Study of Freeway Access Violations

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•A FREEWAY is a divided arterial highway for through traffic, with full control of access and grade separations at all crossings; but a motorist defines a freeway by the quality of service it provides rather than its physical characteristics. The motorist views the freeway as a superhighway which eliminates annoyances, hazards of left turns, blind intersections, dangerous curves and distractions close to the highway. Freeways are expected to be a motorists' highway with motorists' needs anticipated and fulfilled to a much higher degree than on conventional highways. Experience has shown, however, that it is not enough to merely build freeways. To deliver the promised safety, comfort, and convenience, freeways must have a high degree of operational attention. Control of access, one feature of freeway design, implies that the rights to light, air, view, and access are controlled by public authority. This feature provides a fundamental change in the concept of modern highways. There were indications, however, that the access control feature of freeway design was being violated and that additional controls may be required to insure access control.

The general objectives of this project were to determine the extent and causes of access violations on controlled access facilities, and to provide data that would be useful in controlling existing access violations and in anticipating and eliminating future violations. The specific objectives of this study were: (a) to catalog the types of access violations; and (c) to determine the effectiveness of various design and control features presently being utilized to prevent access violations.

STUDY PROCEDURE

Data Collection

To determine the extent of access violations, it was decided to collect data on controlled access facilities across Texas. Data were collected on approximately 770 mi of freeway which included all Interstate Highways within the state. The locations from which data were actually collected are shown in Figure 1. Since the data collection was to be accomplished on a statewide basis, it was determined that the Texas Highway Department would request each district's maintenance personnel to collect the data using a standard data collection form. Although district maintenance personnel were requested to complete the data collection form, in many districts the traffic engineering personnel completed or supervised the completion of the data collection forms.

The "Shoulder and Rest Area Use Procedure Guide" (1) was helpful in making a data collection form. A first form was made and evaluated in the field to determine its shortcomings. The necessary changes were made and the form was again reviewed and cleared for statewide data collection. Material in addition to the data collection forms sent to each Highway Department district were: an extract of the project statement, data collection procedure sheets, and two completed sample data collection forms. The extract from the project statement explained the specific aim of the investigation,

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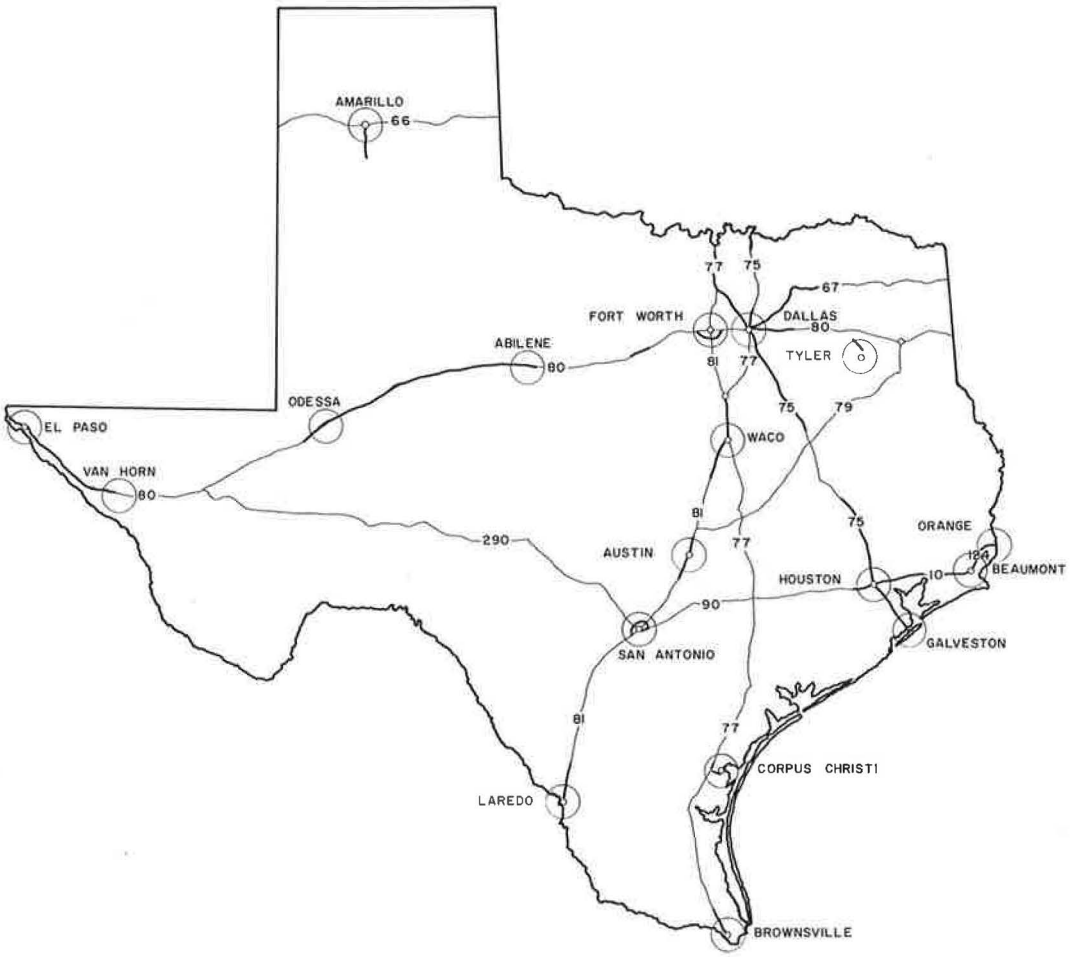


Figure 1. Study locations.

the method of procedure to be used, and the significance of the research. The data collection procedure sheets explained the purpose of the investigation and the information desired, and gave directions for completing the data collection form.

Data requested in addition to the data collection form were a district control-section map showing the location of the facilities from which data were collected, a schematic sheet with a sketch illustrating the conditions for each violation, photographs, if possible, and any pertinent information not covered in the form. The data collection personnel had 4 methods of determining access violations: (a) to see a violation actually take place; (b) to see the tracks of violations that had occurred previously; (c) to remember violations that had been seen on other occasions; and (d) to note past violations which have been eliminated by corrective measures.

Data collection was accomplished on a one-time basis by all districts during the month of March or April 1964. This means that the personnel drove through the facility one time only, completing the data collection forms and taking photographs. Aerial photographs were made of the major types of violations and some of the causes of violations for inclusion in this report.

Analysis of Data

After receiving the data, the forms were checked against the sketch of the violation to insure that each form had been correctly completed. Any errors in the data collec-

1 VIOLATION NUMBER: _____

District _____ County _____

Highway Number _____ Between _____ And _____

Control _____ Section _____

Station (approximate) _____ Urban _____ Rural _____

Location with respect to nearest access (Interchange, Grade Separation or nearby road): _____

2. DATE: _____

3. INSPECTOR: _____

4. VIOLATOR: (Check appropriate block)

( ) Pedestrian ( ) Animal

( ) Vehicle ( ) Other: _____

(Note any specific group of violators such as telephone or power companies, school children, etc.)

_____

5. TYPE OF VIOLATION: (Check appropriate block or blocks)

( ) Median Crossing ( ) Incorrect Use of Entrance Ramp

( ) Separation Strip Crossing ( ) Incorrect Use of Exit Ramp

( ) Nose Crossing ( ) Entrance Where No Entrance Ramp Exists

( ) Crossing Entire Freeway System ( ) Exit Where No Exit Ramp Exists

( ) Unattended Vehicle on Shoulder ( ) Wrong Way on Frontage Road

( ) Parking on Median ( ) Animal Crossing

( ) Hitch-Hiking ( ) Loading or Unloading Passengers

( ) Other: _____

_____

6. FREQUENCY OF VIOLATION: (Estimate the number of violations per week if possible:

( ) Very Often ( ) Occasionally

( ) Often ( ) Seldom

7. PURPOSE OF VIOLATION:

( ) "U" Turn ( ) Access to Home, Farm, or Business

( ) Leisure Stop ( ) Access from Home, Farm, or Business

( ) Business Stop ( ) Access to or from New Development

( ) Emergency Stop ( ) Other: _____

8. CAUSE OF VIOLATION:

( ) No Ramp ( ) Most Convenient Route

( ) No Grade Separation ( ) Frontage Road Ends

( ) No Frontage Road ( ) End of Corrective Measure

( ) Other: _____

_____

(Also describe and show on skematic sheet geometric factors contributing to the violation in addition to those above. Describe what proper route if any is available to traffic and estimate the additional time and distance required. Use the dashed lines to show the proper route on the skematic sheet.)

_____

ADDITIONAL TIME _____ ADDITIONAL DISTANCE _____

Figure 2. Data collection form for analysis of access violations on controlled access facilities.

9. DURATION OF VIOLATION: (Estimate the time required to complete the violation maneuver.)
(___) less than 5 minutes
(___) 5 to 15 minutes
(___) 15 minutes to 1 hour
(___) 1 hour to 5 hours
(___) over 5 hours
(___) variable

10. SEVERITY OF VIOLATION:
(___) Very Dangerous (___) Dangerous (___) Relatively Safe

11. PRESENCE OF VIOLATIONS: (Estimate how long the violation has existed and note if it is of a temporary nature due to roadside construction, etc)
(___) Since highway opened in _____
(___) Temporary for _____ months
(___) Other: _____
(___) Since corrective measure was placed

12. CORRECTIVE MEASURES: (Describe the effectiveness of corrective measures used in the past.)

(___) Signs	(___) Effective	(___) Ineffective
(___) Posts with Barrier Cable	(___) Effective	(___) Ineffective
(___) Ditches	(___) Effective	(___) Ineffective
(___) Curbs	(___) Effective	(___) Ineffective
(___) Chain Line Fences	(___) Effective	(___) Ineffective
(___) Guard Fences	(___) Effective	(___) Ineffective
(___) None	(___) Effective	(___) Ineffective
(___) Guard Posts	(___) Effective	(___) Ineffective
(___) Other: _____	(___) Effective	(___) Ineffective

_____
_____
(Describe any suggested or anticipated measures for elimination of this violation.)
_____
_____
_____

13. Has this violation been eliminated? Yes (___) No (___)

14. ENFORCEMENT: (Rate enforcement level in this vicinity.)
(___) High (___) Low (___) Medium

15. ACCIDENT HISTORY: (Describe and sketch on plan or skematic sheet any accidents at this point which were the result of this violation.)
(___) None Reported
(___) History: _____
_____
_____
_____
_____
_____
_____

16. SKETCH: (Illustrate the conditions described in items 5, 8, and 12 above on approximately 1" = 200' skematic sheet. Ground photos should be provided when justified by the severity of the violation.)
Note profile of violation area as:
(___) Relatively Flat
(___) Other: (Sketch cross section below)

17. VOLUME: (Give average daily traffic on controlled access facility.)
ADT = _____

Figure 2. (Continued).

tion form which could be determined were corrected. This review revealed that some changes should be made in the form. Many of the questionnaires had blocks with "other" checked and the same comment entered. These forms were altered to add separate blocks for these comments before the data were removed. The revised form which included these alterations is shown in Figure 2.

The data were then punched into IBM cards with the coding shown in Table 1 and sorted on the desired columns using an IBM sorting machine. Next, the contents of the sorted cards were printed on paper using the IBM 407 accounting machine. This machine printed a list of the card contents sorted on a certain column and a count of the

TABLE 1

CODE OF DATA COLLECTION FORM

Col.	1-2	Last two digits of TTI project number 65 = Project 1065
Col.	3-4	Number of month data was collected 3 = March 4 = April
Col.	5	Last digit of year data was collected 4 = 1964
Col.	7-8	Texas Highway Department district number
Col.	10-16	Violation number for each district (letters preceding numbers indicate that the district had more than one number 1).
Col.	18	Urban or rural Urban - 1 Rural - 3
Col.	20-22	Location to nearest access in tenths of a mile Blank = Unknown or does not apply
Col.	24	Violator 1 = Pedestrian 3 = Animal 2 = Vehicle 4 = Other
Col.	25	Specific group of violator 1 = No specific group 2 = Specific group
Col.	27-30	Type of violation (up to four may be checked for one violation) A = Median crossing B = Separation strip crossing C = Nose crossing D = Crossing entire freeway system E = Unattended vehicle on shoulder F = Parking on median G = Hitch-hiking H = Other I = Incorrect use of entrance ramp J = Incorrect use of exit ramp K = Entrance where no entrance ramp exists L = Exit where no exit ramp exists M = Wrong way on frontage road N = Animal crossing O = Loading or unloading passengers
Col.	34	Purpose of violation 1 = U turn 2 = Leisure stop 3 = Business stop 4 = Emergency 5 = Access to home, farm, or business 6 = Access from home, farm, or business 7 = Access to or from new development 8 = Other
Col.	36-37	Cause of violation (up to two may be checked for one violation) 1 = No ramp 2 = No grade separation 3 = No frontage road 4 = Other 5 = Most convenient route 6 = Frontage road ends 7 = End of corrective measure
Col.	39-40	Additional time in minutes required for legal route Zeros = No additional time required Blank = Does not apply
Col.	42-44	Additional distance to tenths of a mile required for legal route Zeros = No additional distance required Blank = Does not apply
Col.	46	Duration of violation 1 = Less than 5 minutes 4 = 1 hour to 5 hours 2 = 5 to 15 minutes 5 = Over 5 hours 3 = 15 minutes to 1 hour 6 = Variable
Col.	48	Severity of violation 1 = Very dangerous 2 = Dangerous 3 = Relatively safe
Col.	50	Presence of violation 1 = Since highway opened. . . 3 = Other 2 = Temporary 4 = Since corrective measure was placed
Col.	52 55 58	Corrective measures 0 = Unknown 1 = Signs 2 = Posts with barrier cable 3 = Ditches 4 = Curbs 5 = Chain link fences 6 = Guard fences 7 = None 8 = Other 9 = Guard posts
Col.	53 56 59	Effectiveness of corrective measures 0 = Unknown 1 = Effective 2 = Ineffective
Col.	64	Suggested corrective control measures 1 = No suggestions 2 = Suggested control measures
Col.	66	Violation eliminated or still in existence 1 = Violation still in existence 2 = Violation eliminated
Col.	68	Enforcement level 1 = High 2 = Low 3 = Medium
Col.	70	Accident history 1 = None reported 2 = History
Col.	72	Profile 1 = Relatively flat 2 = Other
Col.	74-78	Average daily traffic Blanks = No data submitted
Col.	80	Ground photo 1 = No photo 2 = Fair photo 3 = Good photo

number of cards printed. Thus, a permanent record of the sorting process was achieved for use in graphically illustrating the project results.

