

ANALYSIS OF ACCESS VIOLATIONS ON
CONTROLLED ACCESS FACILITIES

by

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Research Report Number 65-1

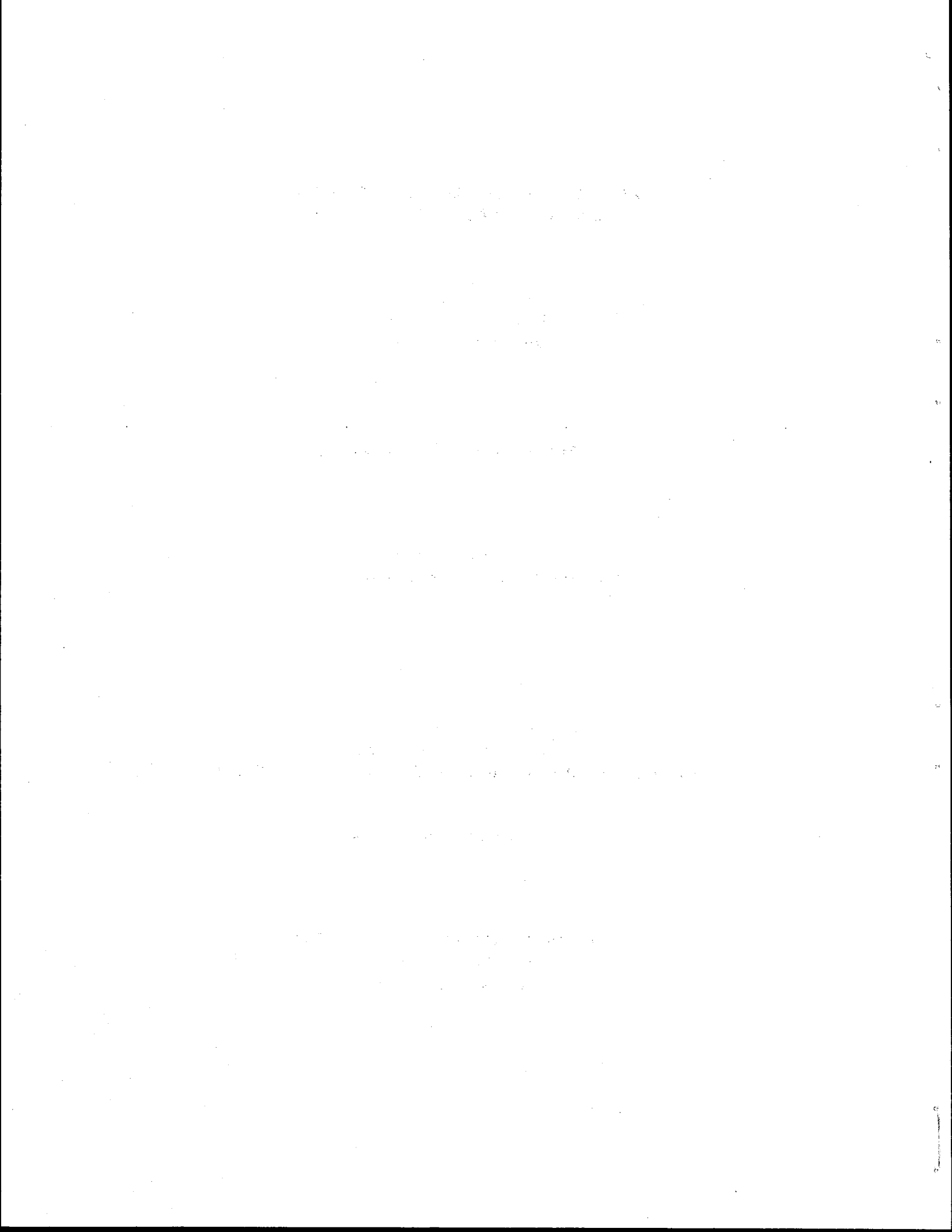
Access Violations
Research Project Number 2-18-63-65

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College Station, Texas



ABSTRACT

A cooperative research program of the Texas Transportation Institute, the Texas Highway Department, and the U. S. Bureau of Public Roads was undertaken to study the problem of access violations on controlled access facilities across the State of Texas. The author cataloged the access violations into 28 types. Each type defines the areas crossed during the violation maneuver. Aerial photos illustrate many of the types of violations.

The extent of access violation locations and the causes of access violations are shown. The effectiveness of present control features as rated by the personnel completing the data collection forms is presented.

Additional considerations concerning access violations such as types of violators, purpose of violations, average daily traffic, severity of violation, additional distance and/or time to go the legal route, and enforcement are discussed to furnish complete background information.

The author shows the significance of the results and applications to traffic operations. The need for the study of wrong-way maneuvers on freeway exit ramps is emphasized.

