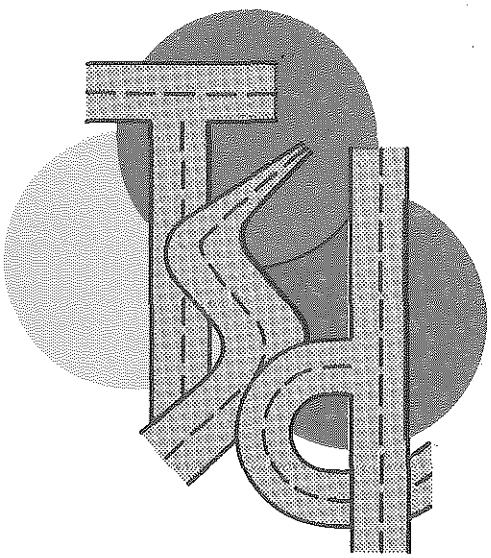
S C O R E

Systematic Correction of Roadside Environment

TSD-SS-142-70



TRAFFIC and SAFETY DIVISION

DEPARTMENT OF STATE HIGHWAYS
STATE OF MICHIGAN

MICHIGAN DEPARTMENT OF STATE HIGHWAYS

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Systematic Correction of Roadside Environment

TSD-SS-142-70

Prepared By

Bureau of Operations
Traffic & Safety Division
Safety & Surveillance Section

September, 1970

ACKNOWLEDGEMENTS

MICHIGAN STATE HIGHWAY COMMISSION

Charles H. Hewitt, Chairman
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Claude J. Tobin

MICHIGAN DEPARTMENT OF STATE HIGHWAYS

Henrik E. Stafseth, Director
John P. Woodford, Deputy Director
Gerald J. McCarthy, Assistant Deputy Director
John G. Hautala, Chief
Bureau of Operations
Harold H. Cooper, Engineer of Traffic and Safety
Lowell J. Doyle, Assistant Engineer of Traffic and Safety

PREPARED BY SAFETY AND SURVEILLANCE SECTION

Max R. Hoffman, Traffic Safety and Surveillance Engineer
Allen A. Lampela, Supervising Engineer
Surveillance Unit
Russell L. Brinks, Study Technician

CONTRIBUTOR TO THE REPORT

Edward H. Hodge, Graphic Design

SYNOPSIS

This report is intended to be used as a guide for the detection and correction of roadside hazards. The need for eliminating or reducing the hazard posed by roadside objects is emphasized by the frequent occurrence and often serious consequence of accidents involving hazards along the roadside. Listed and illustrated are many of the typical roadside hazards with the improvements which can be implemented.

Many such hazards were identified in the special AASHO report, "Highway Design and Operational Practices Related to Highway Safety" (otherwise known as the "Yellow Book"), and this report will help to accomplish the safety practices covered in the "Yellow Book".

General Discussion

Michigan's freeway system has grown over the past 15 years to its present status of being one of the most complete freeway networks in the United States.

Originally, the main objective was to construct a roadway with sufficient laneage to handle the estimated volume of vehicles to be using the highway. As the freeway system was expanded, it became increasingly evident that safe operation of the system depended on several aspects, one of the major ones being roadside design. Accident experience indicated that providing the motorists with a ribbon of smooth pavement was not sufficient. Scars on trees, scrape marks on piers and damaged sections of guardrail were mute testimony that motorists did not always stay on the pavement which had been provided for them.

However, it was also realized that some roadside appurtenances (such as bridge piers, bridge railings, sign supports, guardrail, light standards, and drainage structures) could not be eliminated, but must be treated so as to pose the least possible hazard to wayward vehicles and their occupants.

Furthermore, the roadsides can and should be sufficiently flat, allowing vehicles to recover from an out-of-control, skidding situation, by permitting the vehicle to remain upright. Generally, in these circumstances the occupants will sustain only minor injuries, if any.

Roadside Characteristics

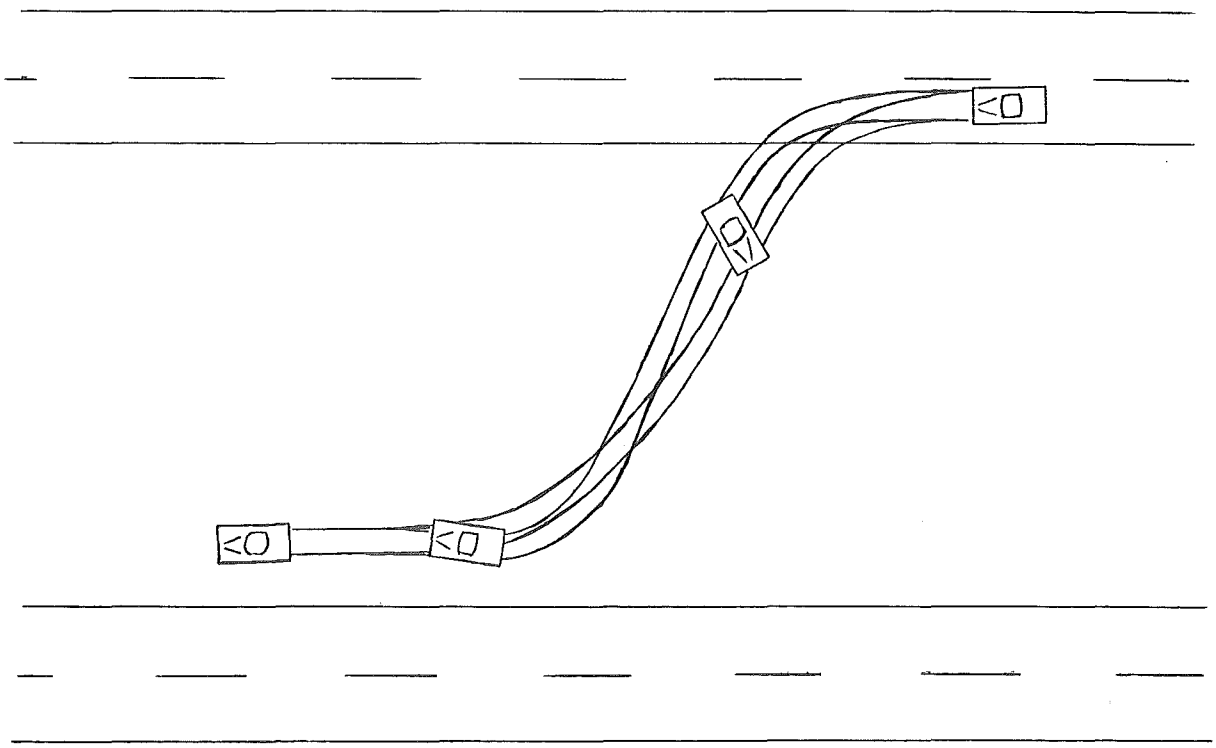
The elements which make up the roadside environment will be itemized to indicate methods of upgrading which may achieve the desired safety along the roadside. The information and illustrations incorporated in this guide pertain mainly to limited access highways; however, many portions can also be applied to free access routes. Regardless of the type of highway, all efforts should be aimed at providing a safe, clear roadside.

