Median Barrier Photographic Study

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A study has been performed to identify damages to and evaluate the effectiveness of the metal median barrier on the Schuylkill Expressway, Philadelphia, in relation to accident occurrence, volume and geometric design, using photography. The median barrier in Montgomery and Philadelphia Counties was photographed for approximately 20 miles using 35-mm strip film, which was then viewed on a dual projector console developed for the Pennsylvania Department of Highways.

The total number of various type median barrier damages detected in the 12-month study period was 1085. Though the traffic volume seemingly had little effect on the number of damages, the geometric design's influence was in evidence with interchange areas and curves showing considerably more impacts. Police accident reports were also studied both before and after the installation of the barrier to determine the effect it had on the number, type, and severity of accidents.

•THE OBJECTIVE of this study was to determine how well a median barrier functions as an integral highway element of vehicle control with respect to preventing median crossings, sustaining major and minor vehicular damages, and reducing both the frequency and severity of accidents.

The Schuylkill Expressway, on which this study was conducted, is the principal connection between the Pennsylvania Turnpike at the Valley Forge Interchange in the King of Prussia area and the downtown section of Philadelphia. The Expressway actually connects the turnpike interchange and the Walt Whitman Bridge crossing into New Jersey. The Expressway is approximately 20 miles long and consists of four-lane and six-lane sections divided by either a 4-ft wide raised median or a 10-ft wide flush median. It carries between 42,000 and 130,000 vehicles daily.

The Department of Highways erected 18.4 miles of type 2 median guardrail during 1962. This steel beam guardrail is mounted "back-to-back" on 4-in. offset I-beam blocks which are attached to steel I-beam posts. The posts are spaced at 12-ft 6-in. intervals. The top edge of the rail is 24 in. above the pavement surface at the median and the lateral width of the rail is approximately 21 in. Approximately 11.4 miles of barrier are located on the 4-ft median while 7.0 miles are on 10-ft median.

A previous study was conducted to ascertain the "Effects of Guardrail in a Narrow Median Upon the Pennsylvania Driver" (Pennsylvania Dept. of Highways and U. S. Bureau of Public Roads, June 1964). To supplement that study it was felt that a more detailed analysis should be made of the damage incurred by the median barrier and if possible to determine its overall effectiveness.

In an effort to find out how often the median barrier was damaged it was photographed monthly and a projection film prepared. The film was viewed on a specially designed viewing console capable of projecting two films simultaneously on the console screen. Each monthly film was compared with the previous months' film and new damages were credited to the study month. Nine categories of damages were recorded and identified by station number of the highway and then coded for electronic data processing use.

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Figure 1. Film viewing console.

A one-year "before" and "after" median barrier installation accident study was also conducted. The results of the photographic portion of the study and the accident study were combined to determine the median barrier's effectiveness.

METHOD OF STUDY

In an effort to determine how often the median barrier was damaged, several approaches to the problem were considered. Due to the extreme hazard involved, several physical identification and notation procedures were abandoned. A new safe method was needed. Photography had been used for other type studies and it was proposed for this one. Since no one had prior experience in this area several methods had to be explored. As a result two possible types of photography were given consideration—strip film photography and 35-mm single-frame.

A pilot study photographing five miles of median rail was undertaken to decide which of these methods was better suited for this type of study. Much experimenting and comparison proved 35-mm strip film to be the more proficient method of photography. It assured more accuracy of detail and eliminated the need for splicing sections of film together.

An overall one-year comprehensive median barrier study was then begun. It was proposed to determine and evaluate through the use of photography the number of times the rail had vehicle contact, the severity of the contacts, and the relationship of contacts to volume and geometric design. Photographing of the median barrier took place monthly during the early hours of the morning with the use of floodlights. The barrier