RESULTS

Types of Access Violations

The first objective of this project was to catalog the types of access violations occurring on controlled access facilities. Access violations were cataloged into types of violations as determined by the path or route of the violator. Each type of violation described the freeway areas crossed during the violation maneuver and the violator's direction of travel. Figure 3 defines the freeway areas as used in naming the types of violations. An example of one type of violation was a "separation strip crossing, exit where no exit ramp exists," which means that the separation strip was crossed in making an illegal departure from the freeway facility.

For a better understanding, many of the types of violations are illustrated in Figures 4 through 7. Types of violations in addition to those illustrated were an unattended vehicle on the shoulder, parking on the median, hitch-hiking, animal crossing, loading and unloading passengers, and the general group catalogs as "other." The classification "other" was used for violations which did not have enough occurrences to be considered as an individual type of violation. A list of all of the types of violations is given in Table 2. Aerial photographs of some types of access violations existing in June 1964 are shown in Figures 8, 9, and 10. While taking the aerial photographs, the photographer noted a blanket salesman selling his goods within the Interstate right-of-way (Fig. 9).

Extent and Causes of Access Violations

The extent or frequency of the types of access violation locations are given in Table 2, which gives both the number of violation locations and percent of all violation locations. The total number of violation locations reported was 986 making the percent for each type roughly one-tenth of the number of violation locations. The 986 violation locations occurred over approximately 770 mi of freeway, a ratio of 1.3 access violation locations per mile of freeway. Twenty-five percent of these violation locations occurred on the 130 mi of urban freeway studied, a ratio of 1.9 access violation locations per mile of urban freeway. The remainder of the violation locations occurred on 640 mi of rural freeway, a ratio of 0.85 access violation locations per mile of rural freeway.

Although there were 28 different types of violations, 5 types were predominant, which accounted for 63.2 percent of the violation locations reported. The predominant or major types of access violations were:

1. Separation strip crossing, exit where no exit ramp exists;
2. Median crossing;
3. Separation strip crossing, entrance where no entrance ramp exists;
4. Unattended vehicle on shoulder; and
5. Crossing entire freeway system.

The frequency of these types of violations and their respective percentages are shown in Figure 11. The type of violation, loading or unloading passengers, was not marked as one occurring in the state, yet it was included because the author noted and photographed this taking place on a Houston freeway. It was believed that a continuous surveillance method of data collection, rather than the once-over method used, would indicate the frequency of this type of violation (Fig. 10).

The number of violation locations shown in Table 2 does not take into account how often each violation was repeated. These data were required to determine the true extent of access violations. Since data were collected on a one-time basis, the frequency of each violation was estimated by the personnel completing the questionnaire in the general terms of seldom, occasionally, often or very often. This estimation is shown in Figure 12. Noting that "often" was marked for 44 percent of the violation locations

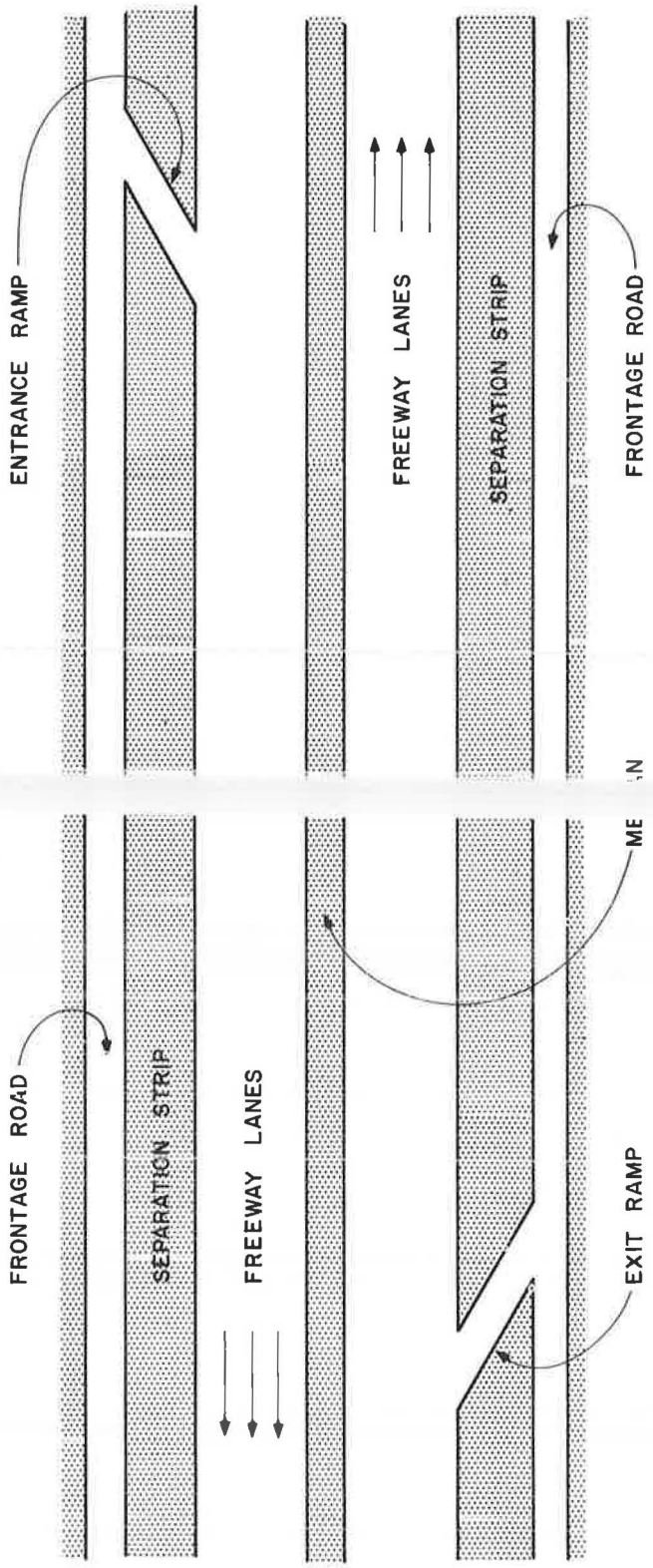


Figure 3 eeway definitions.

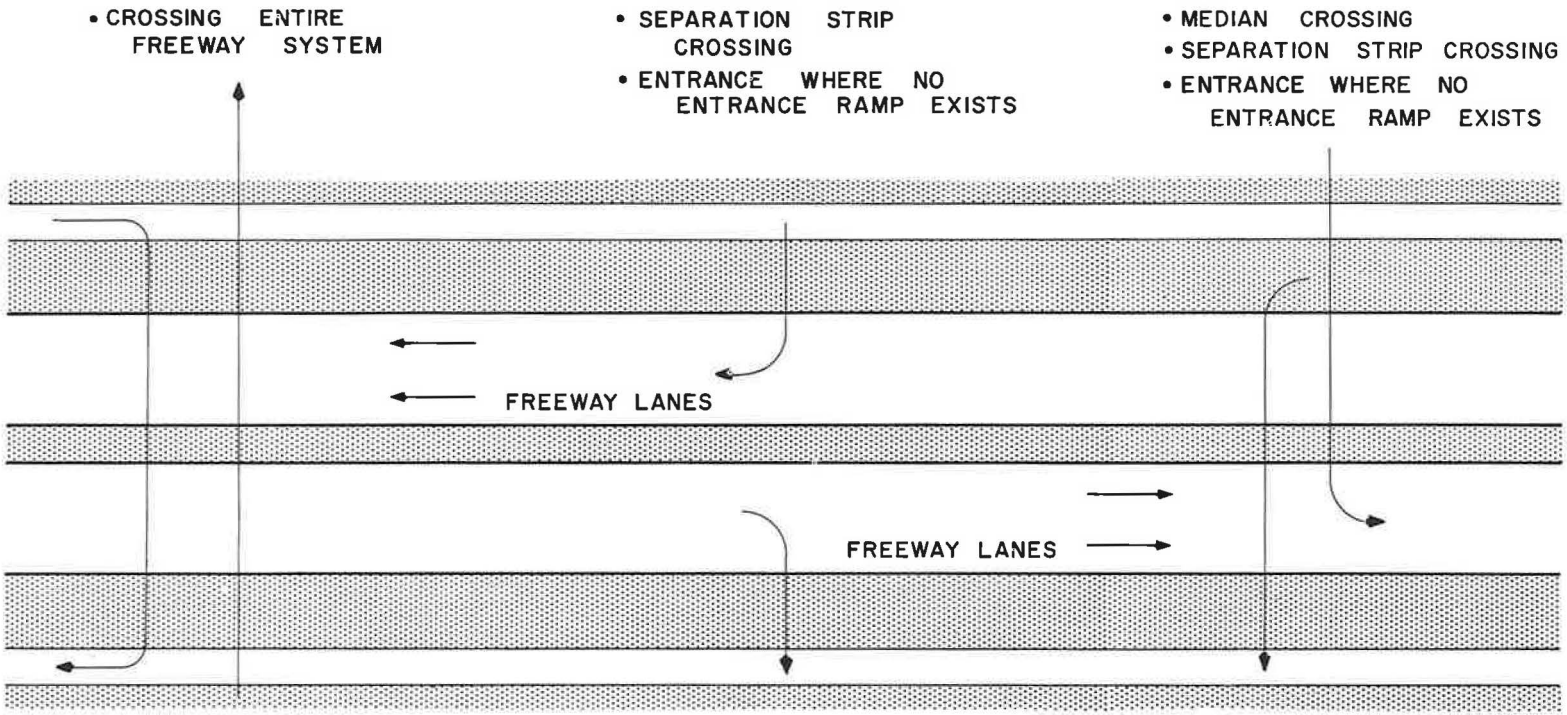


Figure 4. Types of access violations.

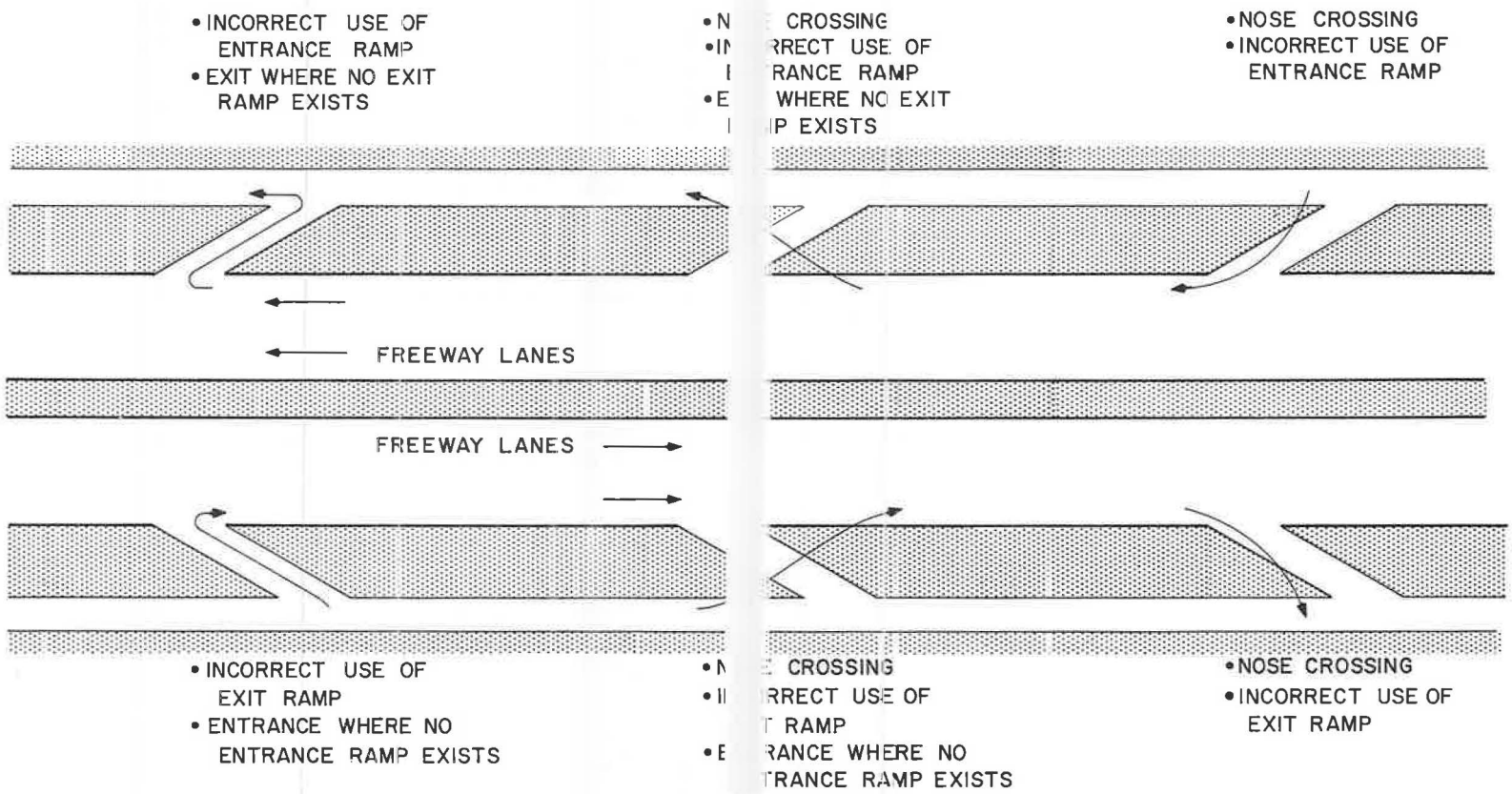


Figure 5. T of access violations.

