Evaluation of Flush Medians and Two-Way, Left-Turn Lanes on Four-Lane Rural Highways

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Three types of medians are typically used on four-lane rural highways in Texas: raised (or depressed) medians, two-way, left-turn lanes (TWLTLs), and flush medians. On roads with flush medians, the area between the travel lanes is paved and can easily be traversed by a vehicle. This type of median is typically used in areas that shift from rural to suburban. Research was conducted to examine the differences in the operation and safety of four-lane rural highways with TWLTLs and four-lane rural highways with flush medians. A review of accident rates found no statistical differences in the number of accidents on highways with TWLTLs and highways with flush medians when driveway densities were low. Field studies also found no difference in the way these two median treatments operate in rural areas. Therefore, it was concluded that drivers use flush medians and TWLTLs similarly. However, Texas law prohibits the use of flush medians as a storage area or an acceleration/deceleration area for turning left into and out of adjacent properties. The results of the research suggest that drivers ignore the meaning of the solid yellow lines used to mark flush medians. Therefore, to promote uniformity and consistency, it is recommended that flush medians be used only on highways on which the frequency and spacing of driveways permit individual median openings at each driveway. On four-lane rural highways on which this is not possible, it is recommended that TWLTLs be used.

AASHTO defines the median as "the portion of divided highway separating the traveled way for traffic in opposing directions" (*1*). Because medians increase the separation between two opposing vehicles, it may be argued that medians, regardless of type, improve traffic safety by reducing the potential for head-on collisions and by providing an area in which errant or out-of-control vehicles can recover before entering oncoming traffic lanes. Depending on their width, medians also improve safety by reducing headlight glare and by providing an area out of the traffic stream for disabled vehicles to stop in case of emergencies. Medians also improve traffic flow by providing motorists with a place to store (or wait) while making a left turn. Many motorists use the median to accelerate or decelerate when turning on or off a highway. In some cases, medians are used to reserve right-of-way for future roadway expansion.

Median types include median islands and two-way, left turn lanes (TWLTL). Each median type is used in different situations to achieve different levels of control over left-turn access to adjacent properties. The type of median used on a highway depends on several factors, including the following (*1*):

- Functional classification and location of the highway,
- Availability of right-of-way,
- Design speed of the highway,
- Type and intensity of development adjacent to the highway, and
- Desired level of control over left-turn access.

Median islands offer the highest degree of control over left turns into adjacent properties. They use a physical barrier or island to separate opposing directions of traffic. Left-turn access is controlled through the placement of established breaks, or openings, in the median and at intersections. The median can range in width from as little as 1.2 m in highly developed areas, where right-of-way is extremely limited, to 23.8 m in suburban and rural areas, where right-of-way is typically less constrained. In general, raised medians are used on a higher functional class of highways, on which it is desirable to maintain as little interruption to the through movement of traffic as possible.

TWLTLs are at the other end of the spectrum in terms of the amount of control that can be exercised over left turns into adjacent properties. With TWLTLs, left-turning vehicles have unlimited access to adjacent properties. TWLTLs can be used by left-turning vehicles from either direction on the highway and can be used as a storage area for left-turning vehicles waiting for gaps in the opposing traffic stream. Traffic engineering research has shown that because the vehicle is physically removed from the main traffic stream, both traffic safety and flow can be dramatically improved with the installation of a TWLTL on a highway (*2–4*). AASHTO (*1*) provides the following recommendation on the use of TWLTLs: "In general, continuous left-turn lanes should be used only in an urban setting where operating speeds are relatively low and where there are no more than two through lanes in each direction."

The task of highway planners is to determine what type of median is most appropriate on highways whose roadside development shifts from rural to urban or suburban conditions. The problem becomes particularly acute where rural highways enter small urban communities. In those areas, the amount of roadside development increases the demand for left-turn areas. There may be situations in which it is desirable to separate opposing traffic streams and control access to adjacent properties without the expense of installing a median island.