Slopes

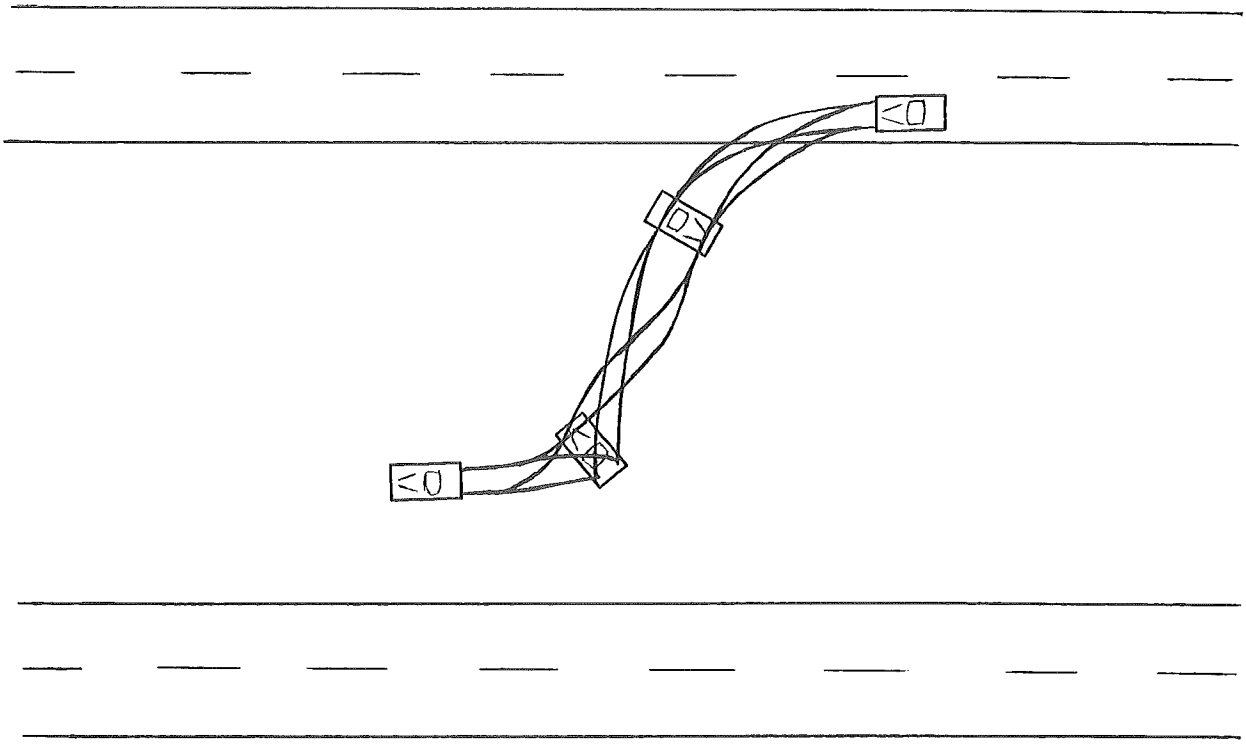
The following photographs of median skid marks show several instances where vehicles did enter a relatively flat median, but remained upright and in a driveable condition. These emphasize the desirability of gentle slopes, which the modern automobile can negotiate in a completely out-of-control attitude without turning over.

It should be noted that the point at which the drivers of these vehicles regained control was almost across the median, and several hundred feet downstream. Any obstruction to these free skidding movements (culverts, ditches, dikes, etc.) could certainly have caused the vehicle to overturn. Tracks such as these can be seen frequently.

The four tracks in the right of the photo were made by a vehicle which skidded as shown in the schematic drawing below. The vehicle was never completely out-of-control since the driver corrected the skid and continued on, probably without stopping.



The driver of this vehicle lost control, turned completely around, but still remained upright sustaining no damage.



A large area of the median has been disturbed, but the vehicle which caused the rutting was not damaged.

There appeared to have been two vehicles involved here, with neither being damaged.

Note the tracks of a vehicle leaving the median and re-entering the paved portion of the roadway.

As illustrated, the flattening of slopes and construction of ditches as far as possible from the edge of pavement are desirable safety features. Since this type of work involves excavation and possibly additional right-of-way, it has been limited to new construction and major reconstruction projects.