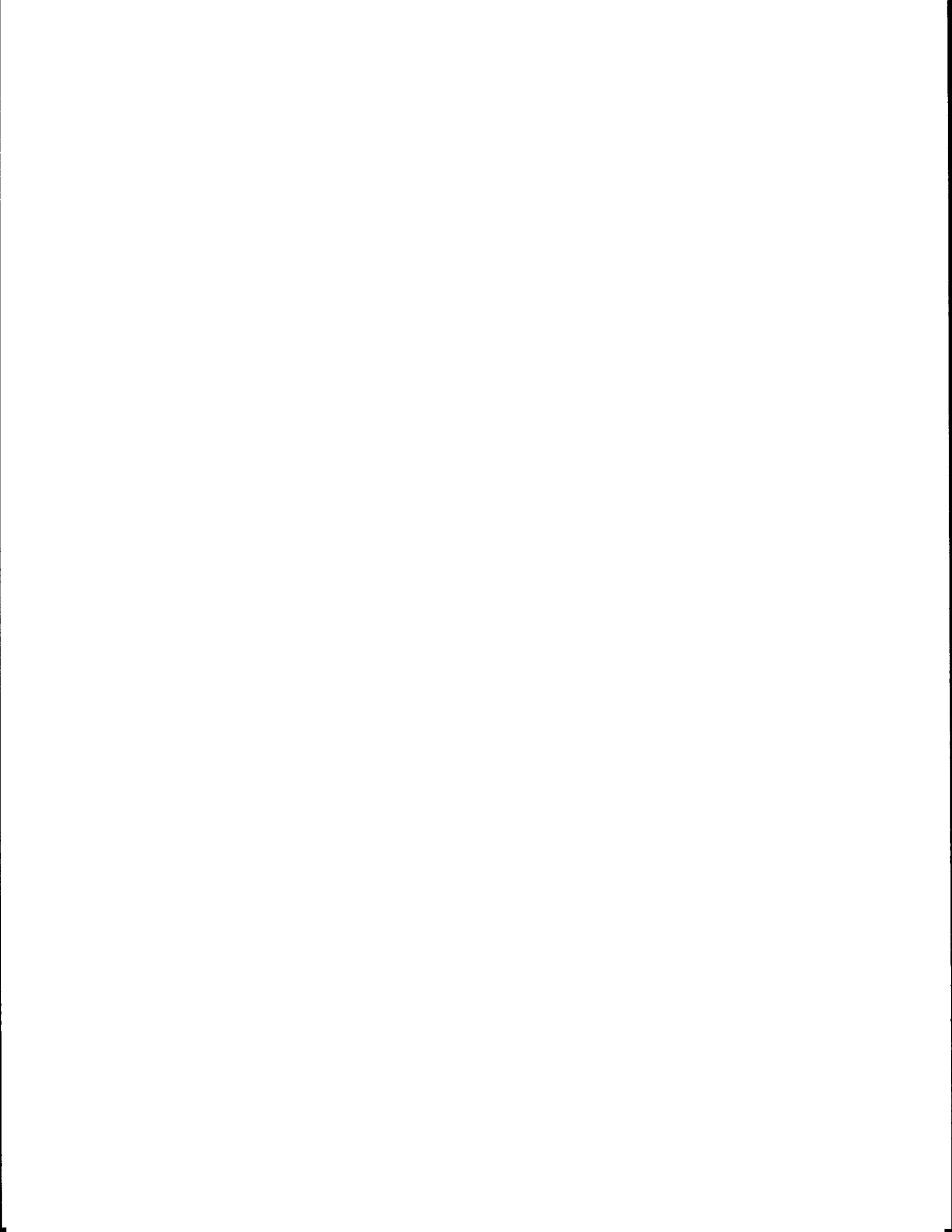


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STATE OF CONNECTICUT

IN SENATE,
January 10, 1907.

REPORT
OF THE
COMMISSIONERS OF THE
LAND OFFICE,
IN ANSWER TO A RESOLUTION
PASSED BY THE SENATE
MAY 15, 1906.

ANALYSIS OF ACCESS VIOLATIONS ON CONTROLLED ACCESS FACILITIES

INTRODUCTION

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 motorist's highway with motorist's 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:

1. To catalog the types of access violations on controlled access facilities.
2. To determine the extent and causes of access violations.
3. To determine the effectiveness of various design and control features presently being utilized to prevent access violations.