In these situations, some jurisdictions in Texas have used flush medians to separate opposing traffic streams. Flush medians combine many of the attributes and features of raised medians and TWLTLs. With the flush median design, the area between the travel lanes is at-grade. The median area is marked with either a single solid yellow line or double solid yellow line. Left-turn access to adjacent properties is provided at left-turn bays that have been striped at established locations. Since the median area is at-grade, it

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can be easily traversed by drivers turning into and out of adjacent properties. Many drivers use flush medians as if they were TWLTLs; however, this appears to be a violation of Texas law. Article VI, Section 62 "Driving on Divided Highway" of the *Texas Motor Vehicle Laws* (*5*) states:

> Whenever any highway has been divided into two (2) or more roadways by having an intervening space or by a physical barrier or clearly indicated dividing section so constructed as to impede vehicular traffic, every vehicle shall be driven only upon the right-hand roadway unless directed or permitted to use another roadway by official traffic-control devices or police officers. No vehicle shall be driven over, across or within any such dividing space, barrier or section, except through an opening in such physical barrier or dividing section or space or at a crossover or intersection as established by authority.

This section of the law has been interpreted as prohibiting the use of a flush median as a refuge area for left turns as well as prohibiting vehicles from turning across a flush median, except at established openings (*6*). Therefore, there appears to be a discrepancy between the law and the way drivers use flush medians.

The purpose of this research was to examine the differences in the operation and safety of four-lane rural highways marked with TWLTLs and four-lane rural highways marked with flush medians. Field studies were performed in a Texas Department of Transportation (TxDOT) district (Lufkin) to measure how four-lane highways in fringe areas operate when they are marked with either a TWLTL or a flush median. A comparison of accidents on four-lane highways marked with TWLTLs and four-lane highways marked with flushed medians also was performed to determine whether there is a difference in the safety of highways with these types of median treatments. On the basis of the results of these analyses, recommendations were made on the application of flush medians on rural four-lane highways.

METHODOLOGY

Field studies were performed to evaluate the traffic operational characteristics of flush medians and TWLTLs on four-lane rural highways. The primary goal of the field studies was to determine whether there is any difference in the operations at these different median treatments. It was reasoned that if the frequencies of particular maneuvers (i.e., left turns from a through lane, left turns from within the median treatment, etc.) were similar at each type of median treatment, then the two median treatments were considered to be performing similar functions (i.e., serving as refuge or storage area for left turning vehicles, etc.). To test this hypothesis, field studies were performed to observe how drivers use the two median treatments in rural areas to make left turns into and out of adjacent businesses.

Study Sites

Operational data were collected at four sites. Three of the sites were located on US-69 west of Lufkin, Texas. One of these was located along a section of US-69 that had been striped with a TWLTL (Site 1). At this site, traffic was observed entering and exiting a gasoline station/convenience store. The other two sites on US-69 were located along a portion of the highway that had been striped with a flush median. One of these two driveways provided access to a self-service laundry (Site 2), and the other provided access to a construction company storage yard (Site 3). No high-volume generators that could be used in the data collection effort were located in the flush median section of US-69.

The fourth site (Site 4) was located on US-59/Loop 224 on the outskirts of Nacogdoches, Texas. US-59/Loop 224 is, for the most part, a divided roadway that passes to the west of Nacogdoches; however, a portion of roadway (approximately 0.8 km) was striped as a flush median. The driveway that provided access to a gasoline station/convenience store was selected for the study. This particular site was similar in characteristics and traffic volumes to the two-way, left-turn site on US-69 in Lufkin (Site 1).

Data Collection

Manual turning movement counts were performed at each of the four sites. Two hours of turning movement data during three data collection periods were gathered: a.m. (7:00 to 9:00), noon (11:30 to 1:30), and p.m. (4:30 to 6:30). These time periods were assumed to have the greatest probability of traffic performing the desired turning movements into the selected study locations. Turning movement volumes were recorded in 15-min intervals for the entire duration of the 2-hour data collection period.