Slopes of 1 on 6 or flatter have shown adequate safety performance for out-of-control vehicles, while 1 on 4 slopes may have contributed to fatal accidents. Consequently, only slopes which are 1 on 6 or flatter should be considered for use near the roadside. Since only those sections of freeway which have been completed recently have the type of cross-section which utilizes 1 on 6 slopes, the problem of steep slopes near the roadway exists on older portions of the freeway system. Projects of slope correction in conjunction with removal of guardrail could be very beneficial in certain areas.

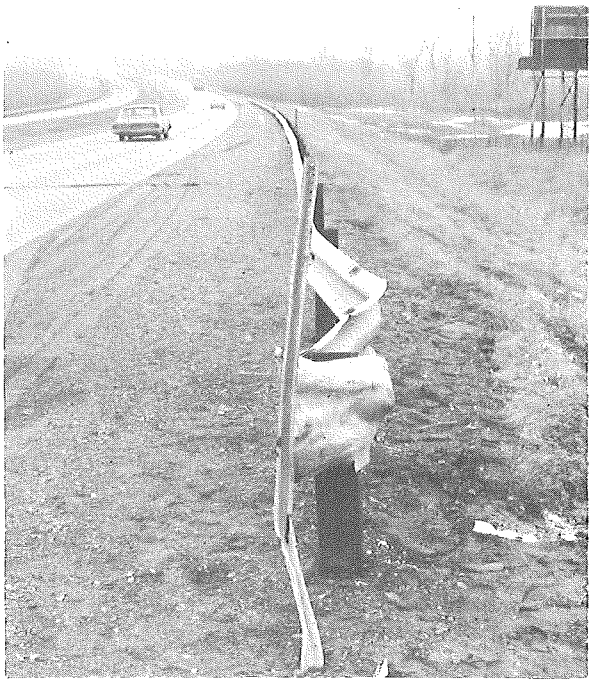
This photo shows a 1 on 4 back slope which an out-of-control vehicle struck while skidding sideways, causing the vehicle to overturn resulting in fatal injuries to the driver.

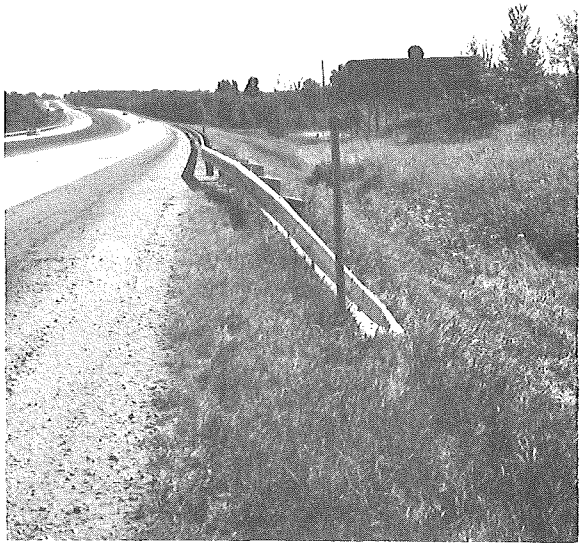
Guardrail

Due to revisions in the Standard Guides and Standard Plans, numerous guardrail installations are not in accordance with current standards. The changes necessary to upgrade existing installations to present standards depend largely on the purpose of the installation. In an area where guardrail is used to protect the motorist from a 1 on 2 slope, the use of additional guardrail with a buried-end section is generally adequate; whereas upgrading a section of median guardrail on a heavily traveled urban freeway would necessitate complete removal of the existing guardrail, reconstruction of the median to provide flush shoulders, and construction of a concrete barrier wall (page 16).

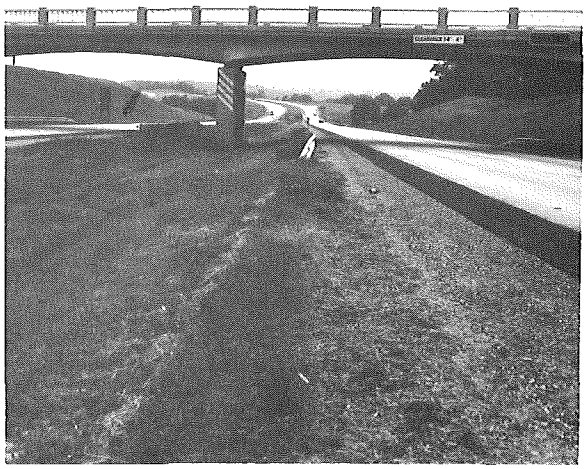
Connect short sections of guardrail to eliminate numerous end sections.

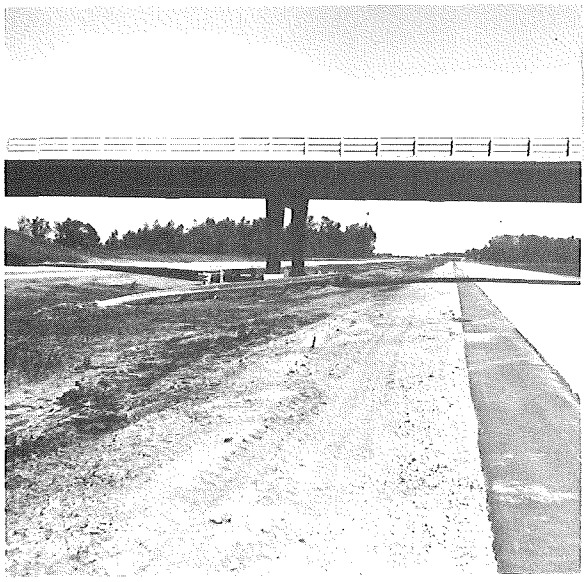
Note the damaged end section of guardrail and the recommended corrective treatment which was installed to prevent a future recurrence of the same type of accident.