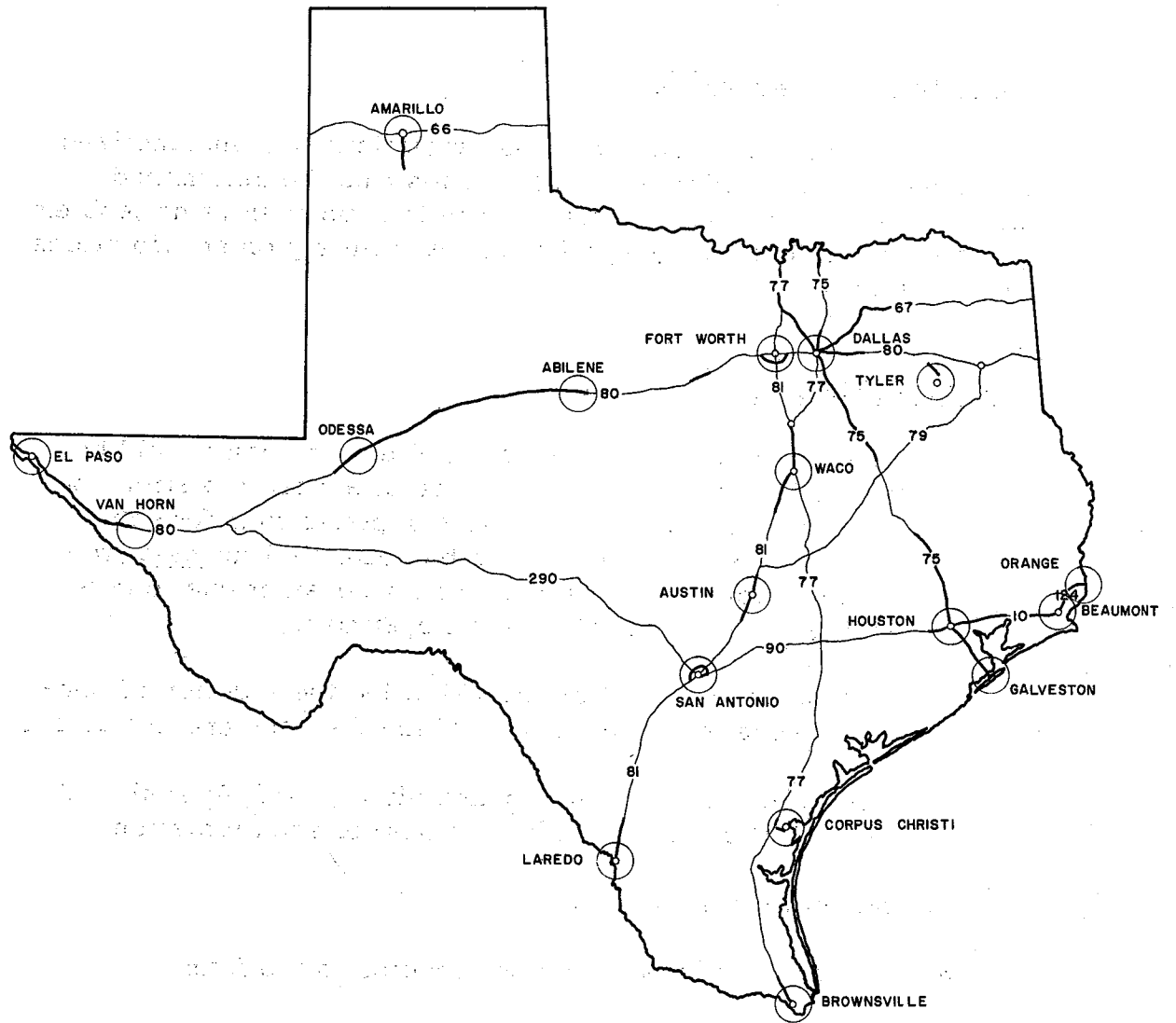
STUDY PROCEDURE

Data Collection

To achieve the objective to determine the extent of access violations, it was decided to collect data on controlled access facilities across the State of Texas. Data were collected on approximately 770 miles of freeway which included all Interstate Highways within the State. The locations of the facilities from which data were actually collected are shown in Figure 1. Since the data collection was to be accomplished on a state-wide 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 Texas Highway Department Districts participating in this project were numbers: 1, 2, 3, 4, 8, 9, 10, 12, 14, 15, 16, 17, 18, 20, 21, 23, and 24.

The "Shoulder and Test 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. Materials in addition to the data collection forms sent to each Texas 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, the method of procedure to be used, and the significance of the research. The Data Collection Procedure sheets (Figure 2) 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 four methods of determining access violations. They were: (1) to see a violation actually take place, (2) to see the tracks of violations that had occurred previously, (3) to remember violations that had been seen on other occasions, and (4) to note past violations which have been eliminated by corrective measures.



STUDY LOCATIONS

FIGURE 1

FIGURE 2

DATA COLLECTION PROCEDURE for ANALYSIS OF ACCESS VIOLATIONS ON CONTROLLED ACCESS FACILITIES

PURPOSE OF INVESTIGATION

The extent and causes of access violations and unauthorized maneuvers on Controlled Access facilities must be determined. Ultimately this information will be used to remedy existing problem violations and to anticipate and eliminate future problem violations at the design level.

INFORMATION DESIRED

1. Data Collection Form: A Data Collection Form should be completed when there is evidence of access violations or unauthorized maneuvers. Use a separate form for each violation. A form should also be completed for past problem violations which perhaps no longer exist due to corrective measures taken by the Department.
2. District Control-Section Map showing the location of controlled access facilities from which the data are collected.
3. Schematic sheet with approximately a 1" = 200' scale with a sketch illustrating the conditions for each violation.
4. Photographs if possible.
5. Any pertinent information not covered in the form.

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

Upon receipt of 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 Collection form which could be determined were corrected. This review of the data collection forms 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 Figures 3 and 4.

The data were then punched into IBM cards with the coding shown in Appendix A, 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 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 5 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.

FIGURE 3

Data Collection Form

for

Analysis of Access Violations on Controlled Access Facilities

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:
If not, check appropriate block.)
 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 _____

(Over)

FIGURE 4

DATA COLLECTION FORM (CONTINUED)

9. DURATION OF VIOLATION: (Estimate the time required to complete the violation maneuver.)
- | | |
|---|--|
| <input type="checkbox"/> less than 5 minutes | <input type="checkbox"/> 1 hour to 5 hours |
| <input type="checkbox"/> 5 to 15 minutes | <input type="checkbox"/> over 5 hours |
| <input type="checkbox"/> 15 minutes to 1 hour | <input type="checkbox"/> 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.)
- | | | |
|---|------------------------------------|--------------------------------------|
| <input type="checkbox"/> Signs | <input type="checkbox"/> Effective | <input type="checkbox"/> Ineffective |
| <input type="checkbox"/> Posts with Barrier Cable | <input type="checkbox"/> Effective | <input type="checkbox"/> Ineffective |
| <input type="checkbox"/> Ditches | <input type="checkbox"/> Effective | <input type="checkbox"/> Ineffective |
| <input type="checkbox"/> Curbs | <input type="checkbox"/> Effective | <input type="checkbox"/> Ineffective |
| <input type="checkbox"/> Chain Line Fences | <input type="checkbox"/> Effective | <input type="checkbox"/> Ineffective |
| <input type="checkbox"/> Guard Fences | <input type="checkbox"/> Effective | <input type="checkbox"/> Ineffective |
| <input type="checkbox"/> None | <input type="checkbox"/> Effective | <input type="checkbox"/> Ineffective |
| <input type="checkbox"/> Guard Posts | <input type="checkbox"/> Effective | <input type="checkbox"/> Ineffective |
| <input type="checkbox"/> Other: _____ | <input type="checkbox"/> Effective | <input type="checkbox"/> 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 = _____

