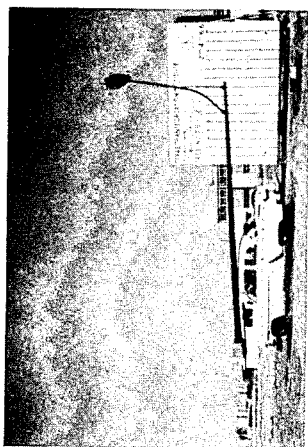
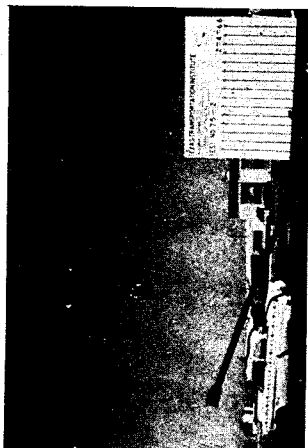
pole in research done at Texas A. & M., Texas Transportation Institute.
Is that correct?

Mr. HUFF. Yes.



Mr. PRISK. A series of shots just before the car reaches the pole. Of course, this is the attitude of the pole and the car.





It strikes the pole ((Texas) slides) continuing through the impact. (Slide.) This is what happens. (Slides.) Breakaway occurs. (Slides.) The pole is completely in the air, over the top of the car. (Slides.)

Mr. CONSTANDY. Very good.

Mr. HUFF. The vehicle was traveling in the neighborhood of 60 miles an hour for that test.

Mr. CONSTANDY. Thank you, Mr. Huff.

That would conclude the presentation we had on lighting.

I would like to ask the members of the panel to comment on what they have seen.

Would you begin, Mr. Wilson?

Mr. WILSON. I do not see how this can be a controversial item at all. I think it is just plain commonsense that there are a couple of things you can do to lights and you do not have to specify the type of pole, providing they use some kind of frangible or breakaway base.

Largely through the work, testing work of other States and General Motors, we have adopted a frangible base for our steel light poles that we now use. We are doing this on new contract work and are going back on the existing installations that we have.

To give you an idea of what the magnitude of the problem would be in California, we have in past years lost about 20 lives by people hitting light standards.

Mr. CONSTANDY. Each year?

Mr. WILSON. Each year. We think this is so serious that we have taken the steps that I have just mentioned, largely through the research efforts of others.

We have also moved our light standards back from a position that you saw in some of these slides back to 18 feet from the traveled way. We have done this by going to a higher light pole and using a longer mast arm. This has given us probably better lighting and with the new developments in the lighting itself, we are able to get, in the gore area particularly, a single light doing the job that we normally had two lights doing. So this right off the bat cuts out one fixed object which formerly was beyond the gore area and in a very vulnerable position.

One thing I would like to mention in connection with lighting is its interference with signs but in just a little bit different light than Mr. Ricker previously mentioned. That is that improperly placed luminaires can place glares on existing signs and prevent their being read properly.

When I first saw these slides, I felt——

Mr. CONSTANDY. Which is right now?

Mr. WILSON. Yes. That is correct. I thought that we had conquered the problem of having raised bases, these concrete bases, but as the slides went on, I saw that apparently the States have not conquered this problem.

I might point out the yellow book is very specific in this regard: that bases, concrete bases of all kinds, whether for light standards or signposts or whatever they may be, should be flush with the ground and no higher.

I think that is about all the points I would like to make.

Mr. CONSTANDY. Thank you. Mr. Skeels?

Mr. SKEELS. The location that we see on these light poles being so close to the road is probably the result of the fact lighting is specified by the lighting engineer, and his primary purpose is to light the road. This is his job. And he specifies a distance that is dictated by lighting requirements and not by safety requirements.

I have talked to some of these people and they recognize that they are putting a hazard there but they do not put much weight on the seriousness of the hazard.

Data we have gathered at the General Motors proving ground indicates 47 percent of the cars that leave the travel surface go more than 12 feet from the edge of the travel surface; 18 percent of them go more than 30 feet from the travel surface. At the proving ground we do put our lights 30 feet from the travel surface. And we do not use them on high-speed roads. We have never had one hit.

I would think that 20 to 30 feet would be a very reasonable thing.

The lighting engineer is going to take some loss in efficiency of lighting. I do not think he can do as good a job with a light pole this far from the road as he can up where he would like to have it. But we may have to take a tradeoff of lighting efficiency versus safety.

Mr. CONSTANDY. It might inspire them to do research in that area and perhaps come up with one that would be as effective.

Mr. SKEELS. I think maybe they already have. As has been indicated, there have been big advances in this field recently and at the proving ground we just arbitrarily told them how far away they had to keep the lights from the paved surface and they should do the best they could with this ground rule.

In any case, regardless of how far it is from the surface, if it is in the position where it can conceivably be hit, it must have a slip or a frangible base. This is primary and all light poles should be designed with this in mind.