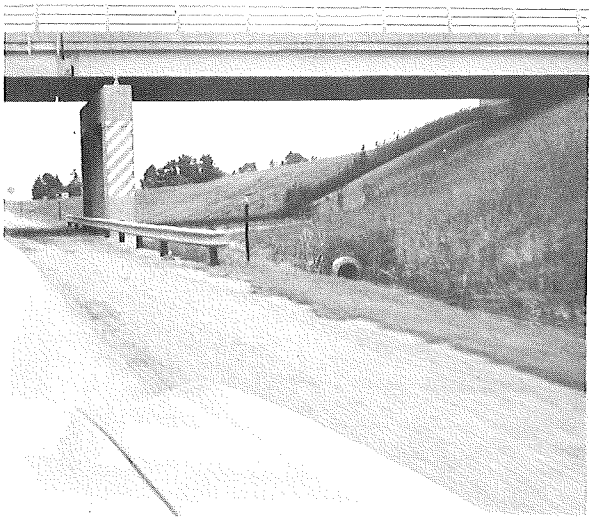


Improper location of guardrail can create an additional hazard, rather than offer protection from an existing hazard as intended. This guardrail is positioned so that a vehicle which leaves the roadway in advance of the hazard can pass behind the guardrail directly into the hazardous area.



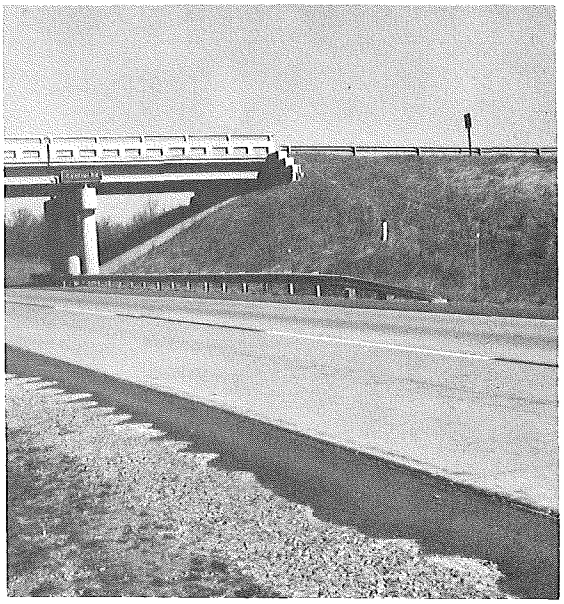


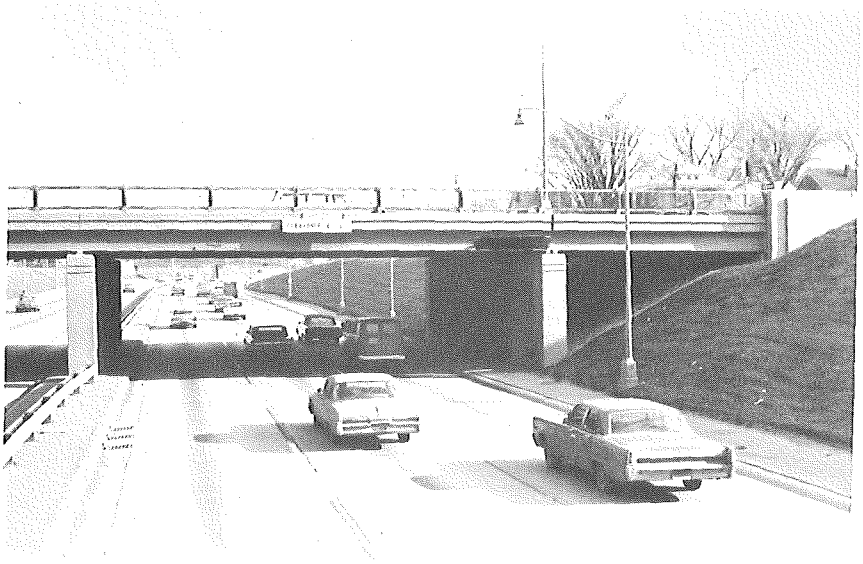
Flaring and locating the guardrail adjacent to the hazard not only provide better protection for wayward vehicles, but also greatly increase the area for a safe recovery without striking the guardrail. A different end treatment for guardrail is presently being considered.



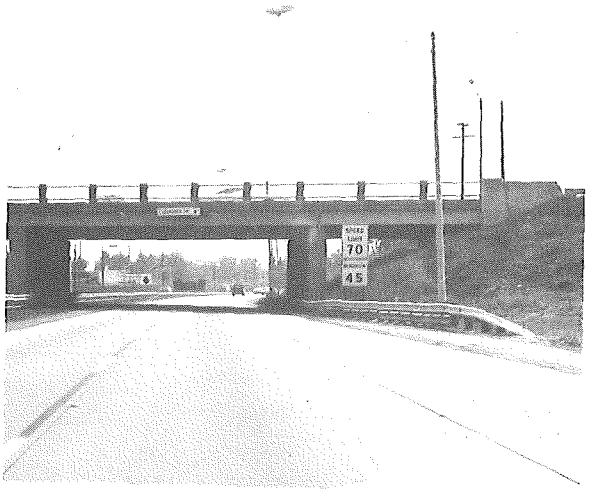
This short section of guardrail provides very limited protection from the pier and no protection from the concrete culvert.

The guardrail at this location offers greater protection from the pier and culvert where one exists.