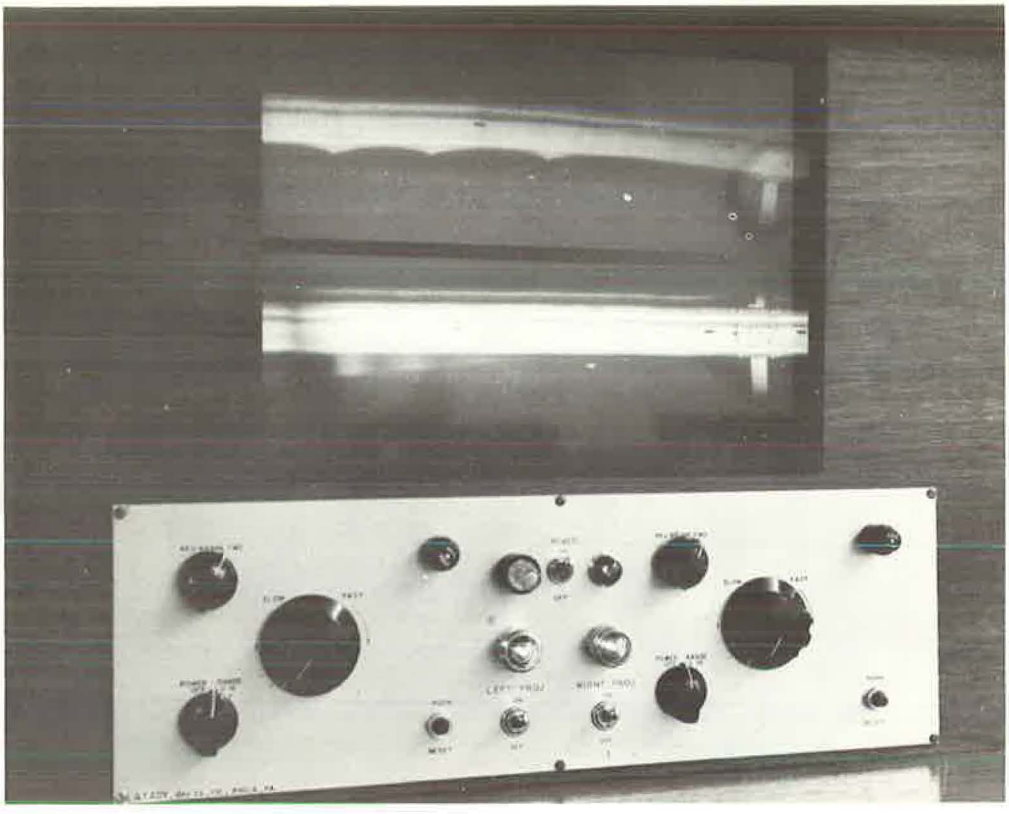

Figure 2. Console control panel and viewing screen.

was filmed from a moving vehicle averaging 30 to 35 mph in both eastbound and westbound directions. The film was processed and divided into four reels per month of equal ten-mile sections.

The Pennsylvania Department of Highways had devised a 35-mm strip film viewing console for the purpose of viewing monthly films (Figs. 1 and 2). The console's external appearance most nearly resembles the once-familiar player piano; that is, in the upper portion of the console, in the center, is a screen on which is viewed the moving median barrier. The "keyboard area" surface is used for recording collected data.

Basically the console can be divided into two sections, the base and the top. The base has four drawers, two on each side. The upper drawers house 35-mm strip film projectors. By the use of prisms and mirrors the images are reflected through the top portion of the console onto the viewing screen. The projector on the right produces its image on the upper half of the screen, the one on the left on the lower half. Since the projectors are housed within the drawers, cooling fans were provided to eject heat from the projectors. Focusing of the projectors and zooming to increase the size of the image on the screen can be accomplished by controls located on the outer face of the drawers.

Directly under the viewing screen is the console control panel. It provides for advance, stop, and reverse of each projector individually. The variable operational speed of each projector is also individually controlled. Power supply and projector protection fuses and on-off switches are also located in the panel.

The console design permits the department to obtain monthly summaries of median barrier damages by comparing one month's film with the previous month's film. This

is done by loading both projectors with the same sections of filmed median barrier from succeeding months. The latest film is advanced until rail damage is detected and then stopped. The previous month's film is advanced to the same location. If the damage appears on both films it is known that the damage has been previously recorded. If the damage does not appear on the film of the prior month the damage is recorded and credited to the month of the latest film. To properly identify the same sections of median barrier on both films, sequential identification numbers, relating to highway station numbers, had been permanently applied to the barrier every 300 feet. The console is capable of projecting two films simultaneously across the screen by adjusting the variable speed controls.

