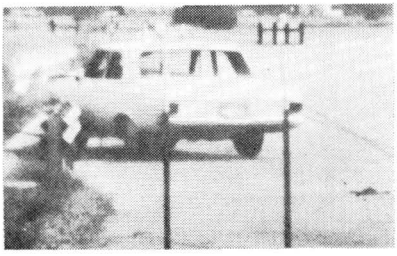
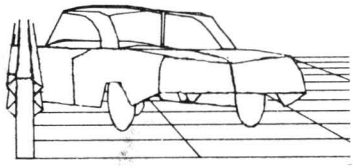
SUMMARY REPORT 140-8(S)

IMPACT PERFORMANCE AND A SELECTION CRITERION FOR TEXAS MEDIAN BARRIERS

SUMMARY REPORT
of
Research Report Number 140-8
Study 2-5-69-140





SEC. .100

Test Impact and Simulated Impact With
the Metal Beam Guard Fence

Cooperative Research Program of the
Texas Transportation Institute and the Texas Highway Department
In Cooperation with the
U. S. Department of Transportation, Federal Highway Administration

April, 1974

TEXAS TRANSPORTATION INSTITUTE
Texas A&M University
College Station, Texas

Impact Performance and a Selection Criterion for Texas Median Barriers

by

Hayes E. Ross, Jr.

To prevent median crossover accidents, the Texas Highway Department (THD) uses, in most cases, one of two basic median barriers. These are the concrete median barrier (CMB) and the metal beam guardfence (MBGF). The CMB is for all practical purposes a "rigid" unyielding barrier, while the MBGF is considered to be a "flexible" barrier, one that deforms upon impact. The two barriers are shown in Figures 1 and 2.

Several studies have been conducted to determine the impact performance of the CMB. It has been shown that for small impact angles the CMB can safely redirect an encroaching vehicle. However, these studies also showed that as the impact angle increases the impact severity increases considerably.

With regard to the MBGF, only a very limited amount of impact performance data existed prior to this study. One of the objectives of this study was therefore to determine its impact

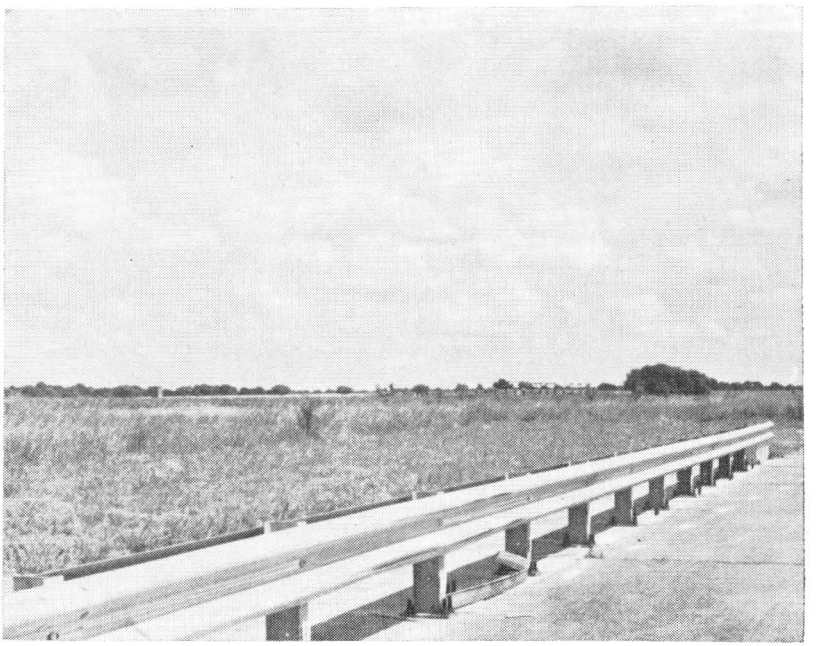


Figure 1. Metal beam guard fence.