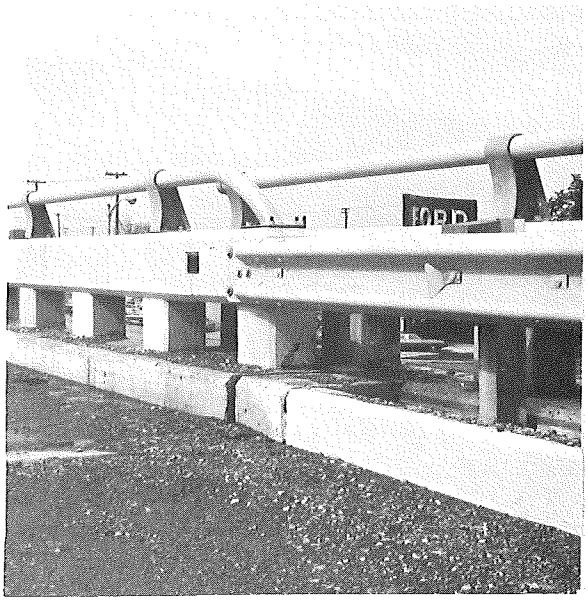




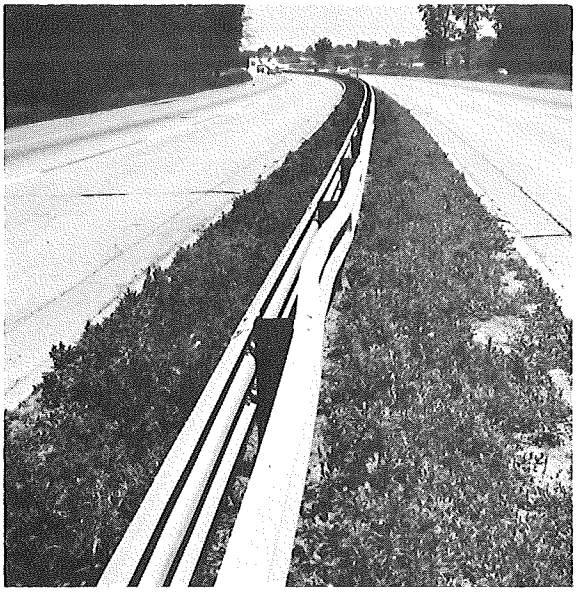
These are similar locations. The above location lacks motorist protection from fixed objects, while the location below utilizes guardrail to provide protection from a light pole, sign and bridge pier.



Present practice for terminating guardrail at a bridge requires attaching the guard-rail to the face of the parapet.

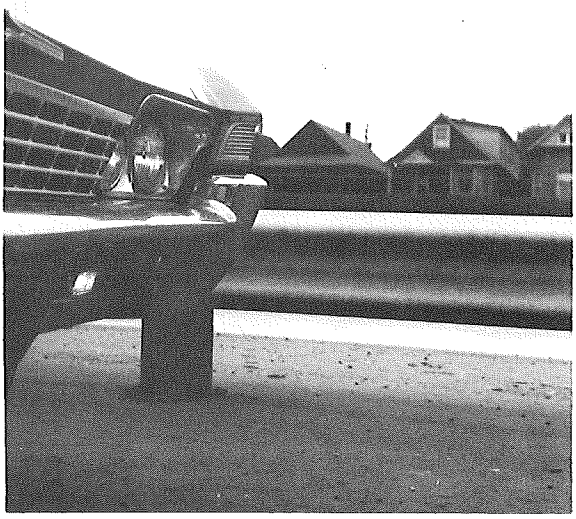


This is a location where the hazard could be reduced considerably by flaring the guardrail and attaching the end to the face of the bridge rail as shown above.



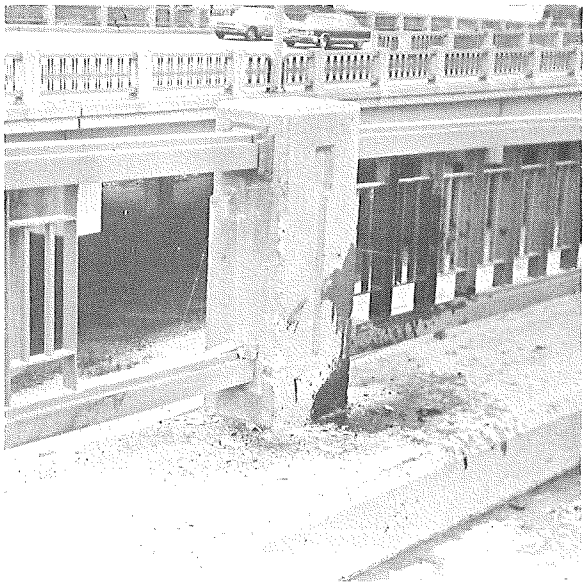
Shown here is Type AD median guardrail. Older installations have a top height of only 24 inches. Present standards specify a minimum top height of 27 inches, 30 inches is desirable.

Note the relationship between guardrail height (24") and bumper height (a state-owned 1968 automobile). This illustrates a condition which may contribute to a vehicle vaulting the guardrail.



Bridge Rail

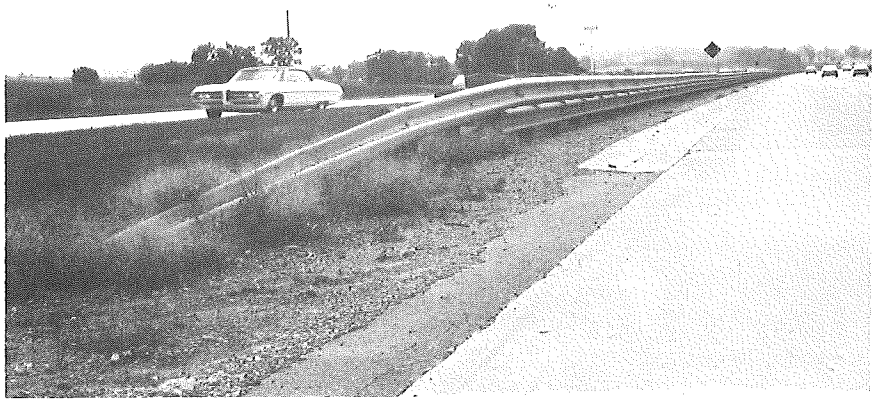
The impact with this concrete post was fatal to the driver of the vehicle.