MEDIAN BARRIER DAMAGES

In evaluating the effectiveness of the median barrier on the Schuylkill Expressway, it must be considered how often it is hit, and what the extent of the damage is.

The study area was photographed in both eastbound and westbound directions and the film examined for median barrier damage. The original filming, taken in May 1964, provided an inventory of all damages incurred by the metal median since its installation. Though it was common knowledge that the barrier had been struck many times not reflected in police accident reports, it was never known how many times it was actually hit. Varying types of damage totaling 4370 were found in the inventory, an average of 109 per mile.

Three classifications—minor, medium, and major—with nine more descriptive subdivisions, provided a means for establishing the severity of these damages. The nine progressively more severe classifications of damage were defined as follows:

1. Minor
   Scratch: slightest type of damage—very thin line of damage—not deep or wide—surface only.
   Scrape: wider than scratch and deeper into the rail's surface—a thick scratch.
   Dent: a slight indention in the rail's surface as if caused by a blunt instrument—no scratch or scrape involved.
2. Medium
   Scrape: similar in many ways to a minor scrape, but usually deeper and more severe, appears darker on film than minor scrape.
   Dent: indention of rail deeper than in the case of a minor dent—generally a series of deep dents closely grouped.
   Scrape and Dent: combination of denting and scraping of a severe nature, but not twisting the rail out of alignment.
3. Major
   Twisted Rail: rail hit with such impact that the alignment no longer exists—usually involves much scraping and extremely severe dents.
   Twisted Post: post supporting the guardrail has been bent from a vertical position and/or severed.
   Breakthrough: rail has been severed and laid open from top to bottom—most severe of all damage categories.

Of the 4370 recorded inventory impacts, 90 percent or 3996 fell into the minor category, 7 percent or 324 were medium, and the remaining 3 percent were major in nature. There were no breakthrough damages reported.

Because of an accumulation of dirt and wear on the median barrier when the original or inventory run was filmed it is probable that many of the medium scrapes were minimized to a minor type nature, thus accounting for an abnormal relationship between medium and minor. This conclusion was drawn as the result of physical investigation of a number of questionable areas.

The actual 12-month study period ran from June 1964 to May 1965, and does not include the inventory run in May 1964. All statistics are based on the 12-month study period only.

TABLE 1

TOTAL MONTHLY MARKINGS ON MEDIAN BARRIER ACCORDING TO SEVERITY INCLUDING INVENTORY RUN

Severity	1964							1965					Total
	May[a]	June	July	Aug.	Sept.	Oct.	Dec.	Jan.	Feb.	Mar.	Apr.	May	
Minor scratch	2142	77	17	9	5	15	15	0	7	4	15	20	2326
Minor scrape	1778	91	48	40	25	44	31	12	22	26	35	25	2177
Minor dent	76	4	1	1	0	0	5	1	1	0	0	0	89
Medium scrape	165	22	59	46	24	58	17	15	14	32	44	59	555
Medium dent	36	2	0	1	0	1	1	1	2	0	0	0	44
Medium scrape and dent	123	3	6	3	4	1	13	2	1	2	12	12	182
Major twisted rail	31	4	4	4	1	2	8	0	2	1	1	2	60
Major twisted post	19	0	0	1	1	0	1	0	0	0	0	0	22
Major breakthrough	0	0	0	0	0	0	0	0	0	0	0	0	0
Total	4370	203	135	105	60	121	91	31	49	65	107	118	5455

[a]Original inventory run.