Traffic volume and turning movement counts were performed for traffic traveling on the highway and for traffic exiting the selected driveway at each site. For the highway traffic, vehicle turning movements were grouped into the following categories:

- Total traffic: the sum of all through and turning traffic traveling in both directions on the highway at the driveway location;
- Total left-turning traffic entering driveway: the sum of all left-turning traffic entering the study driveway by turning left from the through lanes, turning left from the median area, or turning right after executing a U-turn at a nearby median opening;
- Left turn from median area: the number of vehicles entering the study driveway by turning left from within the median area;
- Left turn from through lanes: the number of vehicles entering the study driveway by turning left from a through travel lane; and
- Right turn after U-turn at median opening: the number of vehicles entering the study driveway by making a right turn after performing a U-turn at a nearby median opening.

For vehicles exiting the study driveway, vehicle turning movements were grouped into the following categories:

- Total exiting traffic: the sum of all left-turning and right-turning traffic exiting the site through the study driveway;
- Exiting left turn: the number of vehicles exiting the site through the study driveway by performing a left-turn maneuver; and
- Number of two-stage movements: the number of left-turning exiting vehicles that used the median either as an acceleration lane or as a storage (or waiting) area to execute a two-stage, left-turn maneuver.

Videotapes also recorded operations at each of the study sites during the times for which turning movement data were collected. The videotape served as a backup to the manual counts in case additional post hoc analyses were desired or if clarifications of the data were required.

Data Reduction

A summary table showing the number of vehicles performing each type of maneuver is presented in Table 1 for the three data collection periods (a.m., noon, and p.m.). These data were then used to compute the following operational measures:

- The percentage of left-turning traffic that turned from within the marked median (i.e., used the median as a storage area),
- The percentage of left-turning traffic entering the driveway that turned outside of the marked median (i.e., turned left from a through lane), and
- The percentage of exiting traffic that used the median for a two-stage left turn maneuver.

For the most part, traffic volumes and driveway density were higher, and more development existed in the section of US-69 that contained the TWLTL site (Site 1). Generally, the flush median sites were located in a more rural area with lower driveway densities and lower traffic volumes. As a result, a limited amount of traffic entering and exiting the driveways for the two flush median sites on US-69 was observed (Sites 2 and 3).

STUDY RESULTS

The percentage of vehicles entering and exiting the sites for the three data collection periods revealed that most drivers executed their turns from the median area, regardless of how it was striped. At all but one location, almost all the traffic observed entering the four study sites did so using the median area.

No vehicles were observed turning left from the through lane at any of the flush median sites. The data suggest that drivers do not perceive the striped median as an area prohibited to travel and use the flush median as they would a TWLTL.

Except for the a.m. period at Site 2, relatively few vehicles were observed traveling to an established median opening and performing a U-turn to gain access to the sites. At Site 2, 40 percent of the vehicles entering the site did so after making a U-turn at a nearby median opening; however, this observation was based on an extremely limited number of vehicles entering the driveway. In terms of actual counts, the 40 percent of traffic entering the site after making a U-turn represents two of the five vehicles using the driveway.

Less than 10 percent of the left-turn exiting traffic at each of the sites was observed using the median as a storage area or as an acceleration lane. A test of proportions was used to determine whether the differences in the observed percentages of exiting traffic using the median for storage or acceleration at Site 1 and Site 4 were statistically significant. Although a greater percentage of left-turn traffic exiting the driveway at the TWLTL site used the median, the test indicated that there was no statistical difference in the percentages for Site 1 and Site 4 in both the a.m. and noon data collection periods. Because of a malfunction in the video recording equipment, the p.m. period data for Site 4 were not available. Therefore, a comparison of the use of the median at Site 1 and Site 4 could not be performed for the p.m. peak. However, comparison of the a.m. and noon periods suggests no difference in the way motorists use a flush median or TWLTL when existing the driveways.