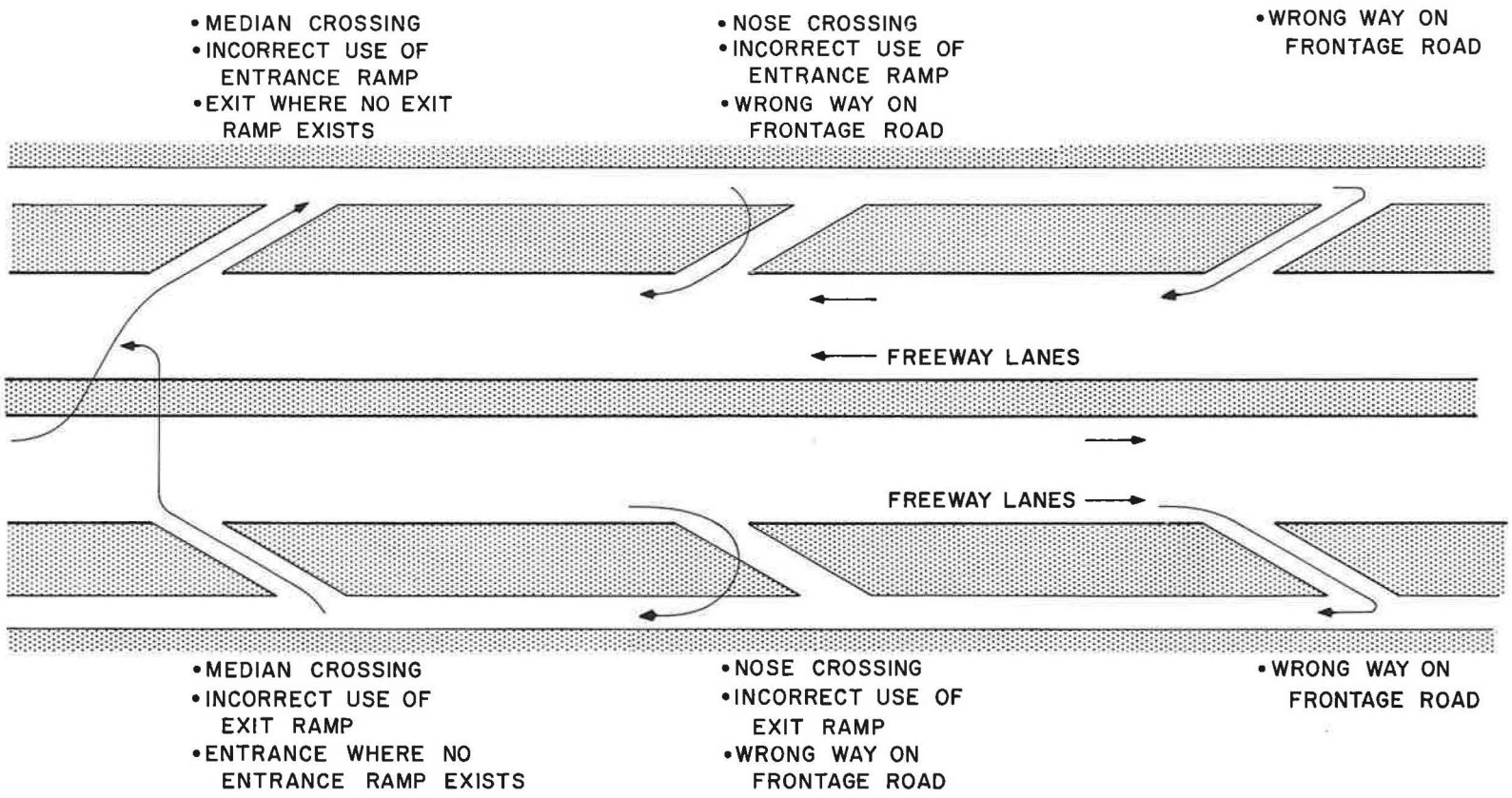


Figure 6. Types of access violations.

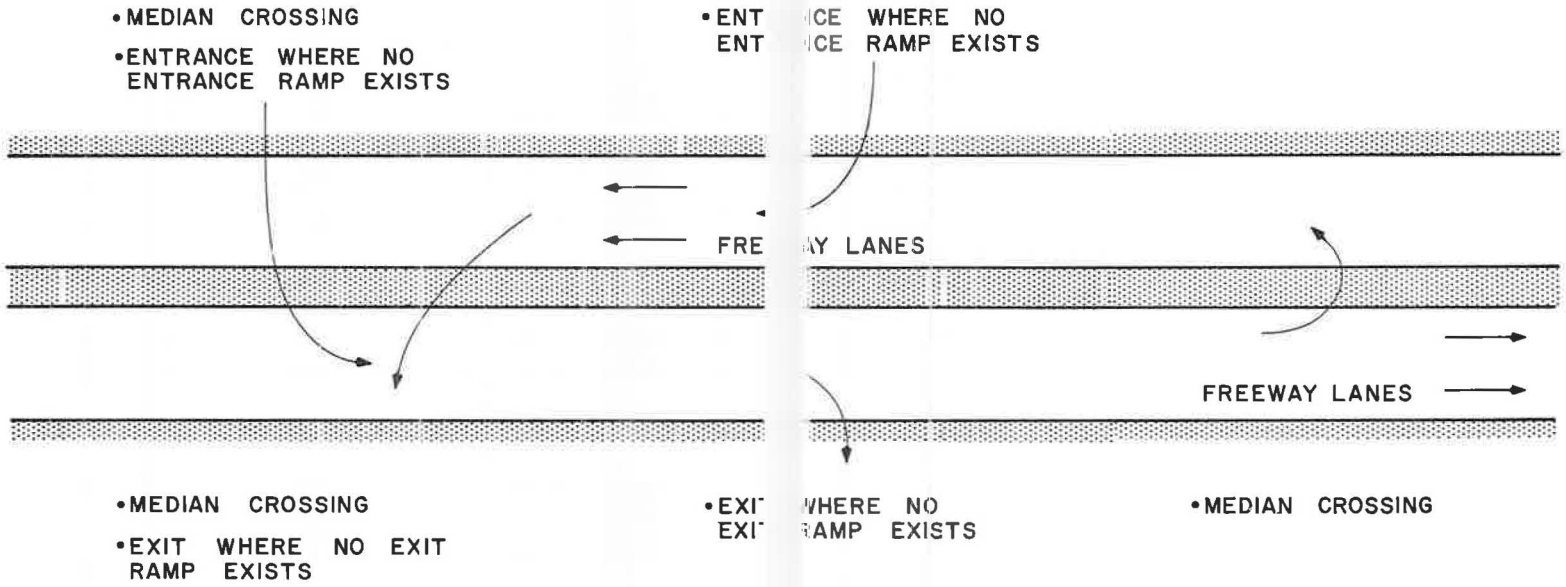
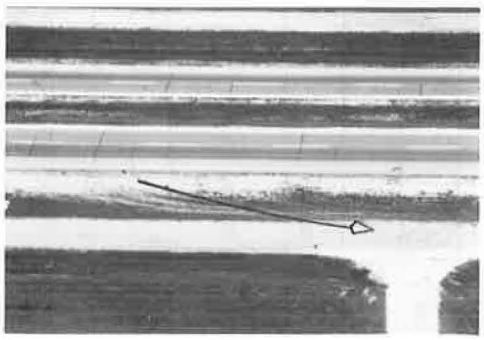


Figure 7. Typ f access violations.

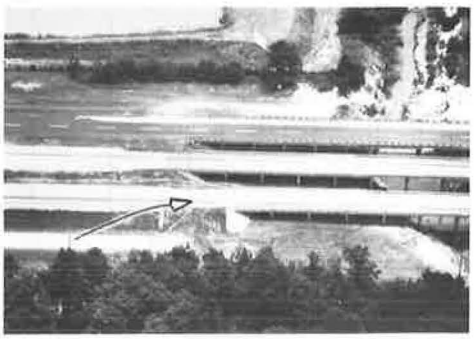
TABLE 2

TABLE OF THE FREQUENCY OF TYPES OF VIOLATION LOCATIONS

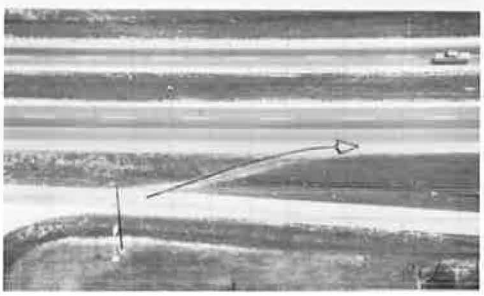
TYPE OF VIOLATION	NUMBER OF VIOLATION LOCATIONS	PERCENT OF VIOLATION LOCATIONS	TYPE OF VIOLATION	NUMBER OF VIOLATION LOCATIONS	PERCENT OF VIOLATION LOCATIONS
MEDIAN CROSSING	180	18.2	CROSSING ENTIRE FREEWAY SYSTEM	58	5.9
MEDIAN CROSSING SEPARATION STRIP CROSSING ENTRANCE WHERE NO ENTRANCE RAMP EXISTS	35	3.6	MEDIAN CROSSING INCORRECT USE OF ENTRANCE RAMP EXIT WHERE NO EXIT RAMP EXISTS	9	0.9
MEDIAN CROSSING SEPARATION STRIP CROSSING EXIT WHERE NO EXIT RAMP EXISTS	48	4.9	MEDIAN CROSSING INCORRECT USE OF EXIT RAMP ENTRANCE WHERE NO ENTRANCE RAMP EXISTS	4	0.4
NOSE CROSSING INCORRECT USE OF ENTRANCE RAMP WRONG WAY ON FRONTAGE ROAD	3	0.3	NOSE CROSSING INCORRECT USE OF ENTRANCE RAMP EXIT WHERE NO EXIT RAMP EXISTS	40	4.1
NOSE CROSSING INCORRECT USE OF EXIT RAMP WRONG WAY ON FRONTAGE ROAD	5	0.5	NOSE CROSSING INCORRECT USE OF EXIT RAMP ENTRANCE WHERE NO ENTRANCE RAMP EXISTS	37	3.8
MEDIAN CROSSING ENTRANCE WHERE NO ENTRANCE RAMP EXISTS	5	0.5	NOSE CROSSING INCORRECT USE OF ENTRANCE RAMP	8	0.8
MEDIAN CROSSING EXIT WHERE NO EXIT RAMP EXISTS	8	0.8	NOSE CROSSING INCORRECT USE OF EXIT RAMP	12	1.2
SEPARATION STRIP CROSSING EXIT WHERE NO EXIT RAMP EXISTS	204	20.7	INCORRECT USE OF ENTRANCE RAMP EXIT WHERE NO EXIT RAMP EXISTS	30	3.0
SEPARATION STRIP CROSSING ENTRANCE WHERE NO ENTRANCE RAMP EXISTS	112	11.4	INCORRECT USE OF EXIT RAMP ENTRANCE WHERE NO ENTRANCE RAMP EXISTS	20	2.0
UNATTENDED VEHICLE ON SHOULDER	68	7.0	MEDIAN CROSSING SEPARATION STRIP CROSSING ENTRANCE WHERE NO ENTRANCE RAMP EXISTS EXIT WHERE NO EXIT RAMP EXISTS	10	1.0
PARKING ON MEDIAN	6	0.6			
HITCH-HIKING	2	0.2			
ENTRANCE WHERE NO ENTRANCE RAMP EXISTS	21	2.1	ANIMAL CROSSING	2	0.2
EXIT WHERE NO EXIT RAMP EXISTS	20	2.0	LOADING OR UNLOADING PASSENGERS	0	0.0
WRONG WAY ON FRONTAGE ROAD	19	1.9	OTHER	22	2.2
			TOTAL	986	100.0



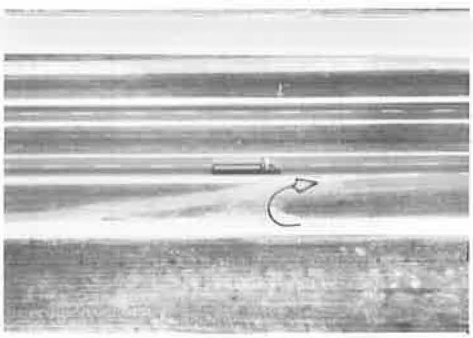
- SEPARATION STRIP CROSSING
- EXIT WHERE NO EXIT RAMP EXISTS.



- SEPARATION STRIP CROSSING
- ENTRANCE WHERE NO RAMP EXISTS.



- SEPARATION STRIP CROSSING
- ENTRANCE WHERE NO RAMP EXISTS.