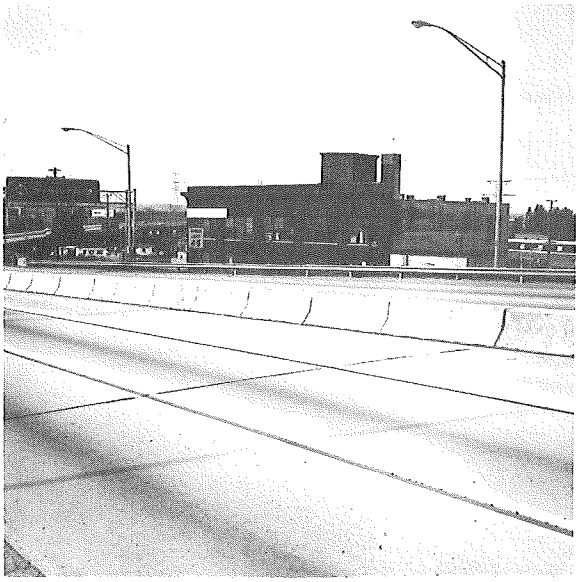
A use for guardrail which is presently experimental, but appears to have considerable merit, is the installation of the standard W beam guardrail to the post which supports the ornamental railing on bridges.

This impact with the guardrail produced only minor injury to the driver of the vehicle.

Median Barriers



Past experience indicates that Type CD guardrail (above) gives superior protection from cross median accidents. Median guardrail is installed when the median width is 36 feet or less.



The concrete barrier wall is the best possible median protection device. It will safely redirect an out-of-control vehicle with no injury to the driver, and allow him to regain control, thereby preventing interference with other vehicles in the traffic stream. Costs of maintenance are understandably low.

Signing

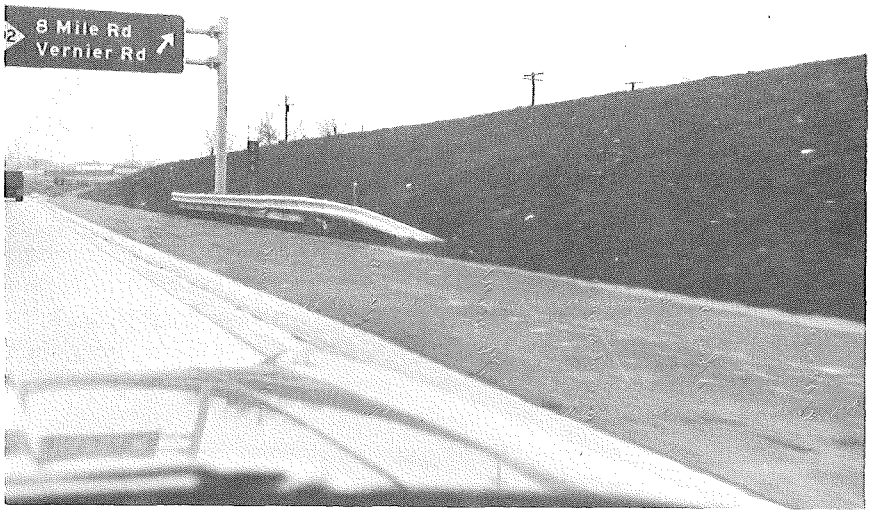
The guardrail in this photo offers only minimal protection from one of the two massive supports of this sign.

Locating signs at a distance of 30 feet from the edge of pavement, as shown, is desirable.

The use of breakaway sign supports eliminates the need for guardrail at this installation and consequently, reduces the potential for a severe accident involving a sign installation.

The accident experience involving breakaway signs thus far has been limited; however, in each case the performance of the supports has been excellent with the results being relatively minor vehicular damage with no injury to the occupants.

These photos show two similar sign installations. The upper photo shows a location of potential hazard to an out-of-control motorist; whereas the lower photo illustrates a guardrail installation which provides wayward vehicles protection from the sign support.

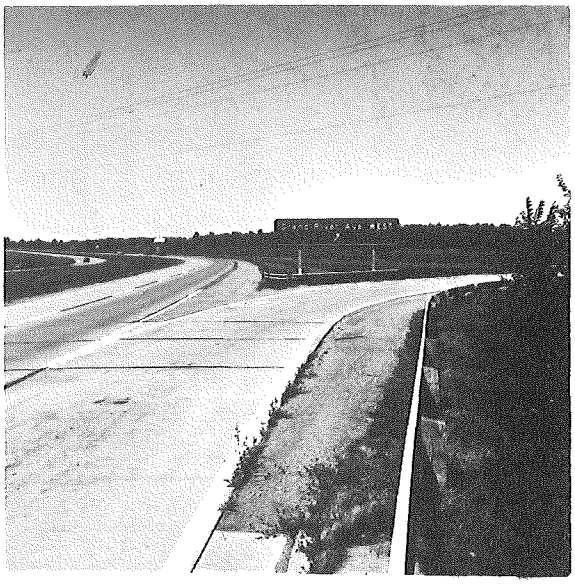


The guardrail offers the motorist protection from the sign supports, yet no protection from the bridge piers is provided.

Bridge-mounted signs eliminate roadside obstacles and should be used whenever feasible.