FINDINGS AND DISCUSSION

The results of the field studies indicated that for all practical purposes, there was no difference in the way the flush medians and TWLTLs function on four-lane rural highways when comparing data for each of the periods observed. For the most part, the proportion of drivers using the flush median as a storage area (both when entering and exiting a driveway) was equal to the proportion of drivers using the TWLTL for the same purpose. In fact, nearly all the vehicles observed entering the driveway at all of the sites turned left from the median area. Very few were observed turning left from the through lanes or going to a nearby median opening to gain access to the study sites. Therefore, the operational data collected indicate no difference in the way flush medians and TWLTLs function on four-lane, rural highways.

The fact that drivers are using flush medians and TWLTLs similarly suggests that either type of median would be appropriate for these roadways. The Manual on Uniform Traffic Control Devices (*7*) recognizes the need for the uniform application of traffic control devices and states that similar situations should be treated in similar ways. Since Texas law prohibits using a flush median as a left-turn lane to gain access to adjacent properties, the findings of this research suggest that, in situations in which denying access to adjacent properties is not needed, the TWLTLs may be more appropriate than a flush median on a four-lane rural highway. Using TWLTLs in these situations would promote the uniform application

TABLE 1 Traffic Counts at Operational Field Study Sites

Time Period	A.M.				Noon				P.M.			
Site Number	1	2	3	4	1	2	3	4	1	2	3	4
Major Road Total Traffic	1784	902	815	1899	1597	871	726	2251	2284	1489	909	2396
Total # of Left-Turns Entering Driveway	24	5	3	43	21	1	3	45	34	0	0	28
Left Turn from Through Lane	0	0	0	0	0	0	0	0	0	0	0	0
Left Turn from Median Area	24	3	3	42	21	1	3	45	34	0	0	28
Right Turn After U-turn at Median Opening	0	2	0	1	0	0	0	0	0	0	0	0
Minor Road Total Traffic	53	5	4	100	36	2	5	109	56	8	5	94
Exiting Left Turn	26	0	1	38	12	2	1	55	31	5	3	44
Number of Two-Stage Maneuvers	2	0	0	1	1	0	0	2	2	0	NA*	NA*

* Data are not available due to equipment malfunction.

of pavement markings in situations where left turns are permitted to adjacent properties.

The use of flush medians should be reserved for situations in which operational and safety concerns warrant that access to adjacent properties be controlled. In such cases, however, a high level of enforcement will be needed to ensure that drivers use the flush median as intended. Without enforcement, flush medians do *not* appear to be effective in controlling access to adjacent properties. Therefore, almost constant enforcement will be required to restrict left-turn access across flush medians. Since constant enforcement is impractical in most situations, the only truly effective way to control left-turn access is by installing a physical barrier, such as a raised or depressed median island or a median barrier. With this type of treatment, left-turn access to adjacent properties is limited to established median openings, the location and design of which can be controlled by the highway agency.

ANALYSIS OF ACCIDENTS

It is well-documented that installing a TWLTL on a roadway that was previously undivided can substantially improve safety and operations. Research shows that accident rates decrease by approximately 20 percent or more after installing TWLTLs on previously undivided highways (*2,3*). Furthermore, TWLTLs can reduce some types of accidents, such as rear-end and sideswipe accidents, by as much as 30 percent (*3*). The reason is that TWLTLs provide an area for left-turning vehicles to queue outside of the through travel lanes while waiting to turn. TWLTLs also provide a refuge and merging area for vehicles turning left out of adjacent properties.

Little, however, is known about the safety benefits of flush medians. A review of the literature did not reveal any studies evaluating the safety benefits of installing a flush median on a roadway that previously was undivided. Furthermore, no studies comparing the operational and safety effects of TWLTLs and flush medians were found.

A comparison of accident rates and accident severity for roadways marked with TWLTLs and flush medians is discussed. The comparison is based on 3 years of accident data. Both total accident and mid-block accident rates are used in the comparison. All the sites used in the comparison were located near Lufkin, Texas, in an attempt to control for regional differences between drivers.