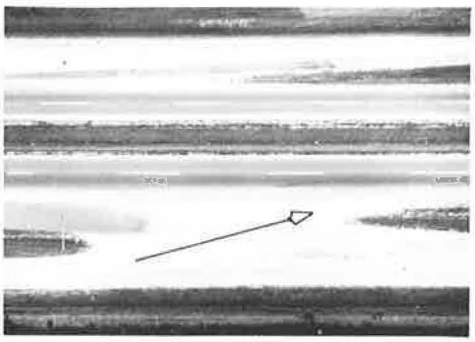


- NOSE CROSSING
- INCORRECT USE OF ENTRANCE RAMP.

Figure 8. Types of access violations.

- UNATTENDED VEHICLE ON SHOULDER.

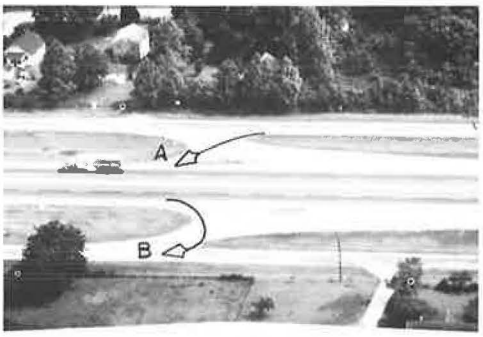
- LOADING OR UNLOADING PASSENGER.



- NOSE CROSSING
- INCORRECT USE OF EXIT RAMP.
- ENTRANCE WHERE NO ENTRANCE RAMP EXISTS.

- BLANKET SALES ON RIGHT OF WAY.

Figure 9. Types of access violations.

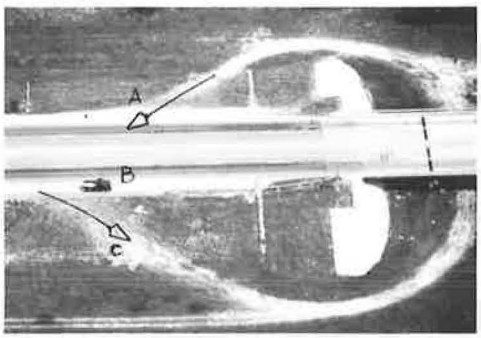


A

- NOSE CROSSING
- INCORRECT USE OF EXIT RAMP
- ENTRANCE WHERE NO ENTRANCE RAMP EXISTS.

B

- NOSE CROSSING
- INCORRECT USE OF ENTRANCE
- EXIT WHERE NO EXIT RAMP EXISTS.



A

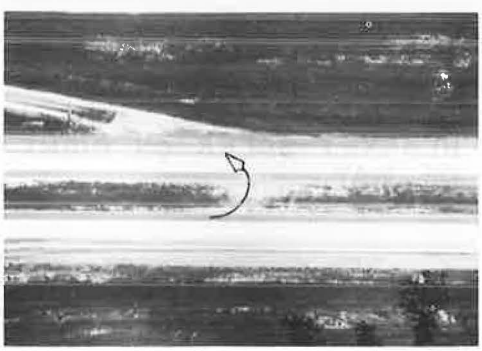
- ENTRANCE WHERE NO ENTRANCE RAMP EXISTS.

B

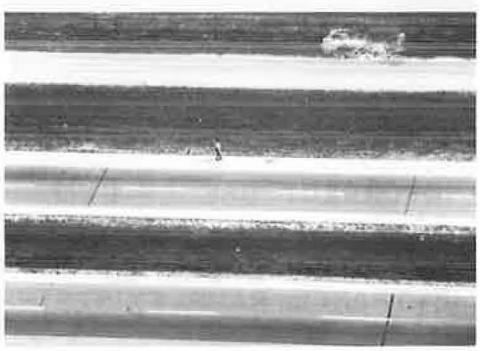
- UNATTENDED VEHICLE ON SHOULDER.

C

- EXIT WHERE NO EXIT RAMP EXISTS.



- MEDIAN CROSSING



- HITCH-HIKING

Figure 10. Types of access violations.

and that "very often" was marked for 24 percent of the violation locations, it may be assumed that the true extent of access violations was several times greater than the total number of the types of violation locations reported (986).

The primary cause of access violations was that the violation route was the most convenient route. This generally resulted from one of two conditions: there was no ramp available, or there was no grade separation available.

Figure 13 shows the frequency of the cause of access violations. Since 2 causes could be marked on the questionnaire for each violation, the sum of the percents for all causes was greater than 100.

The greatest cause of violations was that the violation route was the most convenient route. This cause of violation was indicated for over 52 percent of the violation locations.

Figure 14 shows that 35 percent of the violation locations with most convenient route marked as a cause, required no additional distance to go the legal route. (No additional distance to go the legal route means that the violator could have exited back down the freeway, driven the remainder of the distance on the frontage road, and traveled the same distance as was traveled in the route with the violation.)

Seventy percent of the violation locations required an additional distance of one mile or less to go the legal route. This seemed to leave the freeway designer with little opportunity to design freeways to eliminate this cause of violation, since only 30 percent of the violation locations could be eliminated with ramps, interchanges, etc.,

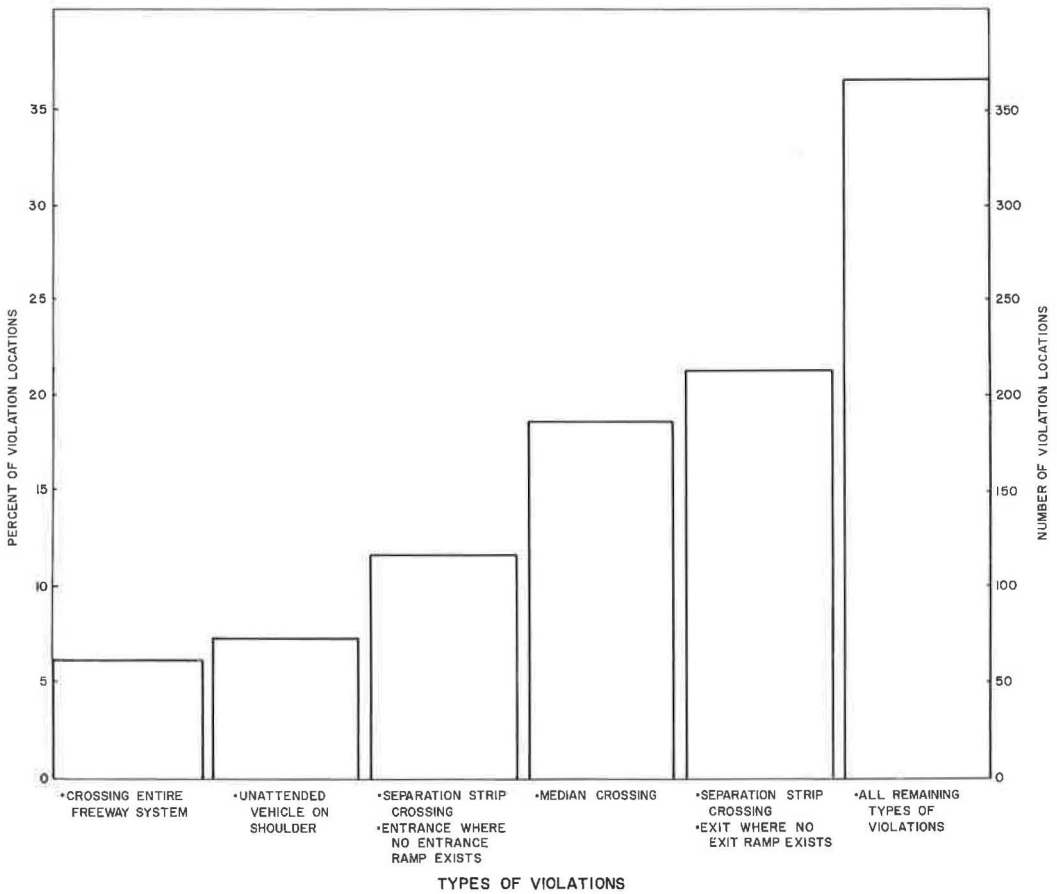


Figure 11. Frequency of major types of violations.

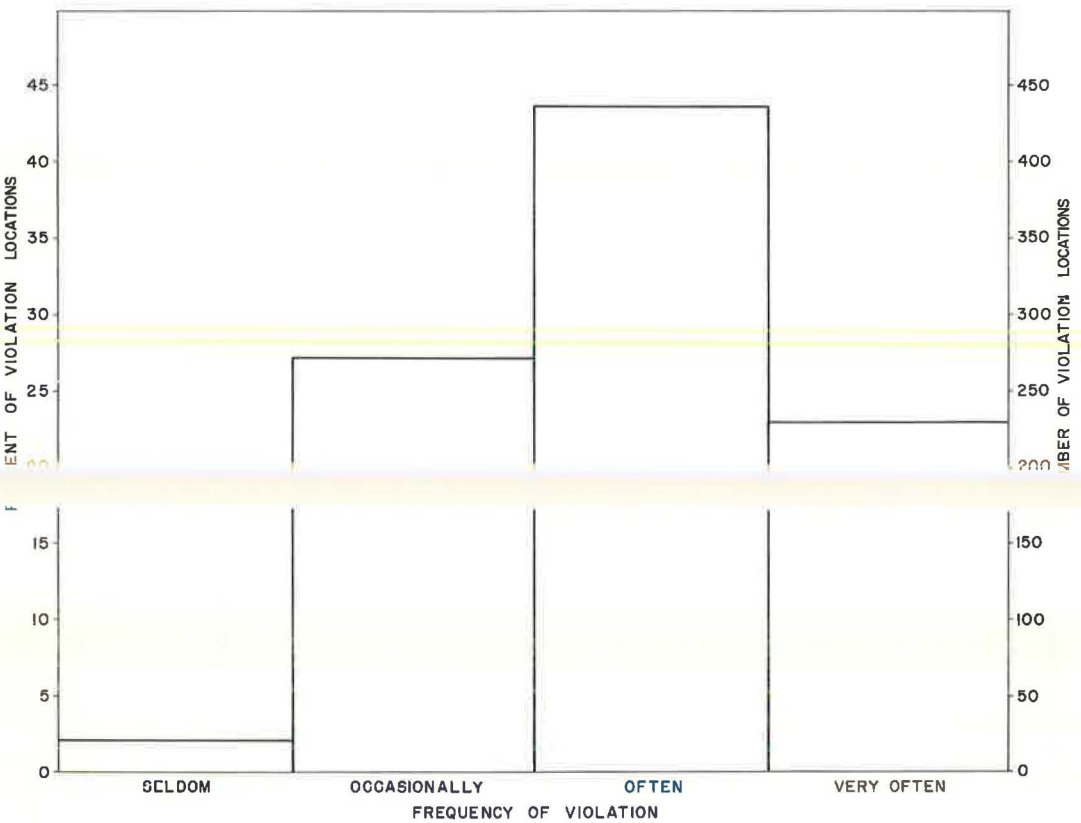


Figure 12. Extent of the frequency of violations.

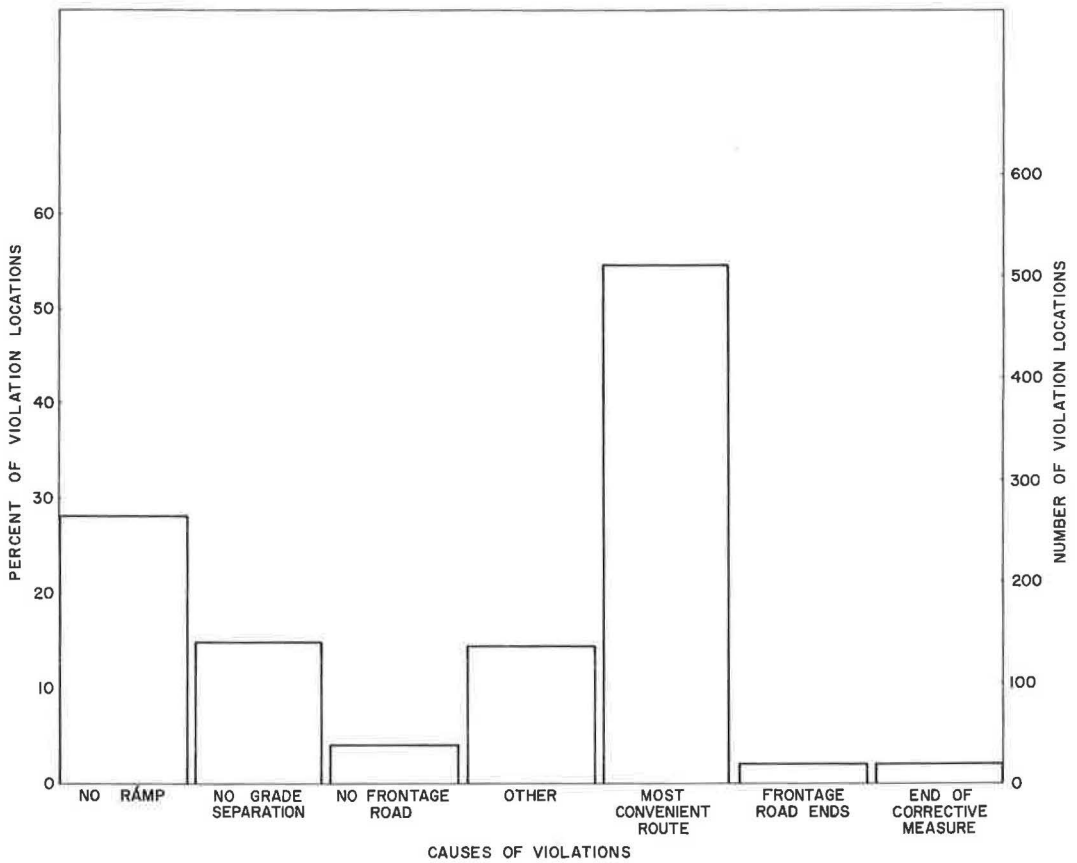


Figure 13. Frequency of causes of violations.