I might point out there is an NCHRP project in the final process of being let—this is administered by the highway research board; it is initiated by AASHO—to look into the best way of accomplishing this or the best ways of accomplishing or of making light poles safe.

Texas uses the frangible base insert. Some States are using an aluminum transformer base which is frangible. And we are using a slip base which was developed from the Texas A. & M. signpost approach.

We have done testing work for the State of Michigan in applying the slip bases to steel posts. It appears to us that the slip base is slightly more effective than the frangible base, but either one of them will save lives. I am not implying the slip base will save more lives than frangible base, but it will do less damage to the vehicle and possibly to the occupants. Either approach appears satisfactory.

Again, all light poles should have one or the other.

Mr. CONSTANDY. Thank you.

Mr. Huff, would you care to add to the remarks you made before?

Mr. HUFF. I would like to correct the record a bit.

Texas uses the frangible transformer base on all new construction and has for some 5 or 6 years. Prior to that we had about 4,000 installations with a steel base. That is the rigid base made of steel. We are adapting the insert to correct that condition.

I would also like to dwell just a moment upon and expand on new ideas Mr. Skeels mentioned. We are working in our Texas Transporta-

tion Institute laboratories on a slip base. We do not know what possibilities it has. I do individually believe this is so new that we should not tie ourselves down to any one form of breakaway light bases. We should all keep working on it to improve on what we have now, which itself is a great improvement over what we had previously.

Mr. CONSTANDY. Very fine. Thank you. Mr. Wilkes?

Mr. WILKES. I agree with all the comments made by other panel members.

I have an observation that in some of those cases where the concrete base is exposed that condition could be corrected by just a small amount of mound of earth around the base.

Mr. CONSTANDY. For reasonable effort and money, they could correct what is now an undesirable situation?

Mr. WILKES. That is right. An alert maintenance man could correct this condition at practically no cost at all.

I am trying to recall from memory but I feel certain that this memorandum of Mr. Turner's that was previously introduced into the record contains the statement that on future Federal-aid projects, the lighting standards should be provided with a frangible or breakaway base. Mr. Prisk could probably check that.

Mr. PRISK. I am not sure it is in here.

Mr. CONSTANDY. Thank you, Mr. Wilkes. Mr. Ricker?

Mr. RICKER. One comment we picked up on the AASHO safety tour last year was that it is practically useless, perhaps hazardous, to put a short section of guardrail in front of a light standard. It is better to hit the light standard than it is the guardrail. The guardrail does not prevent the accident.

I might note the draft standards of the Federal Highway Safety Bureau seem to call for much more use of roadway lighting than most States have done in the past. And this will inevitably cause many more poles to be installed, so that we have to have good design for them.

At the same time, there is no money provided in that program for the installation of this lighting which means that many jurisdictions will be trying to save money and perhaps put in the short mast arms and get the poles too close to the road.

Mr. CONSTANDY. The curse of the first cost versus economics?

Mr. RICKER. Right.

Mr. CONSTANDY. Thank you very much.

Mr. Prisk, will you begin, now, with the segment that contains the signs? I would like to mention here we are concerned with the sign element purely from the standpoint of the mounting of the sign, location of it, and support for it, but we are not at this time particularly concerned with the message on the sign. We will have another segment of the hearings at some later time when we will be concerned with the message.

Improper messages are like waving a red flag to traffic engineers and I realize it. But could we just contain this to—except when you really feel you must say something about the message—the mounting and location?

Mr. PRISK. Thank you, Mr. Constandy.