Analysis Procedures

A comparative approach was used to evaluate the safety effects of TWLTLs and flush medians on four-lane rural highways in Texas. Accident rates from sites that experienced similar traffic volumes and roadside development, but had different median treatments (i.e., either a TWLTL or a flush median), were used in the comparison. Analysis of variance procedures was used to determine whether there was a statistical difference in the accident rates between the roadways marked with the different median treatments. Initially, the analysis sought to compare differences in accident rates and accident severity on four-lane rural highways with median islands, TWLTLs, and flush medians; however, the raised/depressed median sites had to be eliminated from the analysis because they did not have the same operating characteristics (i.e., traffic volumes and roadside development levels) as the TWLTL and flush median groups for the sites available in the Lufkin district.

Study Sites

When a comparative approach is used in studying accident statistics, it is important that the study locations have similar operating characteristics and roadside development levels. This is done to ensure that the effects of the different median treatments, not differences in study locations, are evaluated. For this reason, all the sites used in the accident analysis were taken from the Lufkin district in Texas. By using study locations from the same district, it was believed that regional differences in driving population and growth patterns would be controlled in the analysis. Also, the Lufkin district is primarily rural. Since the emphasis of this study was on the operational and safety effects of TWLTLs and flush medians in rural areas, the study focused on the rural driving population. Finally (and perhaps most importantly), flush medians are a common type of median treatment in the Lufkin district, which made locating potential study sites for both the safety and operational studies somewhat easier.

Potential sites were initially identified using TxDOT's Roadway Inventory Data Base. Candidate locations were identified based on pavement width, number of lanes, and roadway classification (i.e., rural versus urban). Transportation officials from the Lufkin district were then asked to identify the type of median treatment used at each of the candidate locations. In addition, officials from the Lufkin district provided drive-through video recordings of all the flush median and TWLTL sites. The video recordings were later used to estimate the driveway densities at each site.

Table 2 provides a summary of the locations used in the analysis. Initially, six sites were located on highways with TWLTLs, and three sites were located on highways with flush medians.

Accident Rates

Accident frequencies were obtained for each of the study sites using the Texas Accident Data Base maintained by the Texas Department of Public Safety. The accident frequencies were then converted to accident rates using the corresponding traffic volumes from each of the study sites. Accident rates were used to account for differences in the length of each of the study sites. Rates were developed using 3 years (1989, 1990, and 1991) of accident statistics at each of the sites. Both total accident rates and mid-block accident rates were computed for each year from these statistics. Table 2 lists the rates for each site.

To compute the total accident rate, all reported accidents occurring at a study location were used (including those accidents classified as intersection and intersection-related in the TxDOT accident data base). It was believed that this rate provided a true representation of the total accident experience on highways with the different median treatments. This rate included accident data from both signalized and unsignalized intersections.

Mid-block accident rates also were used in an attempt to isolate the effects of the median treatment on safety. The rates were developed using the accidents identified in the data base as occurring in the mid-block sections between intersection locations. They do not include accidents classified as occurring at signalized or unsignalized intersections. However, the rate does include accidents specifically related to vehicles entering and exiting adjacent properties through driveways. It was hypothesized that a high mid-block accident rate indicated potential problems with vehicles using the median to turn into and out of adjacent properties.