Bifurcation (Gore) Areas

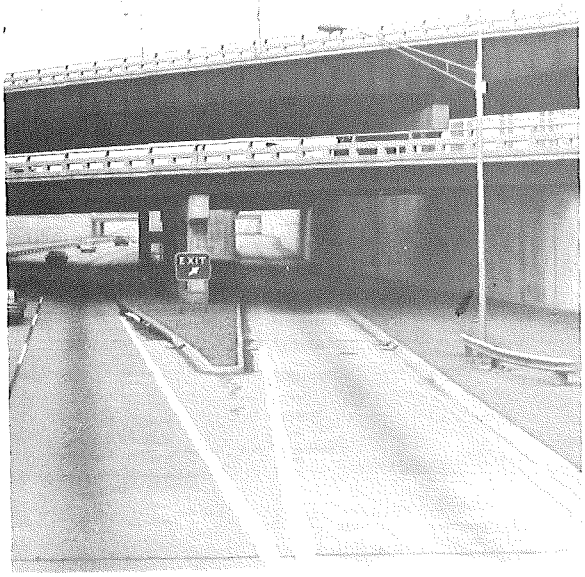
Accident frequency at gore areas is said to be about four times that of the remainder of the roadway.* Consequently, the design of the gore area has considerable influence on the overall safety of a highway.



The hazard posed by sign supports and guardrail in the gore area can be reduced by the installation of wood sign supports and subsequent removal of the guardrail. The grading of the gore area should provide a smooth recovery area for wayward motorists.

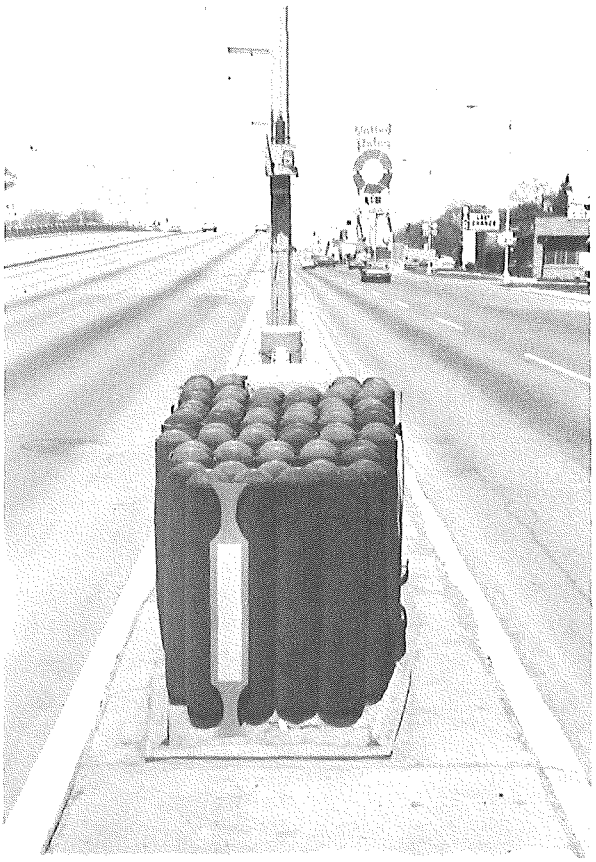
*AASHO Traffic Safety Committee, "Highway Design and Operational Practices related to Highway Safety ", (February, 1967), page 18.

Attenuating Devices

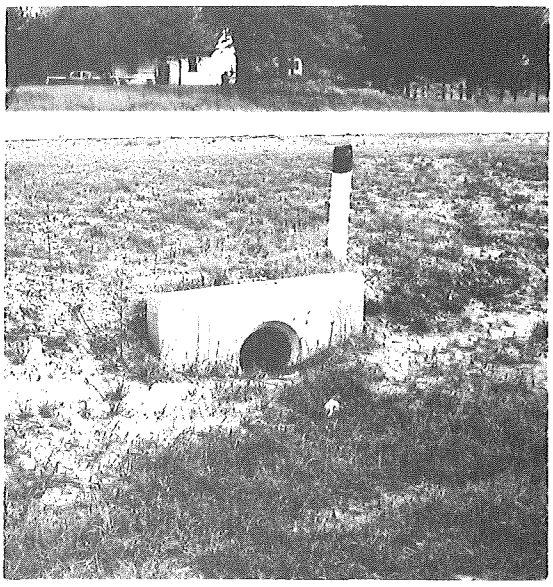


In gore areas where fixed objects, such as bridge piers or retaining walls exist, energy-absorbing devices will provide the best protection.

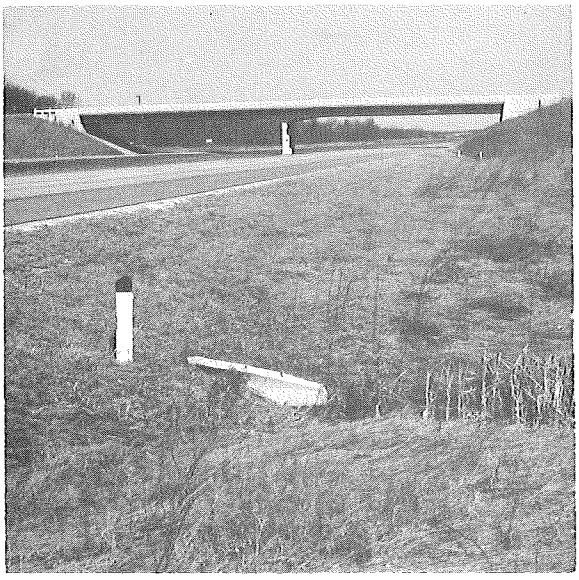
A device that has shown favorable results and one which is reusable after a small amount of maintenance is an assembly of water filled cylinders.