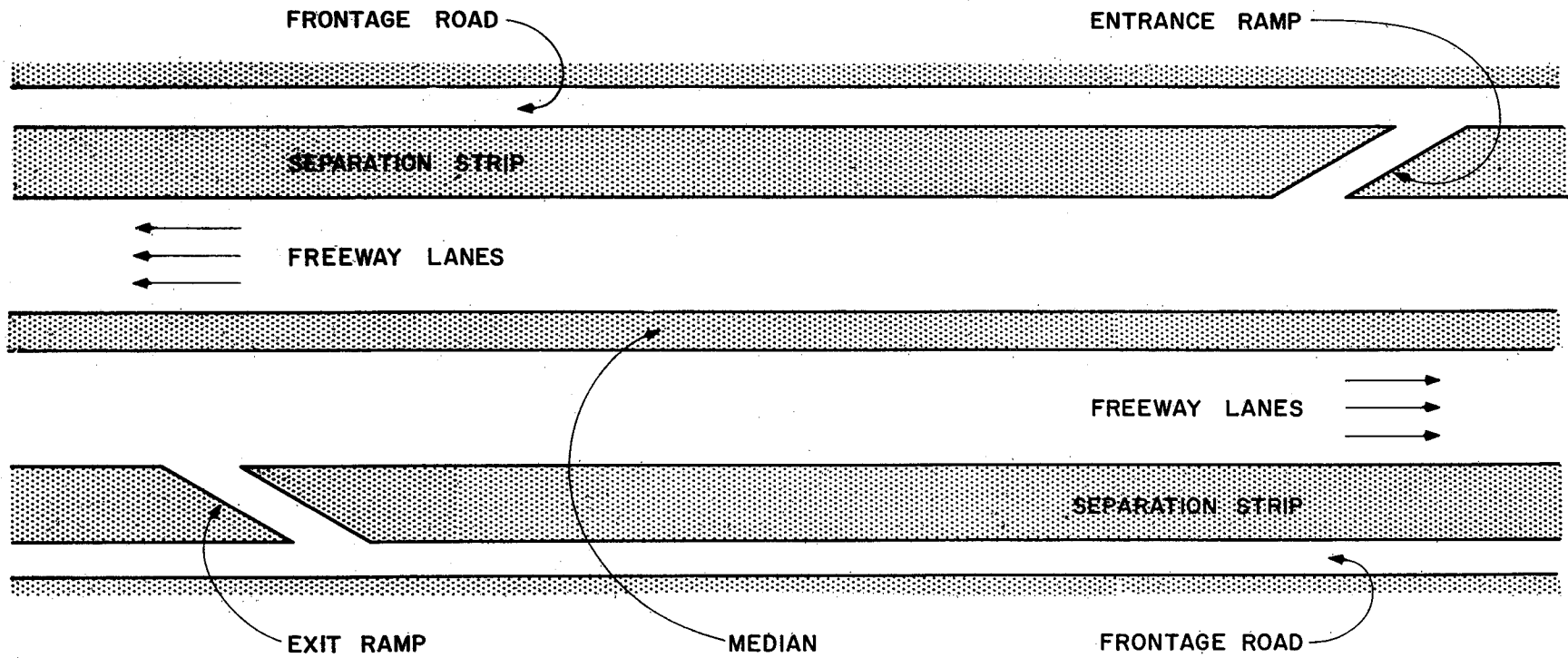
For a better understanding, many of the types of violations are illustrated in Figures 6 through 9. Types of violations in addition to those illustrated were: an unattended vehicle on the shoulder, parking on the median, hitch-hiking, animal crossing, loading and unloading passengers, and the general group cataloged 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 Figure 13. Aerial photographs of some of the types of access violations existing in June, 1964, are shown in Figures 10, 11, and 12. While taking the aerial photographs, the photographer noted a blanket salesman selling his goods within the interstate right-of-way. A photo of this appears in Figure 11.

Extent and Causes of Access Violations

The extent or frequency of the types of access violation locations is shown in Figure 13, which gives both the number of violation locations and the 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 miles 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 miles 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 miles of rural freeway, a ratio of 0.85 access violation locations per mile of rural freeway.