TABLE 2 Characteristics of Accident Sites

Median Treatment	Highway	Length (km)	Speed Limit (kmph)	ADT (1991)	Driveway Density (Drwy/km)	Total Accident Rate*			Mid-Block Accident Rate*		
						1989	1990	1991	1989	1990	1991
TWLTLs	US 59	1.29	80	11,605	100.6	8.03	4.44	7.79	3.78	1.48	4.38
	FM 1275	2.25	72	17,503	47.1	8.98	11.28	10.91	4.19	6.38	5.55
	US 59	1.61	88	5,780	9.6	0.00	0.00	1.48	0.00	0.00	1.48
	SH 103	2.1	72	7,802	30.9	7.05	5.02	1.65	3.13	2.93	0.41
	US 69	1.61	88	13,010	24.1	1.62	1.18	1.16	1.62	1.18	0.93
	LP 304	1.61	80	7,353	12.9	2.83	5.13	3.92	2.83	5.13	3.36
Flush Median	LP 224/US 59	0.97	88	17,486	13.3	1.33	2.79	1.17	1.33	2.79	1.17
	US 59	2.41	88	7,017	14.0	3.24	1.63	0.80	1.62	0.81	0.40
	US 69	5.63	88	6,799	12.4	1.16	0.94	1.11	0.97	0.75	0.55

* Accidents per Million Vehicle Kilometers

In addition to examining the effects of the different median treatments on accident rates, the analysis also examined how the different median treatments may have affected the severity of accidents at a site. Since major accidents (i.e., those resulting in fatalities) tend to be random events on rural highways, mid-block accident statistics were grouped into three categories based on the severity rating assigned to each accident by the investigating police officer:

- Severe: accidents that resulted in a fatality or incapacitating injury,
- Minor: accidents in which the reporting officer noted a non-incapacitating or possible injury as a result of the accident, and
- Noninjury: accidents that resulted in property damage only.

Using these categories, accident severity rates were developed for each of the 3 years at each study site.

Accident Analysis

Analysis of variance techniques were used to determine whether accident rates and severity of accidents differed on highways with flush medians and highways with TWLTLs. Using these techniques, it was possible to determine what proportion of the total difference in accident rates and accident severity on the highways could be attributed to the different median treatments, and what proportion was due to random effects within sites with similar median treatments. Three years of accident statistics were used in the analysis. The analysis examined the total and mid-block accident rates, as well as severe, minor, and noninjury accident rates. Differences in accident rates were assessed at a 95 percent confidence level.

Table 3 summarizes the results of the comparison. As shown in this table, statistically significant differences were found in all the accident rates, except in the rates of severe and minor accidents.

TABLE 3 Summary of Accident Analysis

	Analysis Using All Sites			Analysis Using Sites with Low Driveway Densities	
	TWLTL (6 sites)	Flush Medians (3 sites)	Significant Difference?	TWLTL (3 Sites)	Significant Difference?
Average Accident Rates (Accidents/Million Vehicle Kilometers)					
Total	4.85	1.58	Yes	2.22	No
Midblock	2.70	1.16	Yes	2.14	No
Average Accident Severity Rates (Accidents/Million Vehicle Kilometers)					
Severe	0.18	0.16	No	0.19	No
Minor	0.80	0.43	No	0.47	No
Non-Injury	1.72	0.58	Yes	1.48	No

Note: The initial analysis used data from all the TWLTL sites and compared the average of the TWLTL sites to the average of the flush median sites. The second analysis only used the data from the three TWLTL sites with low driveway density. Its average was also compared to the average of the flush median sites.

This suggests that highways with TWLTLs typically experience higher accident rates, in terms of both total and mid-block accidents, than do highways marked with flush medians. These results also suggest that, in general, the rates of noninjury accidents tend to be higher on roadways with a TWLTL than on those with a flush median.

However, these results were not supported by the results of the operational field studies. For this reason, a more detailed review of the characteristics of the individual sites was performed. As shown in Table 2, considerable differences existed between the characteristics of some of the TWLTL sites and the flush median sites. Several of the TWLTL sites had considerably higher driveway densities. Since the number of access points is expected to have a significant impact on accident rates on a highway, the TWLTL sites with high driveway densities could not be considered comparable to the flush median sites. Therefore, those TWLTL sites that had more than 14.5 driveways per km were dropped.