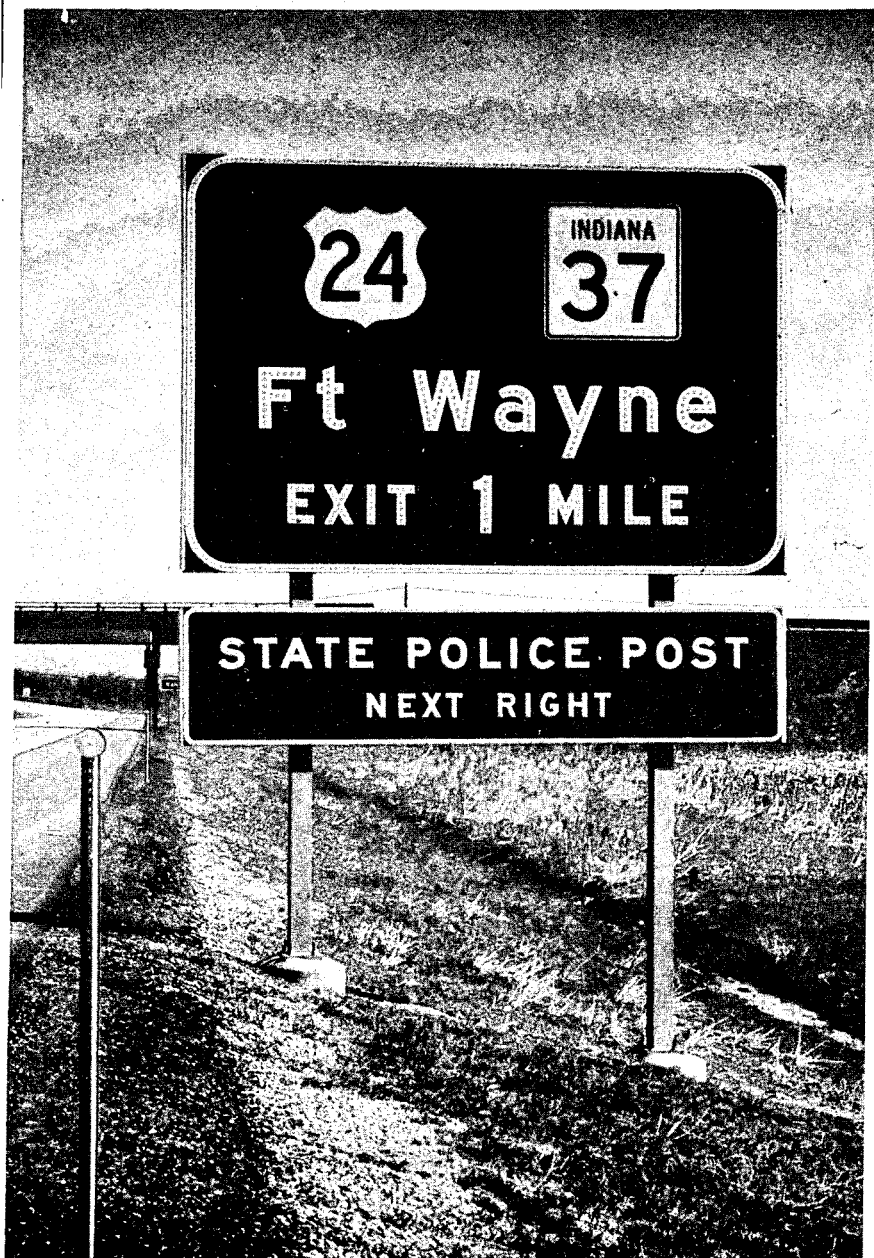
I think of all the subjects that attract the interest of the public, perhaps traffic signing on the Interstate System is one of the most fascinating of all.

We have looked at signs on these sample Interstate projects as representative of conditions around the country. I would like to move in

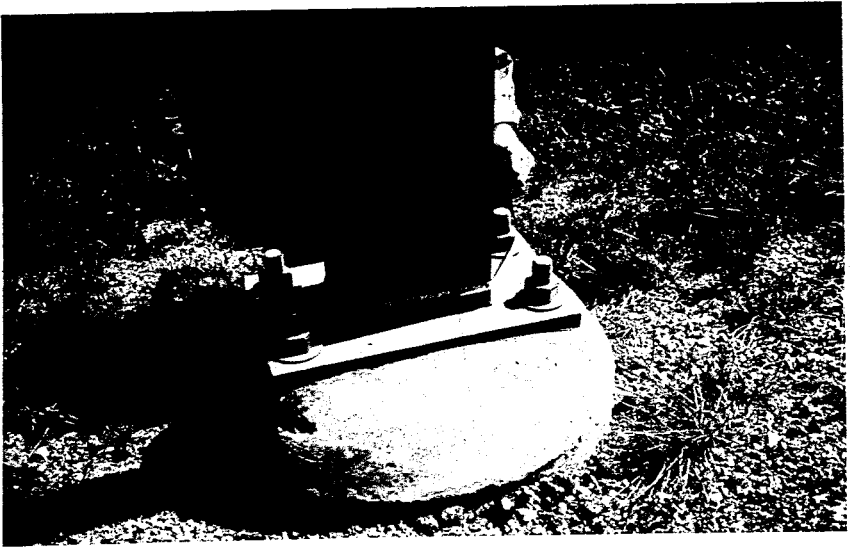
and show you some representative installations that were found on several projects.

Signing is important to the use of the highway. It will be completely useless to build the highway system without appropriate installation of signs.

So here we are with the typical installation for advance notice of an exit on an Interstate project in Indiana.



This is supported by 8-inch I-beams. This is the way the base looks on that sign you saw just a moment ago.



Here is another installation, sign installation, where a regulatory sign is used. In this case, there is a general speed limit of 70 miles an hour, one of 55 for trucks and one of 65 for buses.

I would like to call your attention to the fact this sign is placed in accordance with the minimum standards and is located 2 feet off the edge of the shoulder.

Here is a man over here who is selling auto polish and he is about 50 feet off the road, or maybe more—probably more, 60 or 70 feet off.