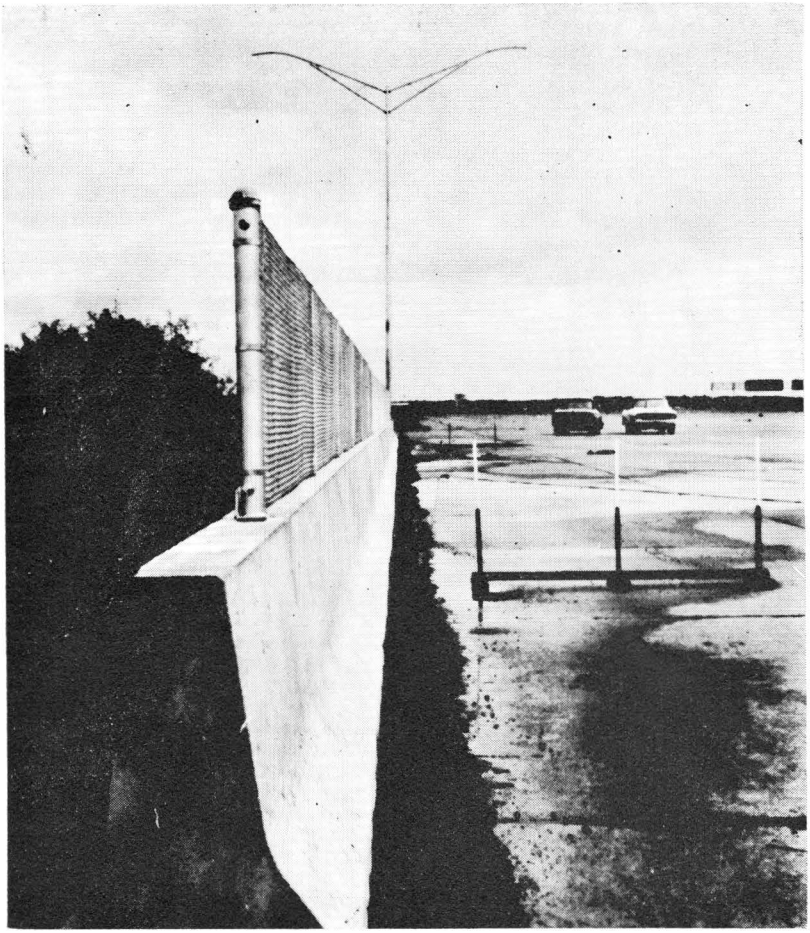


Figure 2. Texas concrete median barrier.

performance so that objective comparisons could be made between the CMB and the MBGF. Crash tests and the Texas Transportation Institute's version of the HVOSM* computer program were used to accomplish this objective. Before applying the HVOSM, however, an extensive validation study was performed. Crash test data were compared with the HVOSM predictions. Some modifications were made to the HVOSM in order to achieve an acceptable comparison.

Another task this study addressed concerned the relationship between median width and the probable angle of impact into a median barrier for errant vehicles. This relationship was needed

*HVOSM—Highway-Vehicle-Object-Simulation-Model. Program was developed at CALSPAN Corporation, Buffalo, New York, for the FHWA.

to develop a selection criterion for the two barrier systems. It has been postulated that the CMB is best for "narrow" medians where high impact angles are improbable and that the MBGF should be used for "wide" medians. However, objective criteria to quantify what "narrow" and "wide" means had to be developed. To accomplish this task, a combination of field measurements and HVOSM computer simulations was used. THD personnel conducted the field measurements. Median barriers on selected urban freeways were inspected for impact damage. Where impacts had occurred, measurements of the angle of impact, median width, etc., were made. These data were then statistically analyzed to determine impact angle probabilities. The HVOSM was used to supplement the field data by defining "upper limits" on impact angles as a function of median widths.