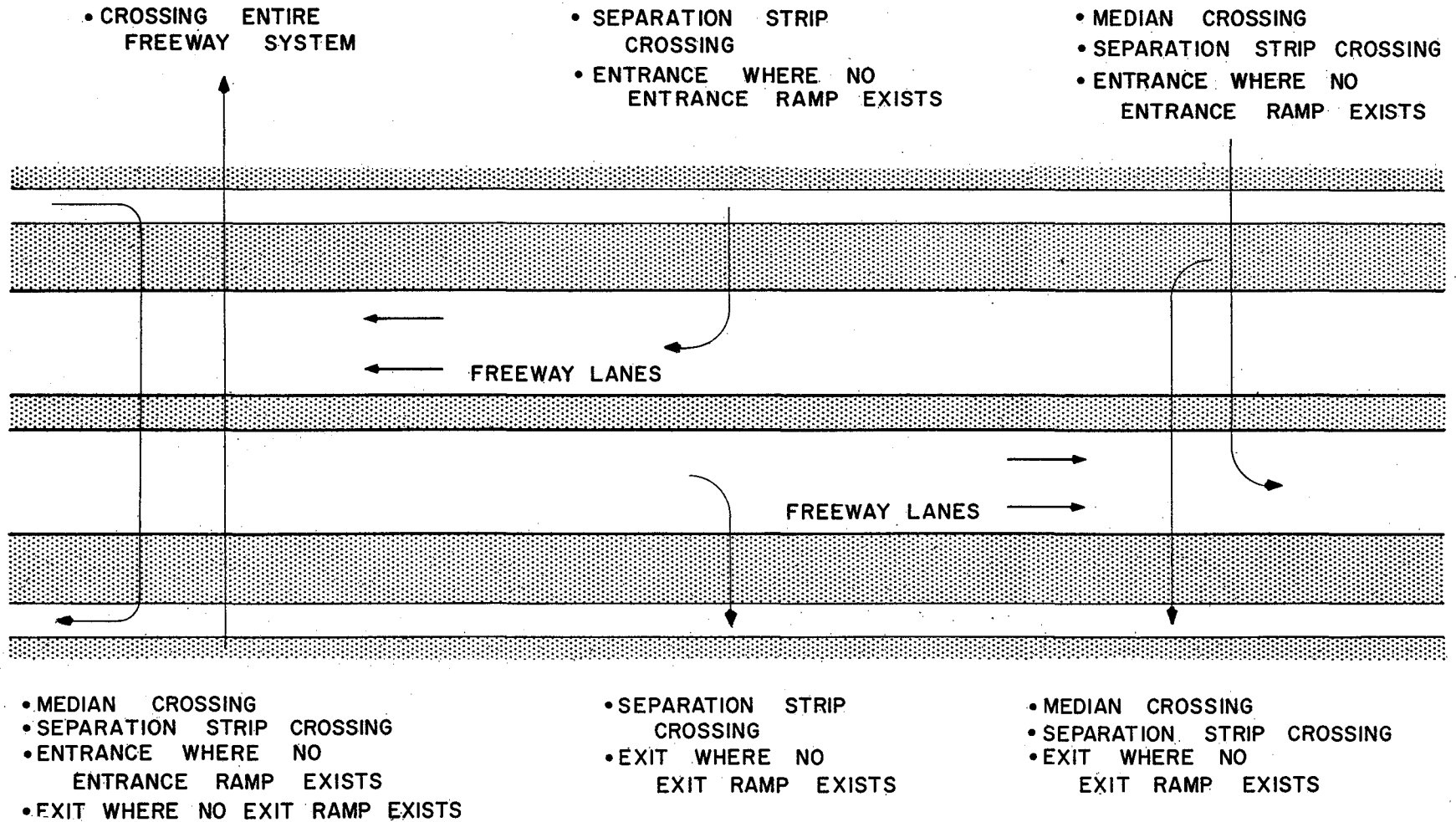
Although there were twenty-eight different types of violations, five types were predominant which accounted for 63.2% of the violation locations reported. The predominant or major types of access violations were:

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.
5. Crossing entire freeway system.