TABLE 2

TOTAL MONTHLY MARKINGS ON MEDIAN BARRIER ACCORDING TO SEVERITY, PHILADELPHIA COUNTY

Severity	1964						1965					Total
	June	July[a]	Aug.	Sept.	Oct.[b]	Dec.[b]	Jan.[c]	Feb.	Mar.	Apr.	May	
Minor scratch	38	15	6	3	10	14	0	3	2	13	11	115
Minor scrape	53	42	18	17	25	22	10	19	12	22	19	259
Minor dent	1	0	0	0	0	5	1	0	0	0	0	7
Medium scrape	3	45	29	8	39	9	11	8	22	36	47	257
Medium dent	0	0	0	0	1	1	1	1	0	0	0	4
Medium scrape and dent	2	2	2	2	0	7	1	0	0	11	10	37
Major twisted rail	0	2	1	1	1	4	0	1	1	0	2	13
Major twisted post	0	0	0	1	0	0	0	0	0	0	0	1
Major breakthrough	0	0	0	0	0	0	0	0	0	0	0	0
Total	97	106	56	32	76	62	24	32	37	82	89	693

[a]July film was underexposed.
[b]No film taken in November.
[c]Total for January is low due to deposits of ice and snow on the median barrier.

TABLE 3

TOTAL MONTHLY MARKINGS ON MEDIAN BARRIER ACCORDING TO SEVERITY, MONTGOMERY COUNTY

Severity	1964						1965					Total
	June	July[a]	Aug.	Sept.	Oct.[b]	Dec.[b]	Jan.[c]	Feb.	Mar.	Apr.	May	
Minor scratch	39	2	3	2	5	1	0	4	2	2	9	69
Minor scrape	38	6	22	8	19	9	2	3	14	13	6	140
Minor dent	3	1	1	0	0	0	0	1	0	0	0	6
Medium scrape	19	14	17	16	19	8	4	6	10	8	12	133
Medium dent	2	0	1	0	0	0	0	1	0	0	0	4
Medium scrape and dent	1	4	1	2	1	6	1	1	2	1	2	22
Major twisted rail	4	2	3	0	1	4	0	1	0	1	0	16
Major twisted post	0	0	1	0	0	1	0	0	0	0	0	2
Major breakthough	0	0	0	0	0	0	0	0	0	0	0	0
Total	106	29	49	28	45	29	7	17	28	25	29	392

[a]July film was underexposed.
[b]No film taken in November.
[c]Total for January is low due to deposits of ice and snow on the median barrier.

Because June 1964 was the first actual month of the study following the inventory, it is presumed that some damages were missed in viewing the inventory run and were consequently picked up in the June viewing of film, resulting in an abnormally high total (Table 1). In January 1965, a heavy accumulation of ice and snow on the median barrier made most damages undetectable, resulting in an abnormal low.

An analysis of both directions of the Philadelphia County study area from City Line to the Walt Whitman Bridge (approximately 7.5 miles) revealed 693 total damages to the median barrier, or an average of 46 per mile for both sides combined. The severity percentages for this area were: minor 55 percent (381 impacts), medium 43 percent (298 impacts), and major 2 percent (14 impacts). Examining the subdivisions, we find minor scrapes and medium scrapes equally responsible for a total of 516 (76 percent) of the Philadelphia area damages. There were 13 major damages but no breakthroughs (Table 2). The Philadelphia study area carries a volume up to 130,000 ADT.

The King of Prussia to City Line study area (approximately 12.47 miles) in Montgomery County has an ADT volume of 42,000. In this study area 392 damages were found, an average of 15.5 per mile. The severity percentages for Montgomery County were: minor 55 percent (215 impacts), medium 40.5 percent (159 impacts), and major 4.5 percent (18 impacts). The minor scrape and medium scrape subdivisions account for 273 damages or 70 percent of the total for Montgomery County (Table 3).

A study of damages by locations revealed some clustering. Four to seven median barrier damages within 200 ft is referred to as cluster type No. 1; cluster type No. 2 is nine or ten median barrier damages within 100 ft. All No. 1 type damage clusters were located at interchange areas involving off and/or on ramps (Fig. 3). Two type No. 2 clusters developed. At station 322 + 00 eastbound, on a curve, nine medium scrape damages were found, and at station 398 + 00 westbound, on a tangent section, ten damages were located varying from a minor scratch to a twisted rail.