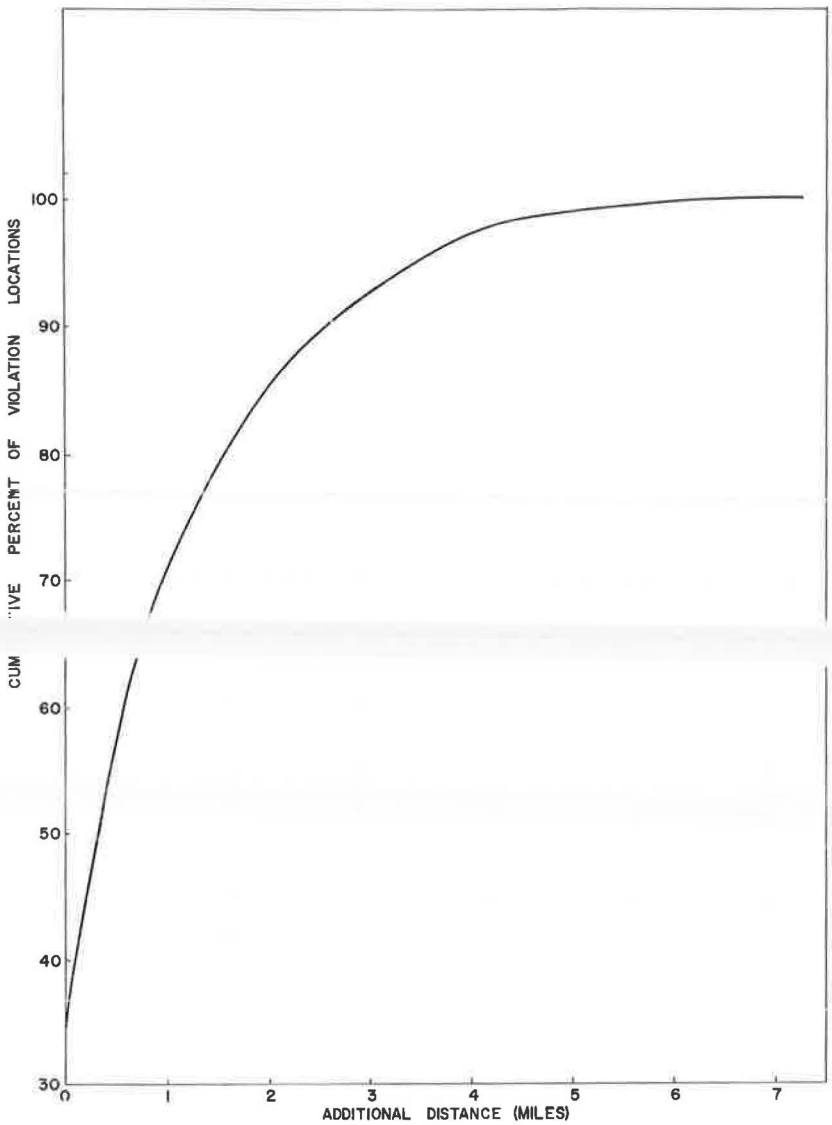


Figure 14. Relationship between additional distance and cause, most convenient route.

spaced at one-mile intervals. At best, the designer would only be able to design corrective measures to enforce the elimination of violation locations for this cause.

Effectiveness of Corrective Measures

The frequency of the use of the different types of corrective measures was determined from the opinions of the field personnel as found in the data collection forms. These frequencies are plotted as bar graphs in Figure 15. The sum of the percent for the bars did not equal 100 percent since up to 3 corrective measures could be marked for one violation.

Determining the effectiveness of these corrective measures was the third objective of this project. Figure 16 shows the percentage that each corrective measure was rated as effective and ineffective. The corrective measure signs were ineffective more often than effective, 78 percent vs 22 percent. Curbs, chain-link fences, and posts with barrier cable showed a very high effectiveness ratio. The sample size for curbs and chain link fences was very small (Fig. 15).

ADDITIONAL CONSIDERATIONS

Types of Access Violators

The access violator was cataloged into 3 types: pedestrian, vehicle, and animal since the type "other" was not marked on any questionnaire. Figure 17 shows the frequency of each of the types of violators with the vehicle accounting for 94 percent. Figure 18 shows that in 10 percent of the violation locations, a specific group was involved. These groups included school children, power companies, telephone companies, roadside advertising companies, and particular business firms. There was a possibility that these violation locations could be eliminated by contacting these groups, pointing out the proper route, noting the severity of the violation, and requesting their help in eliminating the violation. This procedure was effective in eliminating one violation in the Ft. Worth area.

Purposes of Access Violations

Figure 19 shows the major purposes for access violations to be (a) egress from the freeway facility, (b) access to the freeway facility, and (c) a change of direction on the freeway facility. These purposes substantiated the 3 major types of violations which are shown in Figure 11.

Average Daily Traffic

Figure 20 shows that 46 percent of the violation locations occurred on facilities with an average daily traffic from 5,000 to 9,999. The sum of percentages of the bar graphs did not equal 100 percent because 163 (16.5%) of the questionnaires did not furnish a figure for average daily traffic. Only 3 violations were reported with an average daily traffic greater than 30,000.

The 3 major types of violations were correlated with average daily traffic in Figure 21. Approximately 60 percent of the violation locations for each of the major causes took place on a facility with an average daily traffic less than 6,000.

Additional Distance To Go the Legal Route

Figure 22 shows that 35 percent of the violation locations require no additional time to go the legal route. According to this graph, 80 percent of the violation locations occurred when the additional time required to go the legal route was less than 5 minutes.

Severity of Violations

The frequency of the severity of violations is shown in Figure 23. Dangerous was marked for almost 50 percent of the violation locations. An attempt was made to show

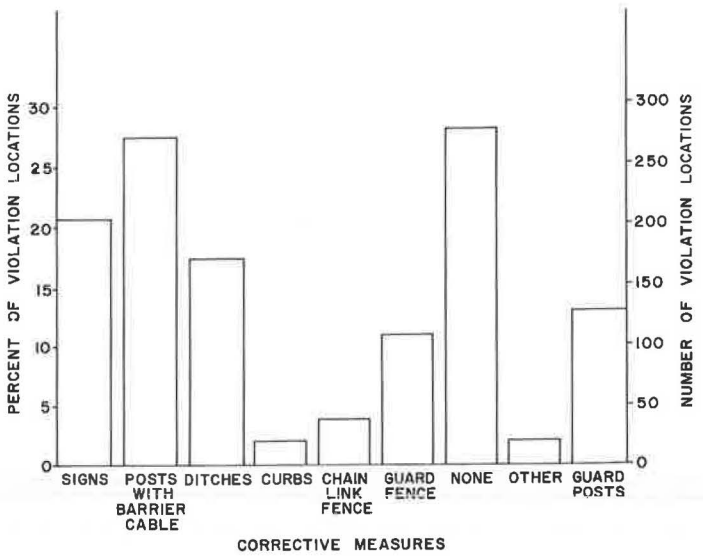


Figure 15. Frequency of corrective measures.

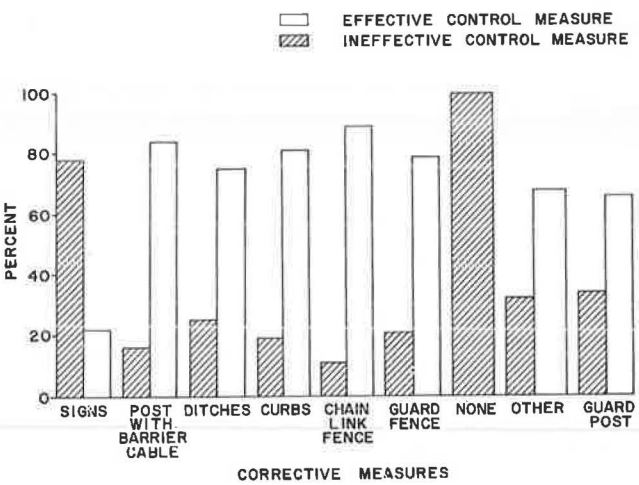


Figure 16. Effectiveness of corrective measures (opinions of field personnel).

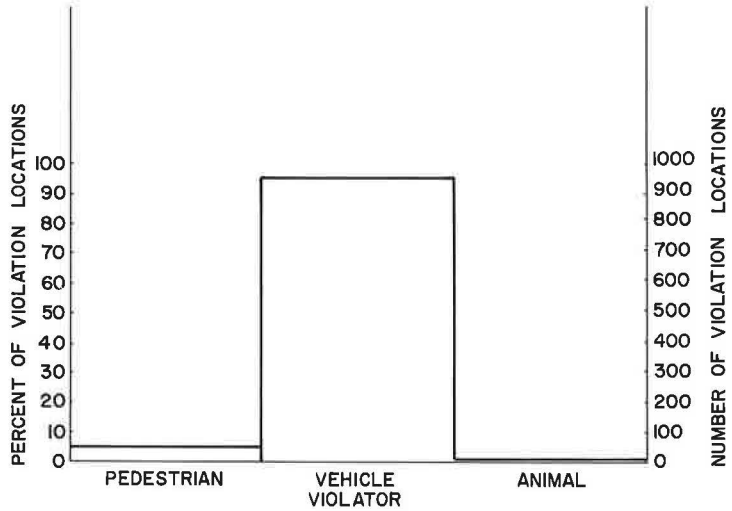


Figure 17. Frequency of violations by violator.

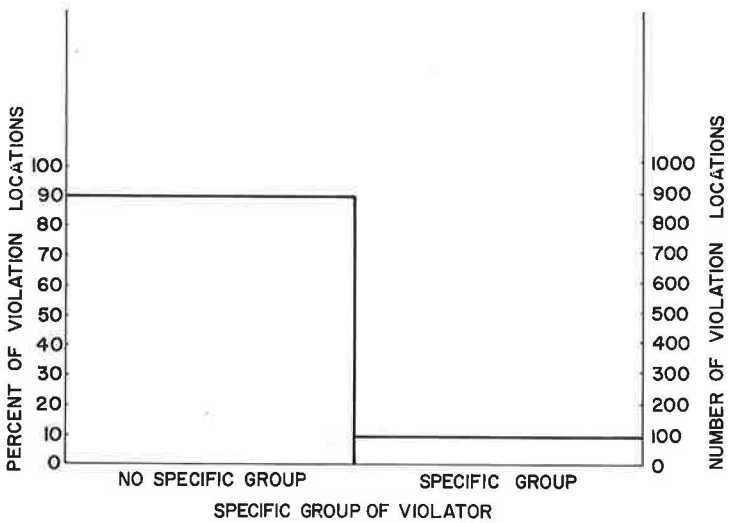


Figure 18. Frequency of violations by a specific group.

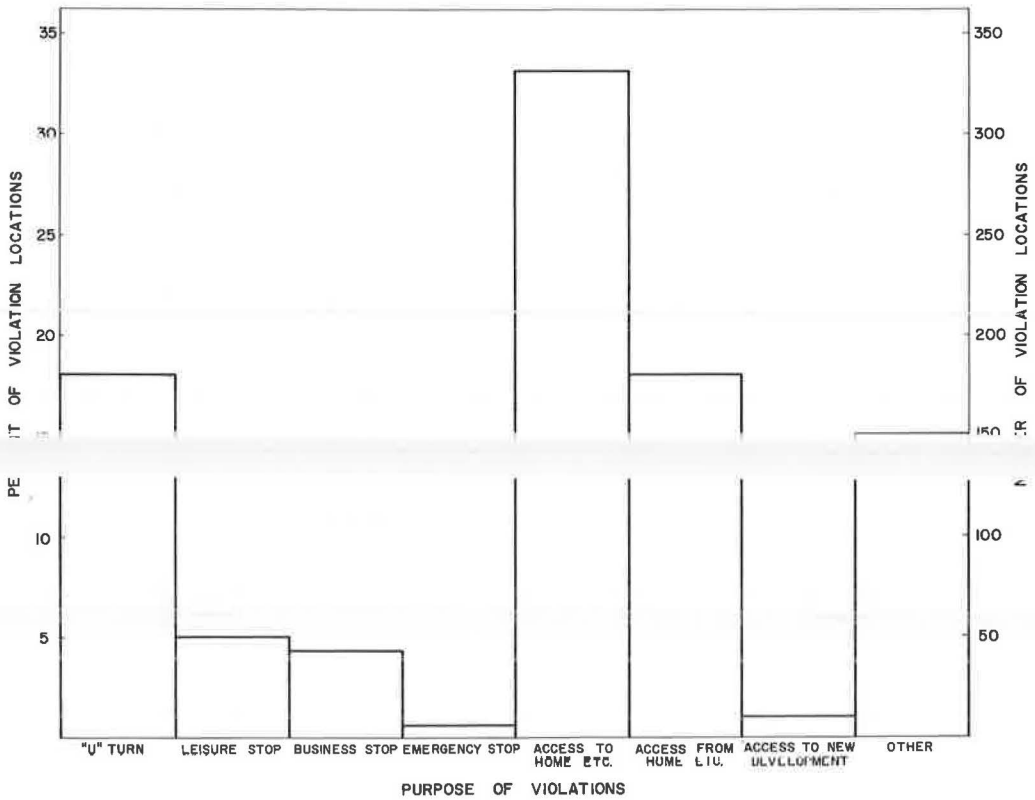


Figure 19. Frequency of purpose of violations.