FREEWAY DEFINITIONS

FIGURE 5



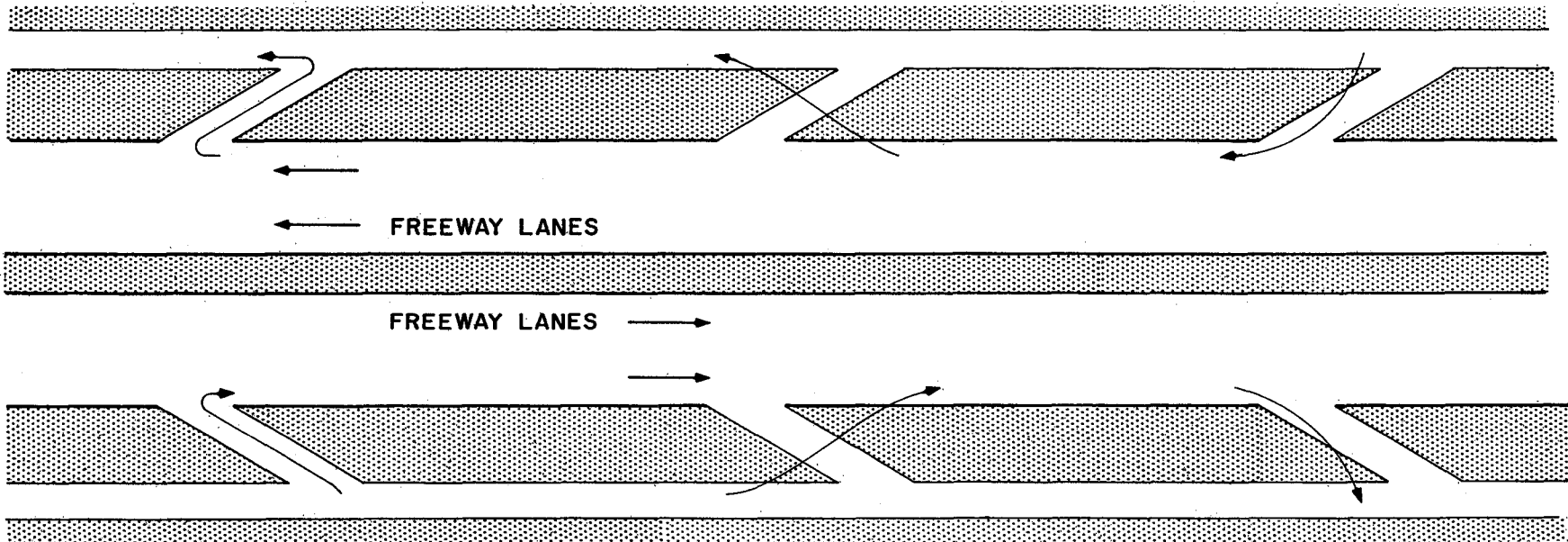
TYPES OF ACCESS VIOLATIONS

FIGURE 6

- INCORRECT USE OF ENTRANCE RAMP
- EXIT WHERE NO EXIT RAMP EXISTS

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

- NOSE CROSSING
- INCORRECT USE OF ENTRANCE RAMP



- INCORRECT USE OF EXIT RAMP
- ENTRANCE WHERE NO ENTRANCE RAMP EXISTS

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

- NOSE CROSSING
- INCORRECT USE OF EXIT RAMP

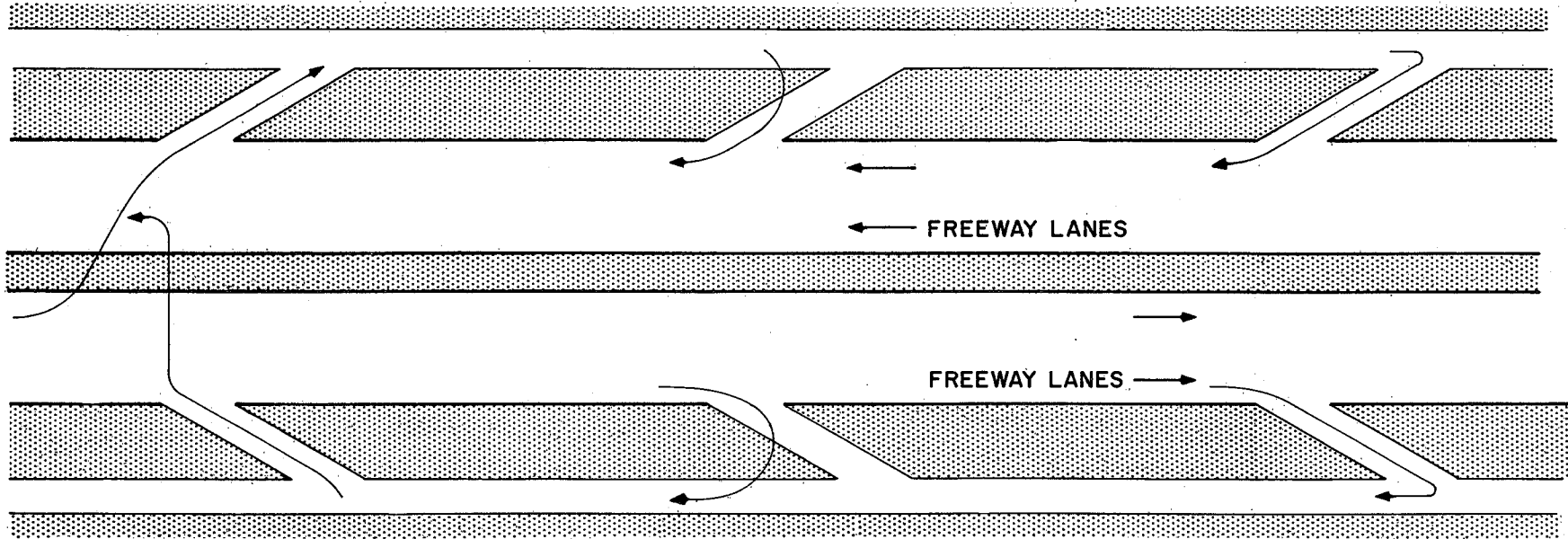
TYPES OF ACCESS VIOLATIONS

FIGURE 7

- MEDIAN CROSSING
- INCORRECT USE OF ENTRANCE RAMP
- EXIT WHERE NO EXIT RAMP EXISTS

- NOSE CROSSING
- INCORRECT USE OF ENTRANCE RAMP