Two widths of median were included in the Montgomery County study, 7.5 miles of 10-ft wide grass median and 4.9 miles of 4-ft concrete. In the 10-ft wide sections

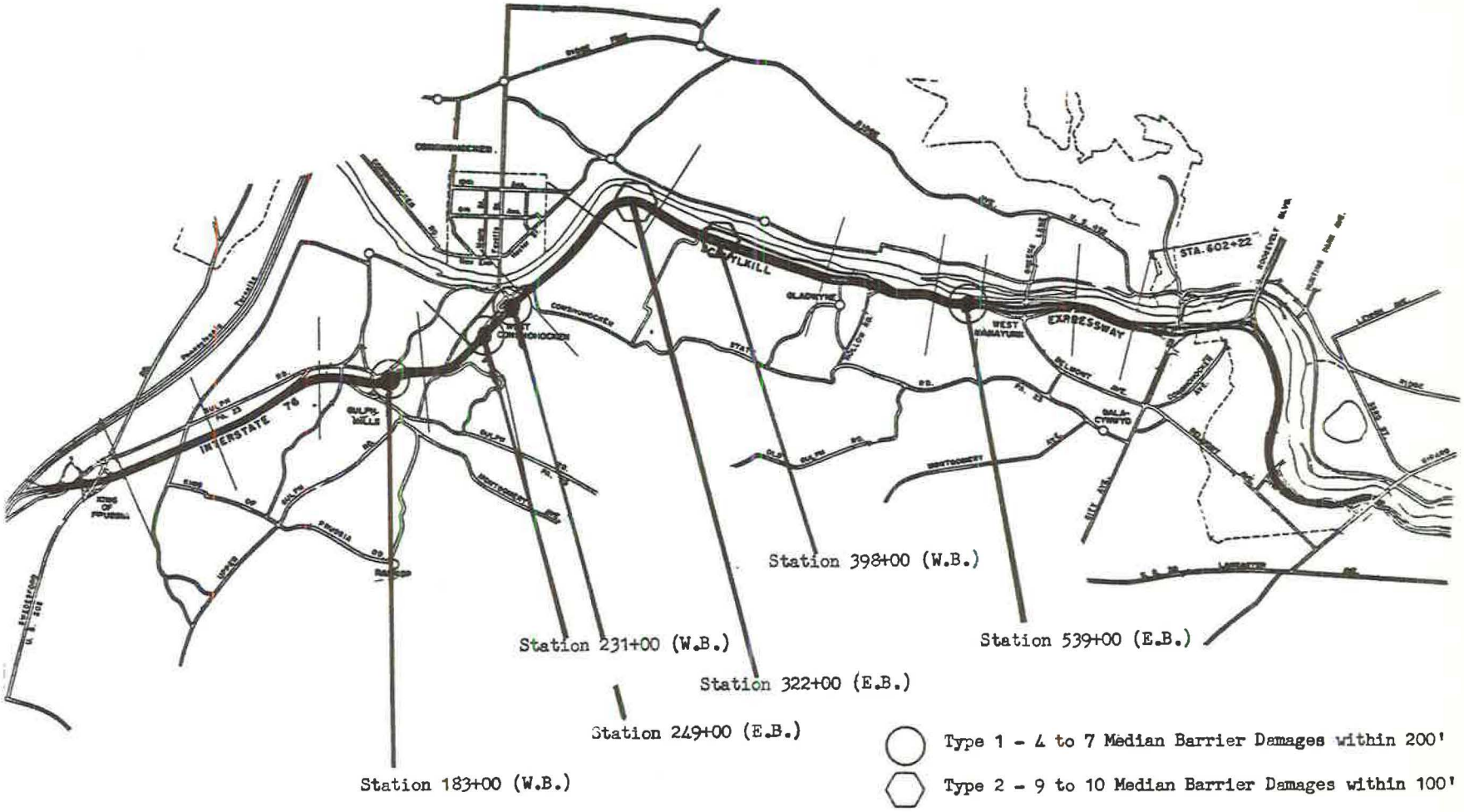

Figure 3. Location of barrier damage clusters.