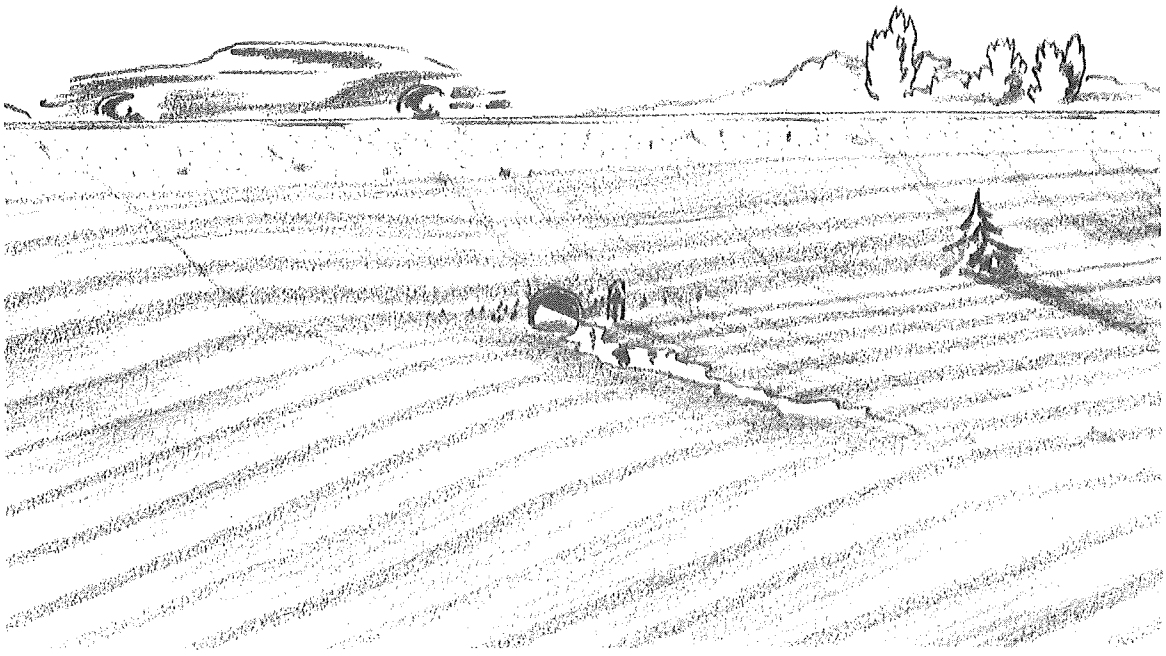
Headwalls



The elimination of many headwalls, as shown above, can be accomplished by simply replacing the headwall with the type of end section shown below.

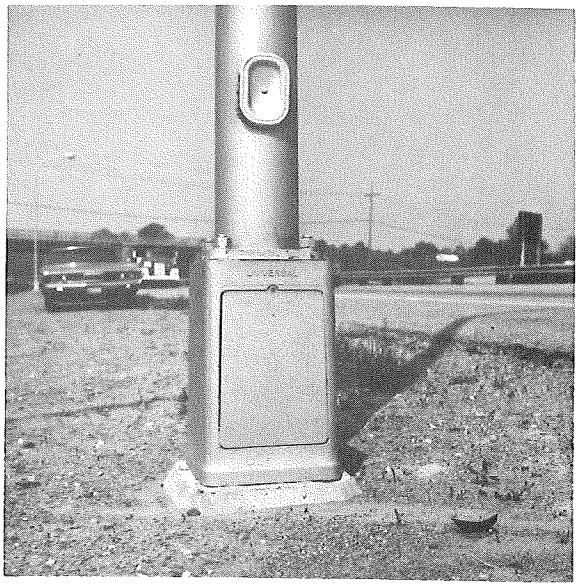


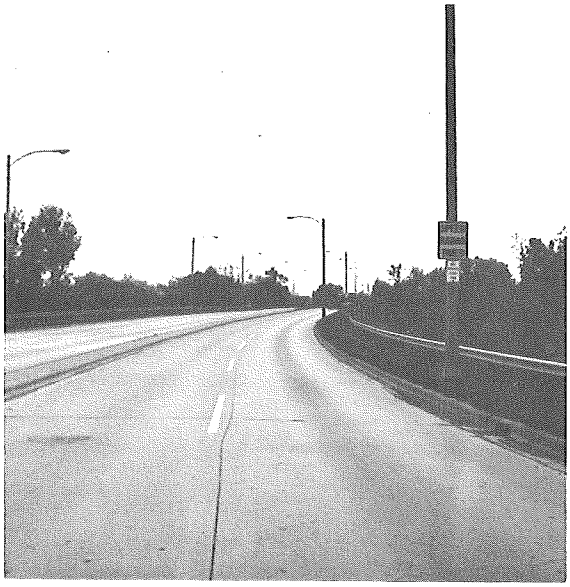
Median dikes are used to channel runoff to culverts which carry the water under the roadway and into drainage ditches. The actual shape of dikes varies considerably as shown in the illustrations. The above illustration shows a hazardous dike with steep sides. The illustration below shows a smoothly contoured dike which will function as intended but does not pose a hazard to wayward vehicles.



Light Standards

In areas where highway lighting is necessary the standards should generally be mounted on frangible bases and located as far as feasible from the edge of the roadway.





Where possible, the standards should be located behind existing guardrail used to protect the motorist from some other hazard.

The main objective in the replacement of light standards should be the location in a protected area or the installation of a frangible base. This will reduce the severity of any future accidents with the installation.

Trees

Tree removal is a very desirable roadside improvement, especially when the trees are located in target positions along curves or in areas where clear vision is necessary.

Some of the trees shown below are less than 30 feet from the edge of a freeway. Removal of trees to a distance of 50 feet is desirable along freeways.

Conclusion

This then is briefly what the "Yellow Book" is all about... providing for hazard free roadsides. Much can be accomplished by removing hazards that currently exist along our roads, and by improving design and operational practices so that similar or other hazards will not be found along highways of the future.