- WRONG WAY ON FRONTAGE ROAD

- WRONG WAY ON FRONTAGE ROAD



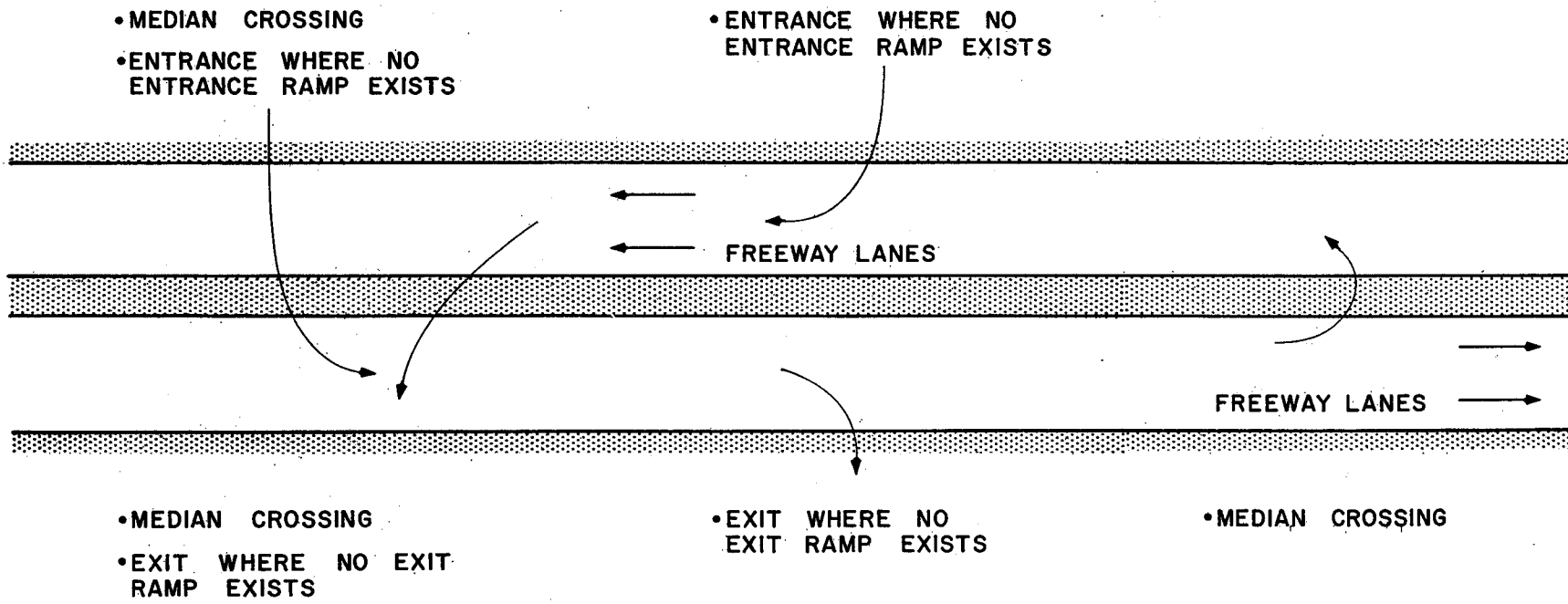
- MEDIAN CROSSING
- INCORRECT USE OF EXIT RAMP
- ENTRANCE WHERE NO ENTRANCE RAMP EXISTS

- NOSE CROSSING
- INCORRECT USE OF EXIT RAMP
- WRONG WAY ON FRONTAGE ROAD

- WRONG WAY ON FRONTAGE ROAD

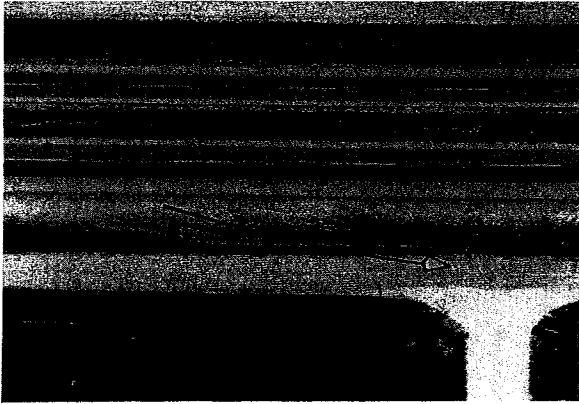
TYPES OF ACCESS VIOLATIONS

FIGURE 8

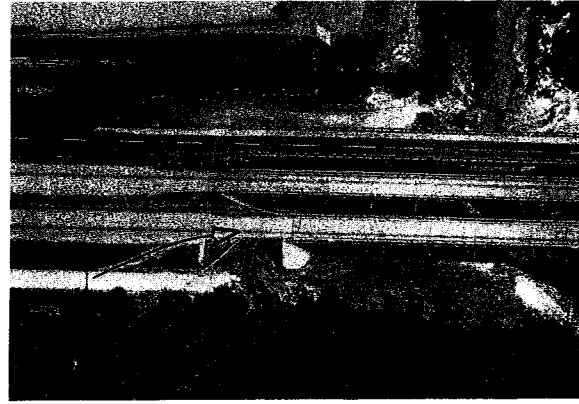


TYPES OF ACCESS VIOLATIONS

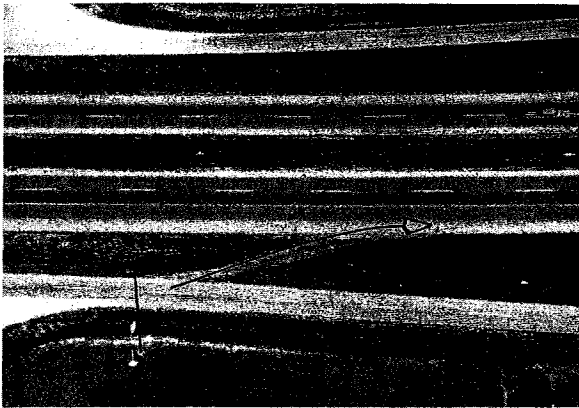
FIGURE 9



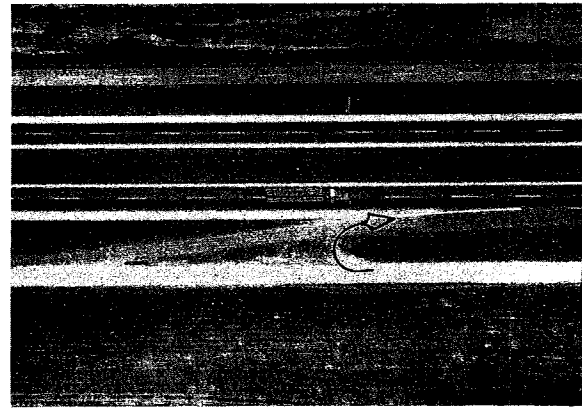
- SEPARATION STRIP CROSSING
- EXIT WHERE NO EXIT RAMP EXISTS.



- SEPARATION STRIP CROSSING
- ENTRANCE WHERE NO RAMP EXISTS.