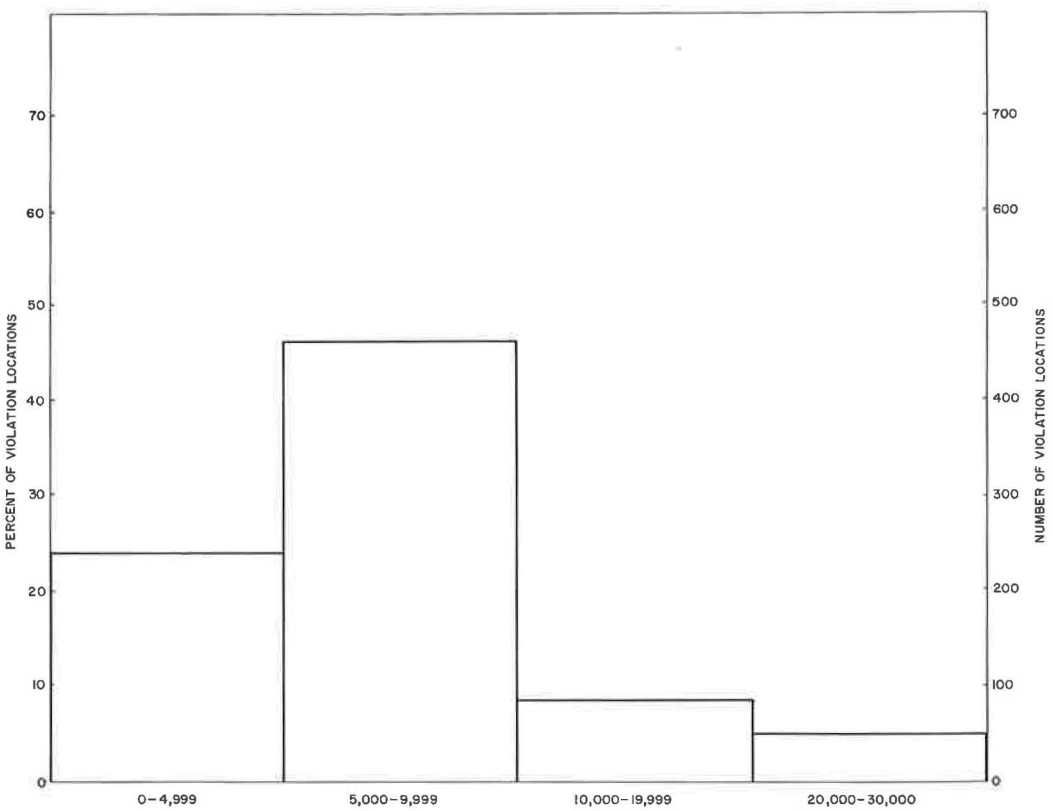


Figure 20. Frequency of average daily traffic.

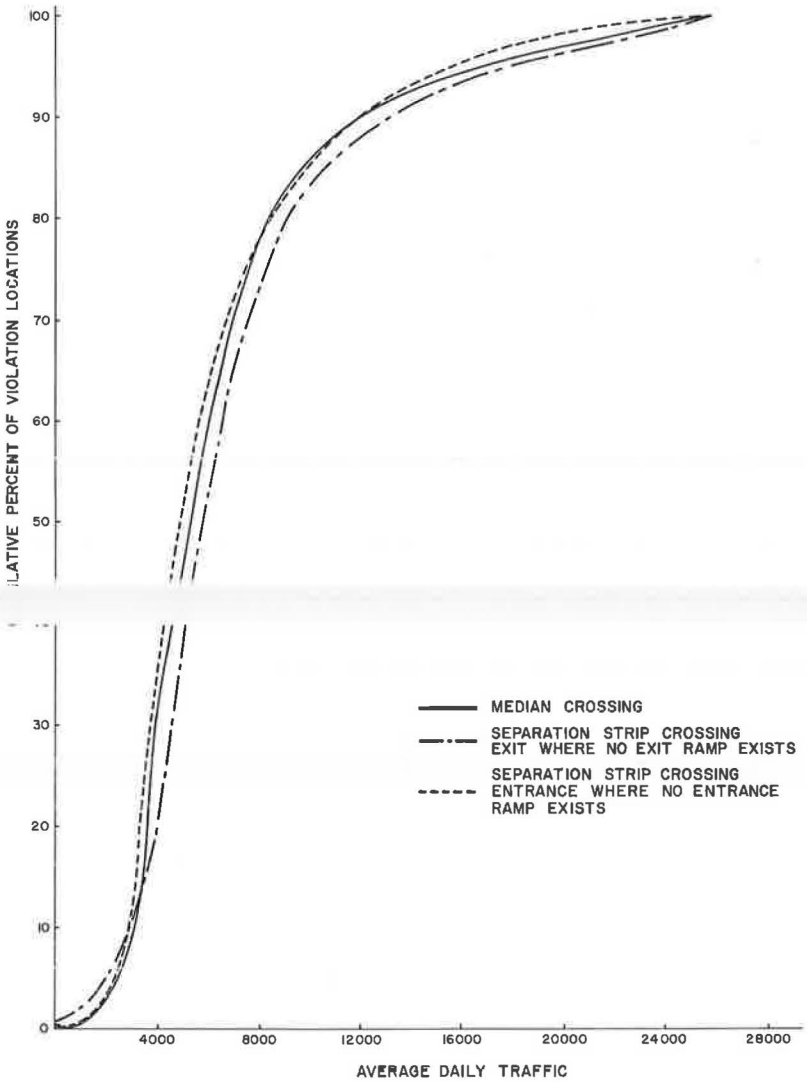


Figure 21. Relationship between average daily traffic and major types of violations.

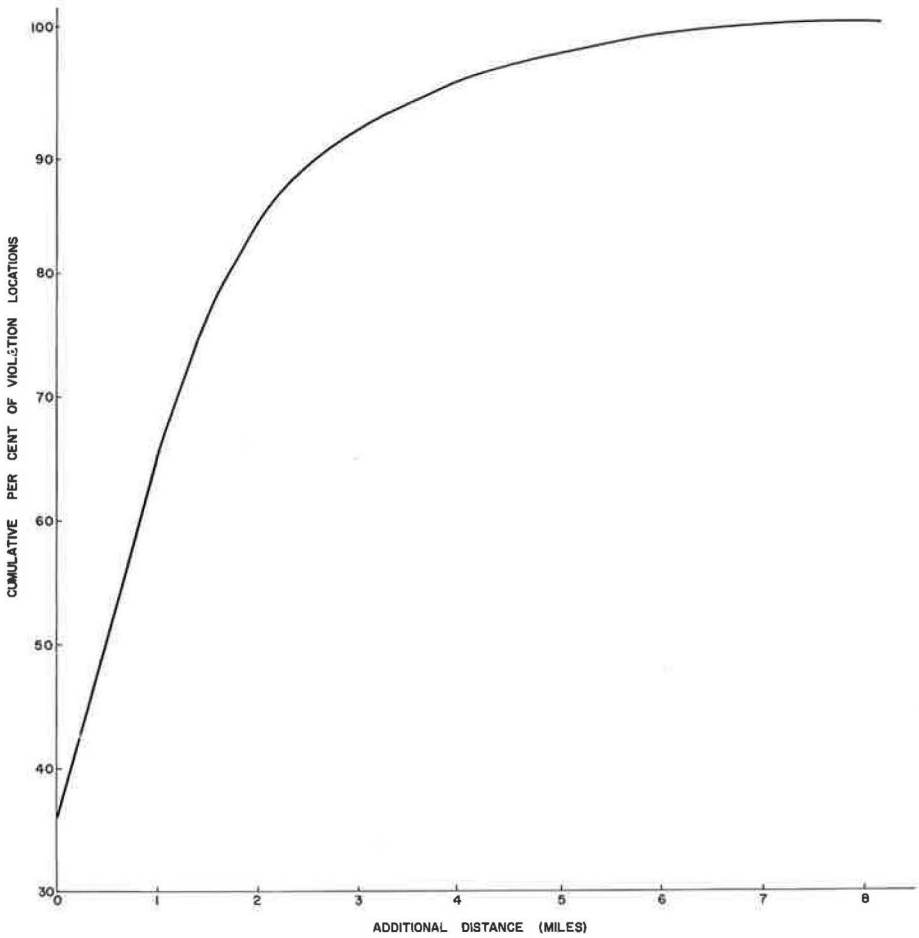


Figure 22. (a) Relationship between additional distance and all violations.

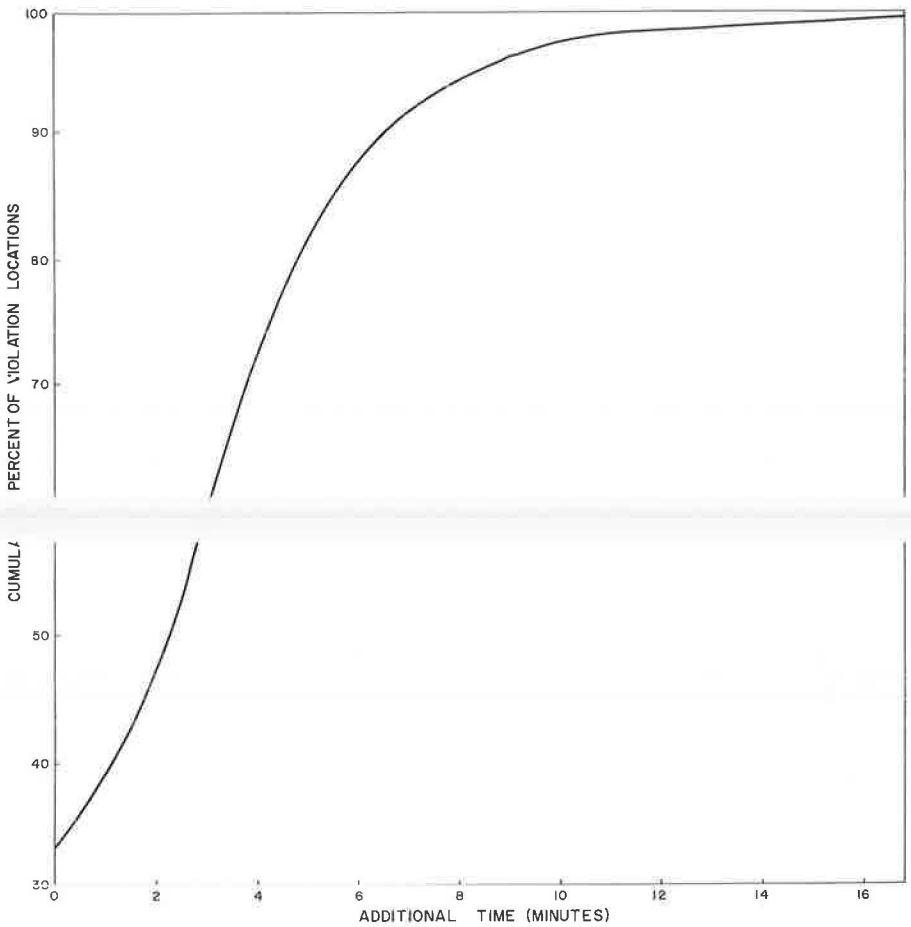


Figure 22. (b) Relationship between additional time and all violations.

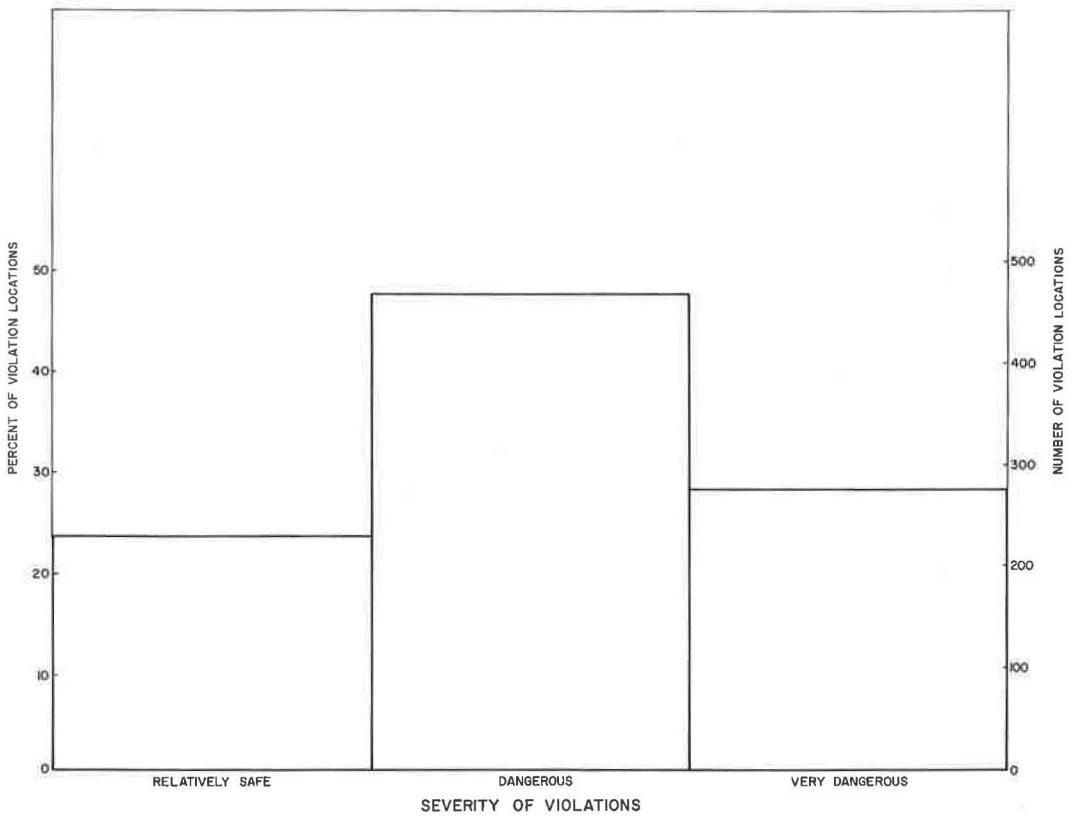


Figure 23. Frequency of the severity of violations.