TABLE 4

ACCIDENT SEVERITY

Category	1960-61	Projected[a] 1964-65	1964-65[b]	Percentage of Abnormal Increase or Decrease
Average daily volume	28,533	—	42,515	—
Total number of accidents[b]	153	227	265	+24
Percentage of accident increase	—	49	73	+24
Number of fatal accidents	4	6	5	—
Number of injury accidents	48	72	81	+20
Number of property damage accidents	101	150	179	+28
Total number killed	7	10	6	—
Total number injured	78	117	122	+ 7

[a]Totals in this column represent a projected increase of 49 percent over the original totals for 1960-61, based on the 49 percent increase in the average daily volume over the four-year period.
[b]As reported by State Police, Montgomery County.

TABLE 5

MEDIAN BARRIER ACCIDENTS

Category	1960-61	Projected[a] 1964-65	1964-65	Percentage of Abnormal Increase or Decrease
Accidents involving median[b]	20	30	52	+111
Crossover accidents	(20)	(30)	(0)	—
Median barrier accidents	(—)	(—)	(52)	—
Fatal accidents involving median	3	4	0	—
Injury accidents involving median	7	10	19	+122
Property damage accidents involving median	10	15	33	+181
Number killed in median accidents	6	9	0	—
Number injured in median accidents	16	24	25	+ 7

[a]Totals in this column represent a projected increase of 49 percent over the original totals for 1960-61, based on the 49 percent increase in the average daily volume over the four-year period.
[b]As reported by State Police, Montgomery County.

TABLE 6

COLLISION TYPES AND MEDIAN INVOLVEMENT

Collision Type	1960-61	Projected[a] 1964-65	Actual 1964-65	Median Involved[b]	
				1960-61	1964-65
Head on	8	12	1	7	0
Rear end	90	135	128	2	7
Angle	14	21	11	8	0
Sideswipe	11	16	25	0	3
Hit fixed object	21	31	93	3	42
Other	9	12	7	0	0
Total	153	227	265	20	52

[a]1960-61 Totals projected 49 percent based on 49 percent increase in traffic volume.
[b]1960-61 Totals include median crossings, 1964-65 totals include hitting median barrier.

TABLE 7

ORDER OF IMPACT ACCORDING TO FIXED OBJECT TYPE[a]

Fixed Object Type	First Thing Hit	Second Thing Hit	Third Thing Hit	Total
Median barrier	39	11	2	52
Guardrail	18	1	0	19
Bridge abutment	8	1	0	9
Embankment	19	4	0	23
Curb	5	1	0	6
Temporary control device	1	0	0	1
Other	2	0	0	2
Unknown	1	2	0	3
Total	93	20	2	115

[a]Applies only to 1964-65 data, i.e., after installation of the median barrier.

there were a total of 213 film-recorded damages for an average of 15 damages per mile, including both sides of the median. In the 4-ft wide sections there were a total of 174 recorded damages for an average of 18 per mile.

Percentagewise, there is 40 percent of 4-ft wide median and 60 percent of 10-ft wide median. Of the total 265 State Police-investigated accidents during the study period, 92 (43 percent) occurred in the 4-ft section. Of the 52 State Police-investigated accidents in which the median was involved, 22 (43 percent) occurred in the 4-ft section.

The 4-ft concrete median, therefore, experiences more activity than the 10-ft grass median. Though it contains 40 percent of the total mileage, it experiences 4.5 percent more damages per mile than the 10-ft median and 3 percent more police-investigated accidents than its proportional mileage.

ACCIDENTS

In 1964 the Pennsylvania Department of Highways published the technical report "Effects of Guard Rail in a Narrow Median Upon the Pennsylvania Driver." Part II of that report was concerned with a "before" and "after" accident study related to the installation of a back-to-back beam-type median barrier. The accident study was based on State Police and City of Philadelphia Police accident reports. It was concluded using police data that in a one-year period before and after installation of the median barrier accident frequencies increased 73 percent and 38 percent in each of two sections studied with a 10 percent increase in volume.

To minimize the effect which the installation of the median barrier would have on an immediate "after" study as reported in 1964, State Police accident records were again analyzed for two comparable one-year periods. The "before" period (prior to installation of the median barrier) was June 1960 to May 1961; the "after" period was June 1964 to May 1965. The "after" period begins approximately two years after the completion of the installation of the median barrier—sufficient time for the motorist to become familiar with and accustomed to the new physical conditions. The "after" accident study period is compatible with the photographic phase of this report.