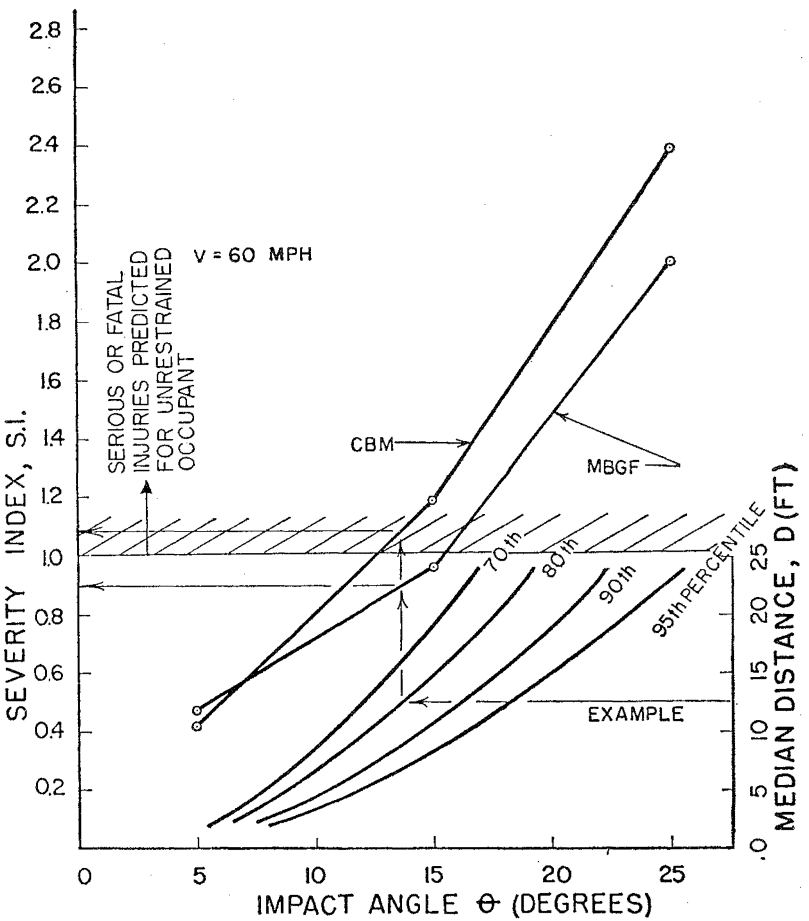


Figure 3. Selection criterion.

The end result of this study was an objective criterion which can be used in the median barrier selection process. The criterion, which is given in Figure 3, shows the relationship between impact severity and median width, on a probability basis, for the CMB and the MBGF barriers.

The Texas Highway Department used this criterion to establish guidelines for the determination of median barrier type. It is noted that these guidelines were established in consideration of other factors also, such as initial costs, maintenance, safety to repair crews, and others. The guidelines are as shown in Table 1.

The following conclusions were drawn as a result of this study:

1. The Texas standard metal beam guardfence will contain and redirect an automobile impacting at 60 mph at impact angles of 7 degrees, 15 degrees, and 25 degrees. There is no tendency for the automobile to become unstable after impact with the MBGF and the exit angle of the vehicle is not large.

TABLE 1. TEXAS HIGHWAY DEPARTMENT MEDIAN BARRIER WARRANTS

MEDIAN WIDTH	BARRIER TYPE
Up to 18 Feet	Concrete
18 to 24 Feet	Concrete or Double Steel Beam
24 to 30 Feet	Double Steel Beam

Serious or fatal injuries are not predicted for impacts at angles less than 15 degrees and speeds less than 60 mph.

2. The as-modified version of the HVOSM can be used to simulate automobile impacts with the MBGF. Close correlations between test and simulated results forms a basis for this conclusion.

3. The severity of impact with the Texas standard concrete median barrier at 60 mph is approximately equal to that of the MBGF for angles of impact of 7 degrees or less. However, as the angle of impact increases, impacts become progressively more severe with the CMB than with the MBGF.

4. The CMB is practically maintenance free whereas it costs approximately $500 to repair the MBGF after a 60 mph, 15 degree, impact. Based on gross estimates, automobile repair costs resulting from an impact with the CMB are slightly higher than those for the MBGF at an impact speed of 60 mph and an impact angle in excess of 7 degrees.

5. Sufficient field data were obtained to determine the percentile distribution of impact angles for a barrier placed in the center of a 24-foot median. A theoretically derived distribution, obtained by application of the HVOSM, compared favorably with the field data. Percentile distributions of impact angles as a function of median distance (distance from roadway edge to barrier face) were obtained by the theoretical analysis.

6. An objective barrier selection criterion was developed from which the impact severity of the MBGF and the CMB can be determined for any given median distance. The criterion is based on a design speed of 60 mph and impacts with a full-size automobile. The Texas Highway Department used this criterion to develop warrants for the use of these two barriers.

The published version of this report may be obtained by addressing your request as follows:

Phillip L. Wilson, Engineer-Director
Planning and Research Division
Texas Highway Department—File D-10R
P. O. Box 5051
VFW Building
Austin, Texas 78763
(Phone: (512) 475-4846)