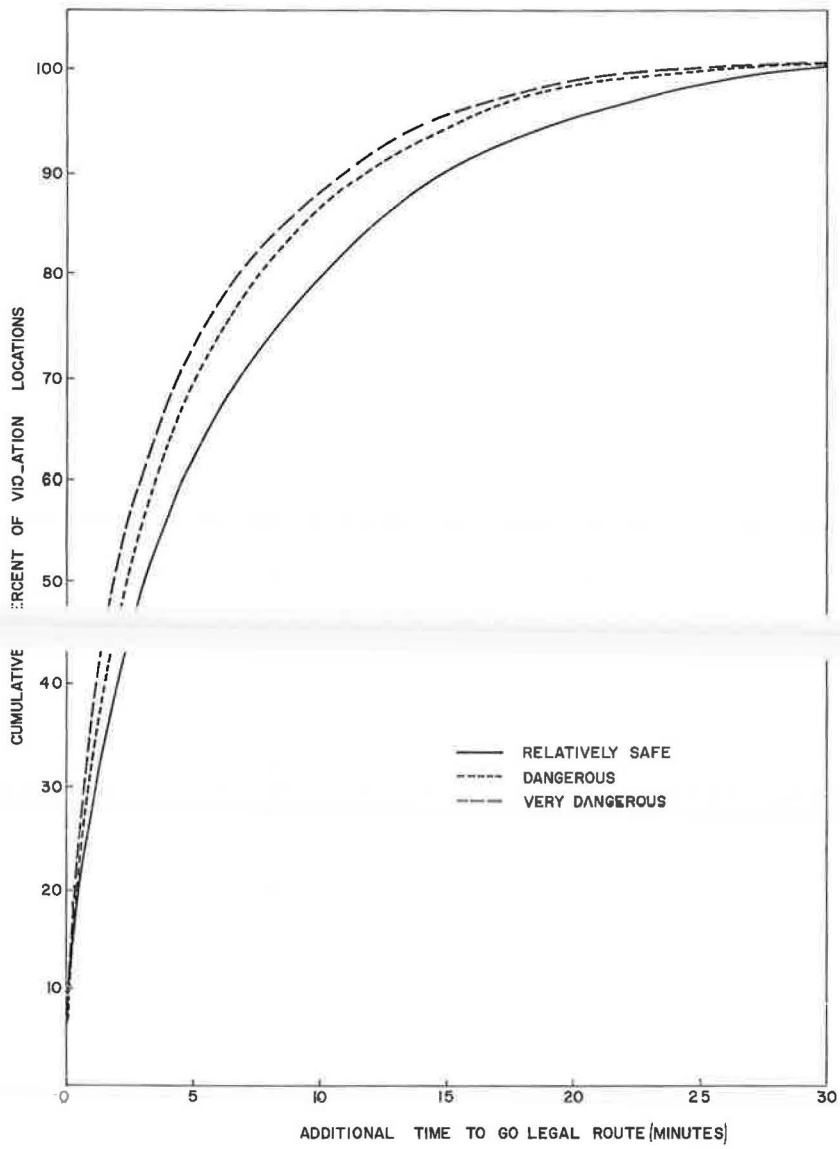


Figure 24. Relationship between additional time and severity of violation.

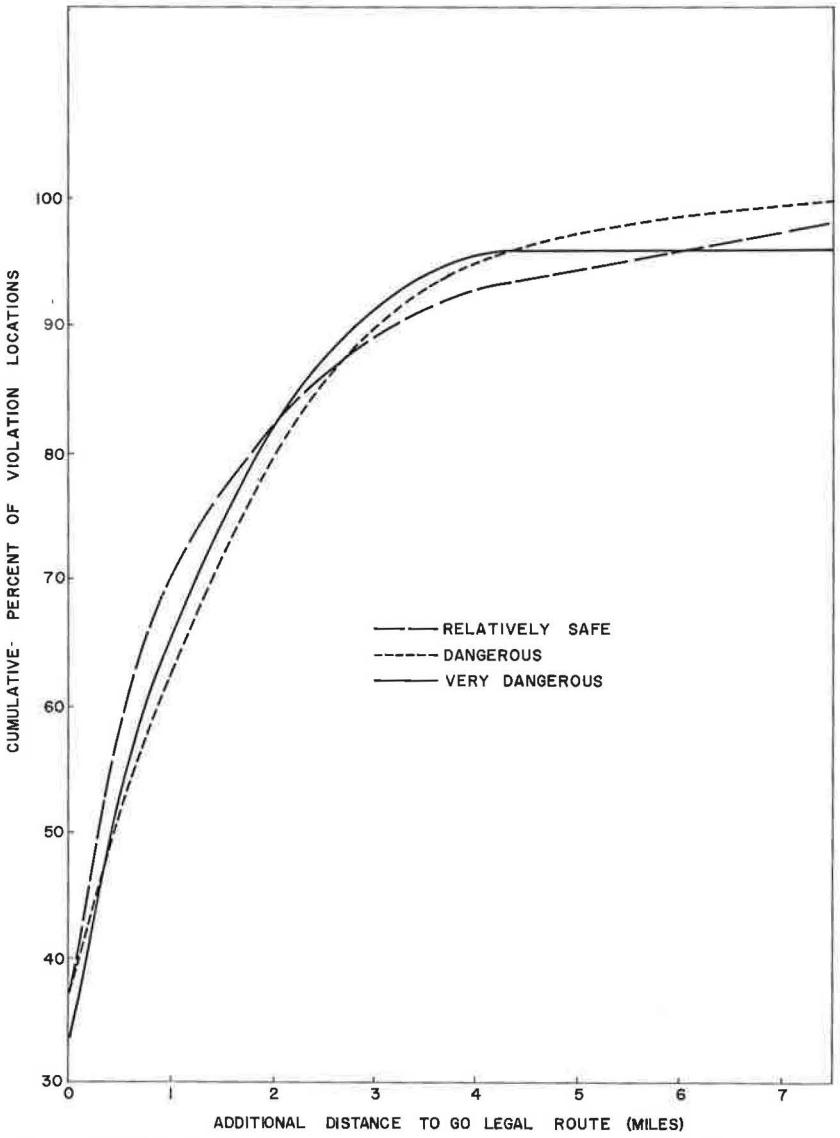


Figure 25. Relationship between additional distance and severity of violation.

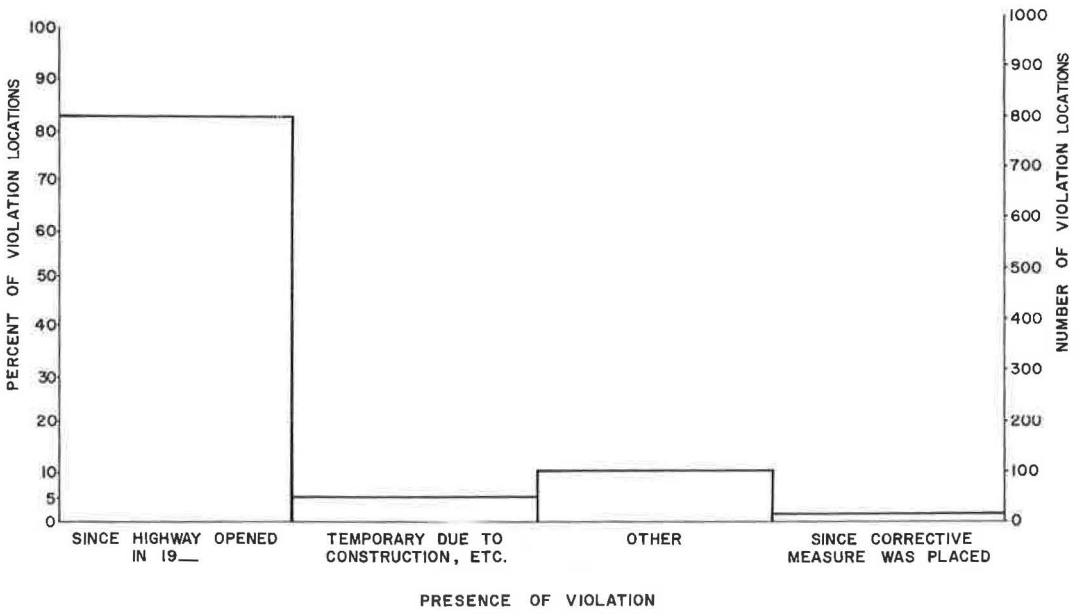


Figure 26. Frequency of presence of violation locations.

that a greater percent of relatively safe violations would occur than dangerous violations for the same additional time to go the legal route. Figure 24 did not substantiate this hypothesis. Therefore, time did not appear to be the basis for determining whether the average driver would violate or go the legal route.

[illegible] Figure 25 [illegible] and very dangerous when the additional distance was between ½ mile and 2 miles. Up to ½ mile, there was practically no difference in the curves, and for distances farther than 2 miles, a greater percent of dangerous and very dangerous violations occurred than relatively safe violations. This comparison was based on the percentages and not on the quantities.

Presence of Violations

Figure 26 illustrates the frequency of the presence of violation locations. The percentages of the 4 bar graphs did not add up to 100 percent since all questionnaires were not completed for this question. Over 80 percent of the violations had existed since the facility opened.

Figure 27 shows the number of violations beginning on new facilities as they were opened to traffic for each of the past 12 years. Figure 28 shows that these numbered over 300. The 300 in existence should have totaled the 800 shown in Figure 26. It did not because the personnel completing the questionnaire failed to fill in the blank when the highway opened, yet realized that the violation location had been used since the highway opened, and marked this box but left the year blank.

Freeway Areas

Figure 29 shows that 75 percent of the violation locations reported occurred on rural freeway facilities and 25 percent on urban freeway facilities. This was anticipated for 3 reasons: (a) the heavy volumes on urban freeways tend to prevent violations; (b) many urban freeways have barrier curbs on frontage roads and a guardrail down the median which prevent some types of violations; and (c) approximately 130 mi of urban freeways were studied in comparison with approximately 640 mi of rural freeways. Yet, there were 1.9 access violation locations per mile of urban freeway while there were 0.85 access violation locations per mile of rural freeway.

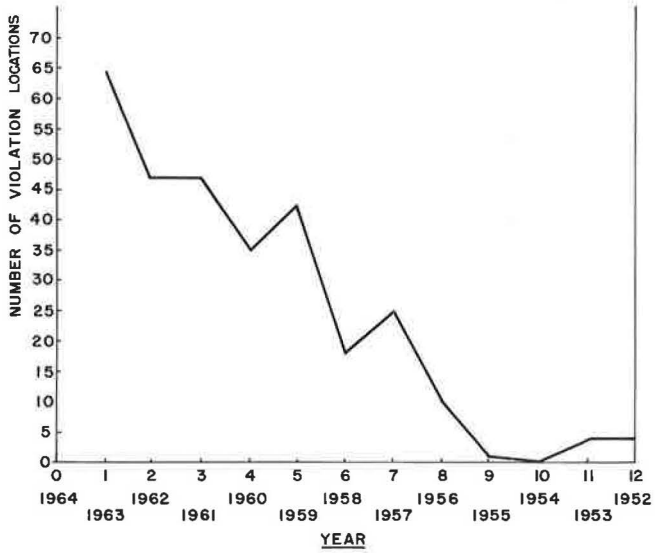


Figure 27. Number of existing violation locations beginning in past years.

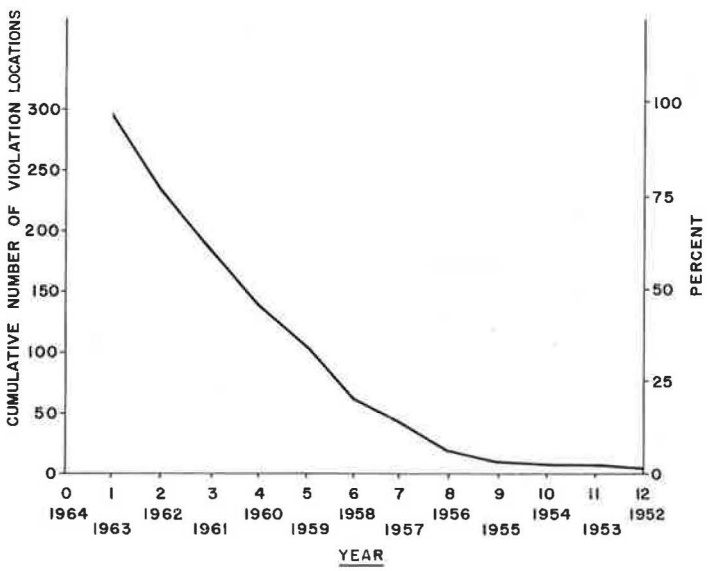
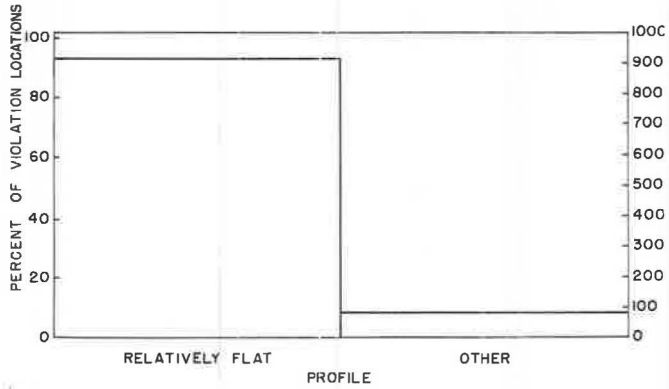
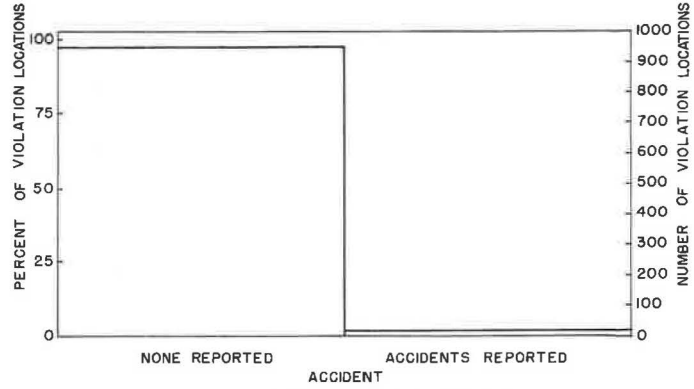


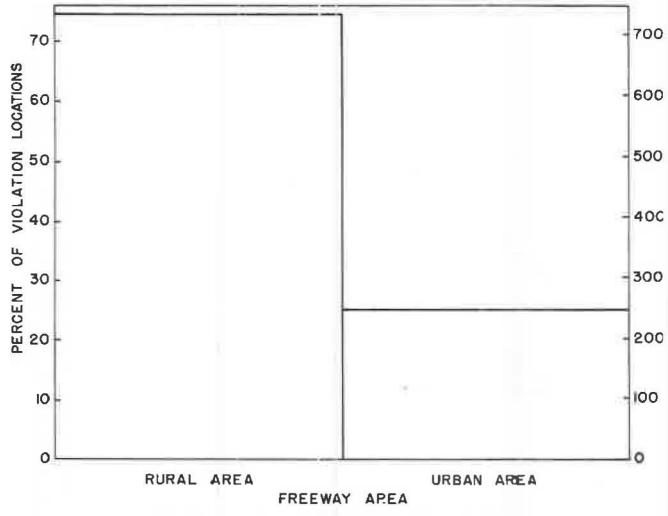
Figure 28. Cumulative number of violation locations.