The following analysis is based on State Police-investigated accidents for the Montgomery County study area only. There was a total 153 accidents in the "before" period and 265 in the "after" period, a percentage increase of 73. In the "before" period traffic volumes averaged 28,533 per day, in the "after" period 42,515, an increase of 49 percent for the four-year period.

Assuming that frequency of accidents is linearly affected by volume for a constant roadway, the "before" accident total should be adjusted 49 percent from a total of 153 to 227. The difference between 227 and 265 accidents reflects a 24 percent abnormal increase of accidents. It is acknowledged that accident frequency is probably more than linearly related to vehicle mileage; however, no mathematical relationship is known to allow a more exact calculation of "abnormal" accident frequency increase.

Tables 4 and 5 present "before" and "after" accident occurrences with respect to the number and severity of all accidents and of those accidents which involve the median only. As Table 4 indicates, there was an "abnormal" total accident increase of 24 percent. This is the difference between 73 percent actual increase in the number of accidents and the projected total increase of 49 percent. There was a reduction from the projected total for fatal accidents. The increase in property damage accidents is the significant factor in this table. The difference in the number of persons killed is not significant.

Table 5 is concerned with State Police-reported accidents involving the median barrier. Crossover accidents did not occur during the "after" period of this study, shown in the 1964-65 column as (0). Median barrier accidents could not have occurred in the "before" period and are reported in the 1960-61 and projected columns as (—).

In the 1960-61 study 20 crossover accidents occurred. Three were fatal accidents, with six persons killed; seven were injury accidents, with 16 persons injured; ten were property damage accidents. The 52 reported median barrier accidents indicate an abnormal increase of 111 percent over the projected 1964-65 figure of 30.

Fatal accidents involving the median have been eliminated during the study period. Injury accidents had an abnormal increase of 122 percent and property damage accidents an abnormal increase of 181 percent.

Table 6 summarizes the type of accidents. The collision type was determined not by the severity of the various types that could be included in one particular accident but by the first event regardless of its severity. In the category of sideswipe accidents the table indicates that in 1960-61 there were 11 such accidents and in 1964-65 a total of 25. In the "before" study the median was not subsequently involved in the 11 accidents. In the "after" study the median was involved three times after the event of the sideswipe. This is not to conclude that other sideswipes did not occur as part of other accidents. For instance, the category of "hit fixed object" could include accidents consisting of first hitting the median barrier, then moving to the right and sideswiping a vehicle in the other lane.

Table 6 indicates again the elimination of crossover head-on accidents in the "after" study. The other significant category is "hit fixed object." The "before" period had 21 such accidents and involved the median only three times. The 49 percent projected increase to 31 such accidents was exceeded by over 290 percent and the median was involved 42 times, a clear indication that the median is an accident factor to be seriously considered.

The hit-object accidents are further analyzed in Table 7 for the "after" study only. It indicates that, in the 52 police-reported accidents involving the median, 39 (75 percent) hit the median barrier first, the others as a result of some other type accident. Of all things hit first the median constituted 42 percent.

MEDIAN BARRIER DAMAGES AND ACCIDENTS

A question asked many times but as yet unanswerable is, "How many vehicles cross the median which does not have a physical barrier and are not involved in accidents since they were able to regain control, turn around, and proceed on their trip?" No attempt is made here to answer this question based on the data collected. The type of data collected does, however, provide some insights.

In the "before" accident study there were a total of 20 reported crossover accidents, in the "after" study none. Had the median barrier not been installed and the 20 crossover accidents increased by 49 percent (the increase of volume) perhaps 30 crossover-type police-investigated accidents would have taken place. This figure of 30 is the projected number of State Police-investigated crossover-type accidents. It does not give an insight into how many could have crossed and returned safely.

An analysis of all State Police-reported accidents for the "after" study indicates that of the 265 total, 52 involved the median barrier. These 52 accident reports were matched with the damages recorded on the photographic study. They comprised 18 minor, 32 medium, and 2 major type damages.