After eliminating the TWLTL sites that had significantly higher driveway densities, accident and severity rates were compared again using analysis of variance techniques. As indicated in Table 3, the results of the analysis showed that there was no significant difference in either total accident rate or mid-block accident rate for highways marked with a TWLTL and highways using a flush median treatment. Neither was any statistical difference observed between the rates of severe, minor, and noninjury accidents. Therefore, it can be concluded that on highways with comparable characteristics (i.e., driveway densities and posted speed limits) one type of median treatment is not superior to the other, at least from a safety standpoint.

It should be noted, however, that this conclusion is only valid for highways with a relatively low level of development (i.e., with a driveway density of less than 14.5 driveways per km). Where driveway densities are higher, a significant difference in the safety performance of highways using TWLTL and flush median treatments may be observed. But since highways with flush medians and high driveway densities could not be found for this analysis, this hypothesis remained untested in this study.

SUMMARY

Medians on rural and urban highways serve many functions, including separating opposing streams of traffic, reducing headlight glare, providing a recovery area for errant vehicles, and providing storage and acceleration/deceleration areas for turning vehicles. The type of median (i.e., flush, raised or depressed, or TWLTL) that should be used on a highway depends on a number of factors. This study offers guidelines on what type of median is most appropriate on highways where the roadside development shifts from rural to suburban. In these situations, some TxDOT districts use flush medians to separate opposing traffic streams. Flush medians combine many of the attributes and features of raised or depressed medians and TWLTLs. Unfortunately, there are no clear guidelines indicating when flush medians are appropriate on four-lane rural highways.

The purpose of this research was to examine differences in the operation and safety of four-lane rural highways with TWLTLs and four-lane rural highways with flush medians. Safety was evaluated by reviewing 3 years of accident records from four-lane rural highways with both of these types of median treatments in the TxDOT Lufkin district. Total accident rates, mid-block accident rates, and three levels of accident severity were analyzed. This review found no statistical difference in accident rates and severity between highways with TWLTLs and highways with flush medians when driveway densities were low (i.e., less than 14.5 driveways per km). Because of the limited number of flush median sites, however, it was not possible to determine whether a difference in safety between these two median treatments exists at higher levels of development (i.e., with driveway densities greater than 14.5 driveways per km).

Field studies evaluating the traffic operational characteristics of flush medians and TWLTLs on four-lane rural highways were performed. Observations of how vehicles used the median area on highways with these two median treatments were also performed. Turning movement volumes at select driveway locations on four-lane rural roadways striped with a flush median or a TWLTL were collected. These data were used to assess whether there was a significant difference in the way left-turning vehicles used the median area.

The field studies found that for all practical purposes, there was no difference in the way drivers used highways marked with TWLTLs and highways marked with flush medians. The number of drivers observed using the flush median as a storage area and as an acceleration lane was about equal to the number of drivers observed using the TWLTL for those maneuvers. Based on the operational data, it was concluded that there was no difference in the way flush medians and TWLTLs function on four-lane rural highways.

RECOMMENDATIONS

On the basis of the results of this study, it appears that drivers are ignoring the meaning of the flush median marking. The results have indicated that drivers use flush medians and TWLTLs similarly. Therefore, it is recommended that in order to promote uniform application of traffic control devices, flush medians should be used only in situations in which the location and spacing of driveways permit left-turn bays at every driveway location. This would provide drivers with an area to store and decelerate when executing a left turn from the highway. If median openings at every driveway are not possible then a TWLTL should be used. Using TWLTLs in these situations would promote the uniform application of pavement markings in situations where left turns are permitted to adjacent properties. However, if there is an operational or safety need to prevent left turns from the median, some form of physical barrier (such as a raised or depressed median island, or a median barrier) should be used to physically prohibit drivers from using the median area. Flush medians should not be used to control access to adjacent properties unless strict enforcement can also be provided.

ACKNOWLEDGMENT

This research was sponsored by the Texas Department of Transportation and the Federal Highway Administration. The technical coordinator for the study was Jerry Shelby.

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Publication of this paper sponsored by Committee on Operational Effects of Geometrics.