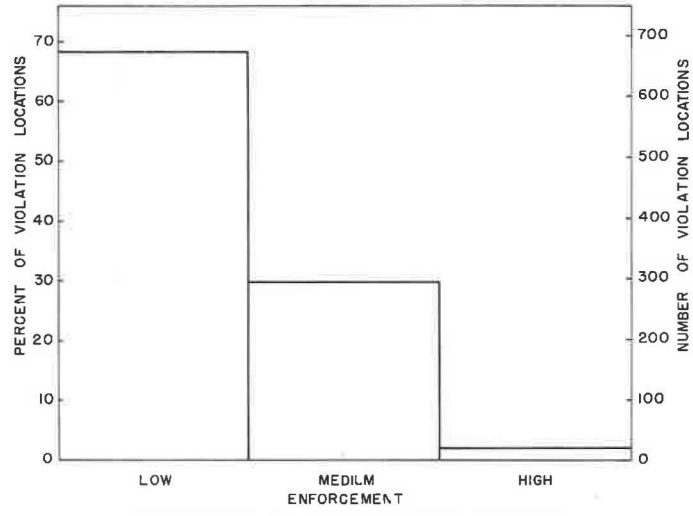
FREQUENCY OF PROFILE



FREQUENCY OF ACCIDENT HISTORY



FREQUENCY OF FREEWAY AREAS



FREQUENCY OF ENFORCEMENT RATINGS

Figure 29.

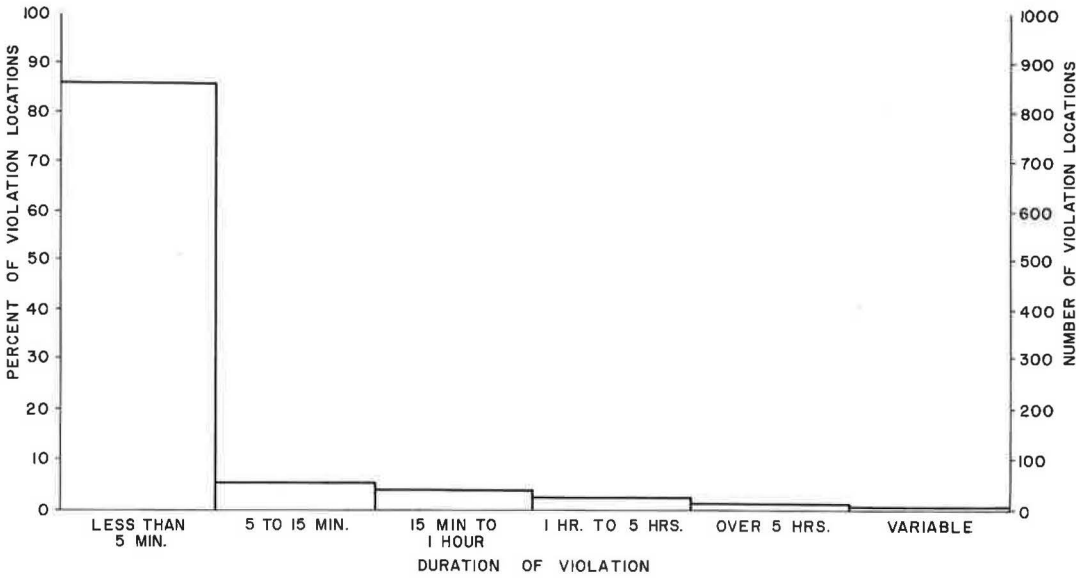


Figure 30. Frequency of duration of violation.

Accident History

Figure 29 shows that a very small number of accidents have been attributed to access violations. However, one fatality resulted from an access violation accident.

Profile

Figure 29 indicates that over 90 percent of the access violation locations occurred on relatively flat terrain.

Enforcement

Figure 29 illustrates the fact that the enforcement level for access violations was generally low. In less than 25 instances was it rated as high.

Duration of Violation

Figure 30 shows that at 86 percent of the violation locations, less than 5 min was required for the execution of the violation maneuver. Since data were not collected using a continuous observation method, a breakdown of less than 5 min was impossible.

CONCLUSIONS

The data were collected on a one-time basis on approximately 770 mi of freeway which included all Interstate highways within the state. The conclusions based on the study performed were:

1. A total of 28 separate types of access violations were observed and defined.
2. A total of 986 access violation locations were observed on approximately 770 mi of Interstate highways, a ratio of 1.3 access violation locations per mile of freeway. Twenty-five percent of these violation locations occurred on the 130 mi of urban freeway studied, a ratio of 1.9 access violation locations per mile of urban freeway. The remainder of the violation locations occurred on 640 mi of rural freeway, a ratio of 0.85 access violation locations per mile of rural freeway.
3. Five types of access violations accounted for 622 or 63.5 percent of the 986 observed access violation locations. These most prevalent types were: (a) separation

strip crossing, exit where no exit ramp exists—204 violations—20.7 percent; (b) median crossing—180 violations—18.2 percent; (c) separation strip crossing, entrance where no entrance ramp exists—112 violations—11.4 percent; (d) unattended vehicle on shoulder—68 violations—7.0 percent; and (e) crossing entire freeway system—58 violations—5.9 percent.

4. The primary cause of access violations was found to be that the violation route was the most convenient. This cause was indicated in over 52 percent of the violations.

5. Prohibitive signs were rated ineffective as corrective measures in 78 percent of the cases.

6. Curbs, chain-link fences, and posts with barrier cable had a very high degree of effectiveness.

7. Access violators were cataloged as: (a) pedestrian, (b) vehicle, and (c) animal. Of these 3, vehicles accounted for 94 percent of the access violators.

8. Approximately 60 percent of the observed violations took place on facilities with an average daily traffic of less than 6,000.

9. The study indicated an extreme desire on the part of the motorist to make direct movements on-to and off-of the freeway.

10. The severity of violations was classed as relatively safe, dangerous, and very dangerous. The persons reporting the data indicated: (a) relatively safe—24 percent of the violation locations; (b) dangerous—49 percent of the violation locations; and (c) very dangerous—27 percent of the violation locations.

SIGNIFICANCE OF RESULTS

In the past, the geometrics of an individual road were developed primarily in relation to safety, right-of-way, physical controls, and economic feasibility. However, because the construction of new facilities vitally affects traffic operations and maintenance procedures, the design of fixed facilities has come to be of special concern to traffic and maintenance personnel. Design engineers have begun, more and more, to consider both traffic and maintenance operations. The principles of location and design must be developed with references to the needs of through and local traffic and

There are many traffic factors which influence geometric design. Vehicles travel the highway under the control of individual operators making it imperative that the abilities and limitations of the driver, vehicle, and the road, both individually and in combination, be considered. This report dramatizes that even the drivers' shortcomings must be taken into consideration. The geometry of the highway facilities must be related to traffic performance and the demands of traffic in order to achieve safe, efficient, and economic traffic operations.

Freeway access violations are the operational effects of certain freeway geometrics, notably ramp spacing, ramp configuration, and the freeway cross-section elements. Traditionally, the chief criteria for freeway connections are the position of major cross-streets and highways, and ramp capacity. The omission of a ramp where traffic desires exit can and does tempt violations. The design of exit ramps, certainly in rural areas, should avoid the appearance of two-way roadways, or any other illusion which might encourage drivers on the crossroad to enter the ramp in the improper direction. It is evident from this study that some travelers on rural frontage roads are not alert to one-way exit ramps. It is not inconceivable that two-way frontage roads will suffer the same fate as the 3-lane, two-way highway of the 1930's. It suffices to say that one-way operation of frontage roads is preferred and should be employed unless there are compelling reasons to the contrary.

The most effective method of reducing access violations at the design level lies in the design of the median and the separation strip. The median serves to delineate the left extremity of the authorized path of vehicle travel, decreasing the amount of inadvertent vehicle encroachment and providing space for vehicles running off the left edge of the pavement to regain control. Landscaping in medians, often used to reduce headlight glare, offers a positive deterrent which traffic will not cross intentionally. The median concept offers flexibility to the planner and the designer. Medians should

be wide enough to serve as a recovery area and positive enough to discourage crossing violations without completely isolating the opposing roadways from each other. A median which cannot be crossed or which prevents visibility nullifies the deterrent effect of police patrols.

Emphasis on safety has led to the incorporation of the separation strip as part of the recovery area available to vehicles out of control. Functionally, however, the separation between a freeway and its frontage road prevents the interference of through movement by local traffic. It should physically discourage crossings from one road to the other except at ramps. Side slopes of 6:1 seem to fulfill both criteria; 8:1 is too easily negotiated, whereas side slopes of 4:1 are too severe for recovery purposes. Pedestrians on freeways are a significant source of access violation. Where special access problems are involved, such as for schools, crossings exclusively for pedestrians may be a suitable solution. Pedestrian overpass sidewalks above the freeway should be enclosed in solid or wire mesh screens to avoid the dropping or throwing of objects from these structures.

After the freeway is built, the problem of coping with access violators is an operational one. Signing and pavement marking are the conventional procedures used to regulate, warn or guide road users. The effectiveness of any sign depends upon its attention, meaning, and respect value. Unfortunately, there is little standardization in signs guarding against access violations.

The recent development of "electronic policeman" (2) in which wrong-way drivers get a positive warning such as a "Stop-Turn Back" illuminated on an exit ramp sign, offers considerable promise. When a car on a secondary road mistakenly enters a freeway exit ramp, 2 wire loops buried in the pavement detect the vehicle and set up a signal that lights the sign. Circuits are arranged to ignore vehicles passing over them in the correct direction. Developments such as these are needed to insure proper operation of off-ramps.

RECOMMENDATIONS

One district, when returning its data collection forms, noted that the frequency of innocent wrong-way violations on exit ramps could not be ascertained by the once-over method of data collection, since no tracks were left and the violation was infrequent. It was recommended that data be collected on a surveillance method to determine the frequency and extent of this type of violation to be significant, studies should be undertaken to determine the best methods to eliminate this type of violation.

The extent and severity of access violations shown in this report suggested additional studies on this subject. These studies should determine:

1. Geometric design changes in freeway facilities which will coincide more closely with drivers' desires. The closer the designer can come to meeting all drivers' desires, the greater the number of violations he will eliminate before they ever occur.
2. The most feasible control measure to be used in eliminating violations now existing on freeway facilities. Factors to be considered should be:

   a. Would any control measure be more of a hazard than the benefit of eliminating the access violations? John W. Hutchinson (3) furnished encorachment rates for the highways he studied. He also notes accident experience with obstacles in the median. Studies of this type must be accomplished to answer this question.
   b. What would be the severity of the accident if the control measure were run into? The most prevalent method presently used in eliminating violations in Texas is wooden posts with barrier cable running between posts. This corrective measure should be tested to determine how the cable reacts when broken during an accident. Does the cable drop to the ground or whip through the air? Possibly another type of post or a smaller wooden post should be used for corrective measures to reduce the severity of any accidents hitting these posts. Actual crash tests on these corrective measures can answer these questions.

c. Would the night visibility of the control measure be adequate? The anticipated problem here is the cable strung between posts. Presently, at some locations, one reflector is attached to the cable centered between the posts. Studies should be conducted to determine if these are adequate to prevent drivers from unknowingly attempting to drive through the cable at night.
d. The need for crossovers for use by police, ambulances, and maintenance vehicles. One method used in Maryland for limiting crossover usage to emergency vehicles is a radio-operated median gate (4). Hutchinson (3) states that agencies requiring emergency access across the median where posts and barrier cables were in place were instructed to carry bolt cutters for the purpose of cutting the barrier cable when necessary. Studies would be undertaken to determine the best method of providing this access.

3. The control measures to be included in the original design and construction to prevent violations that cannot be eliminated through geometric design changes.

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