Next the type of accidents, speeds, location of damages to the rail, size of damages, etc., were analyzed. It was determined that, of the 18 minor barrier damages reported

by State Police investigations, 13 (83 percent) would have at the minimum encroached onto the median and perhaps crossed over. The other 5 were of such a nature that had the median barrier not been installed the vehicle would have continued safely along its way. Of the 32 medium barrier damage accidents, 27 (84 percent) would have encroached or crossed the median, and of the major barrier damage accidents 100 percent would have crossed.

In the Montgomery County study area there were a total of 392 median barrier damages recorded by the photography process. Of these 215 were of the minor type, 159 were medium and 18 were major. Had all these recorded damages been investigated by police a determination of each could be made as to whether or not the vehicle would have crossed the median. This not being the case, the next logical approach was to apply the percentages of those accidents which were investigated by the police. Thus, 83 percent applied to the 215 recorded minor barrier damages would be 178; 84 percent applied to the 159 recorded medium barrier damages would be 134; and 100 percent applied to the 18 recorded major barrier damages would be 18.

This totals 330, which represents the number of film-recorded barrier damages which could have resulted in vehicles encroaching or crossing the median had the median barrier not been in existence. Since the projected 1964-65 crossovers totaled 30, it could be assumed that 300 vehicles suffered either initial or additional damages as a result of the installation of the median barrier.

CONCLUSIONS

The total number of various types of median barrier damage detected in the 12-month study period was 1085. Damages of a scraping nature represented 70 percent of the total in the study period. There were no breakthrough type damages recorded. Though the traffic volume seemingly had little effect on the number of damages, the geometric design's influence was in evidence, with interchange areas and curves showing considerably more impacts.

State Police accident reports for the 12.47-mile Montgomery County section were studied both before and after the installation of the barrier to determine the effect it had on the number, type, and severity of accidents. The period before installation totaled 153 police-investigated accidents compared with 265 after the barrier was installed, representing an abnormal growth over volume of 24 percent. Of the 265 police-investigated accidents, 52 resulted in damage to the median barrier. In the one-year "before" accident study there were 20 police-investigated crossover accidents. No crossovers were reported in the "after" study by the police.

For this same 12.47-mile area there were 392 photographically recorded rail damages. A detailed analysis of the 52 police-investigated reports mentioning damages to the median barrier indicated that, of the total 392 damages, approximately 330 represent vehicles which could have encroached on the median or crossed, had the barrier not been in existence. Of these 330 damages, it could reasonably be assumed that 300 vehicles suffered either initial or additional damage as a result of the installation of the median barrier. It is possible that many of these 300 vehicles would not have been involved in any accident had the median barrier not been installed. These in effect represent vehicles that cross medians (without barriers) and do not become involved in accidents, but regain control and continue on their trip.

The method of study used in this project is being considered by the Pennsylvania Department of Highways as a new research tool. It has the advantages of making collected field data permanent and capable of future review. The method also eliminates the hazards involved if personnel had to be placed in the field, on the highway, to collect the same data. It converts expensive long hours of field time to standard office hours.

Adjustments which have to be made during the period of a study, changes in procedures, etc., can be handled by standard office routine. The requirements for special equipment are also reduced to standard office needs.

It is anticipated that in the future more extensive median barrier studies will be undertaken on the type studied here and also on other type barriers. It is the author's

conclusion that even though considerable material concerning median barrier damages has been reported herein, the method of study is of equal if not of more significance.

ACKNOWLEDGMENTS

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Robert R. Coleman, Assistant Director of the Bureau of Traffic, was instrumental in conceiving the method of study used in the report and the design of the twin-projector strip film viewing console. Latady Development Company of Philadelphia, the contractor, engineered the construction of the console and perfected its operation. Latady Development Company also filmed the median barrier monthly and processed the study film.

Robert H. MacGinnes, Jr., technician in the Division of Research and Studies, deserves special mention for the laborious task of viewing film representing over 500 miles of median barrier to select and catalog monthly damages as they appeared on the film. He also analyzed and categorized the State Police accident reports for both the "before" and "after" periods of the study.