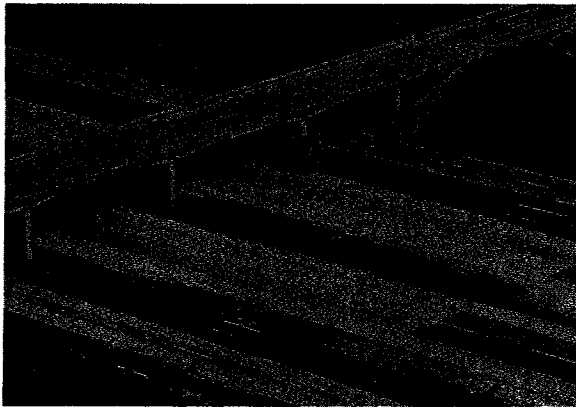
- SEPARATION STRIP CROSSING
- ENTRANCE WHERE NO RAMP EXISTS.



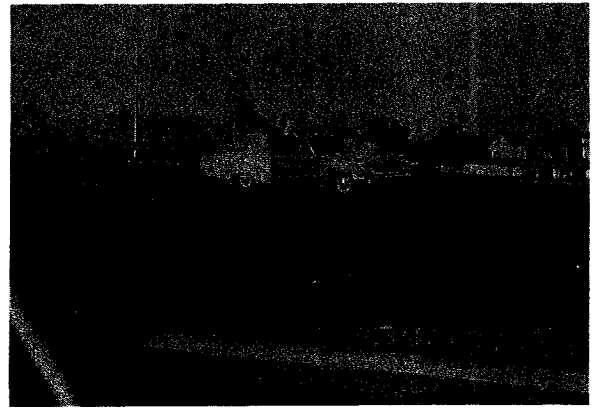
- NOSE CROSSING
- INCORRECT USE OF ENTRANCE RAMP.

TYPES OF ACCESS VIOLATIONS

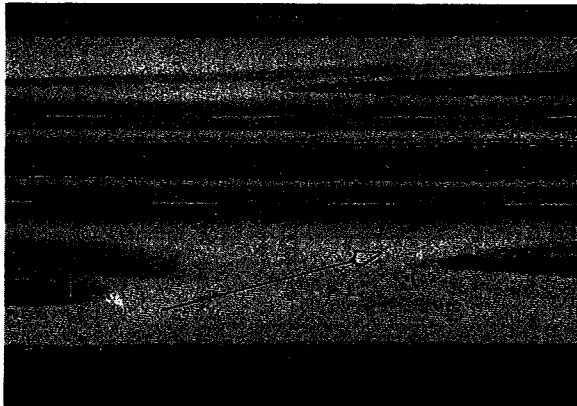
FIGURE 10



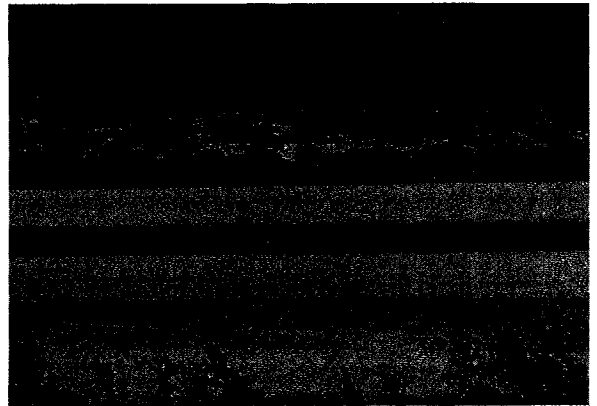
- UNATTENDED VEHICLE ON SHOULDER.



- LOADING OR UNLOADING PASSENGER.



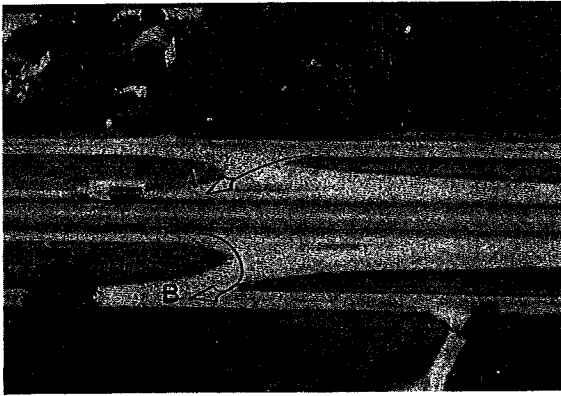
- NOSE CROSSING
- INCORRECT USE OF EXIT RAMP.
- ENTRANCE WHERE NO ENTRANCE RAMP EXISTS.



- BLANKET SALES ON RIGHT OF WAY.

TYPES OF ACCESS VIOLATIONS

FIGURE 11

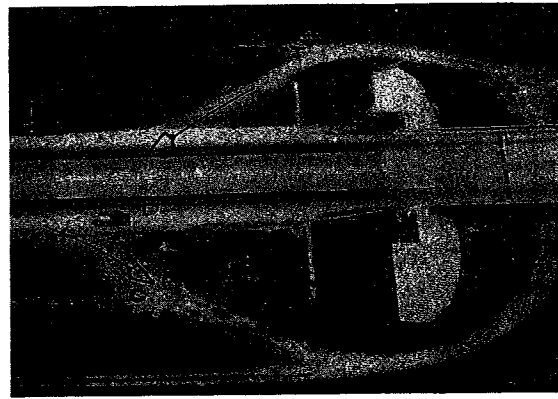


A

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

B

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



A

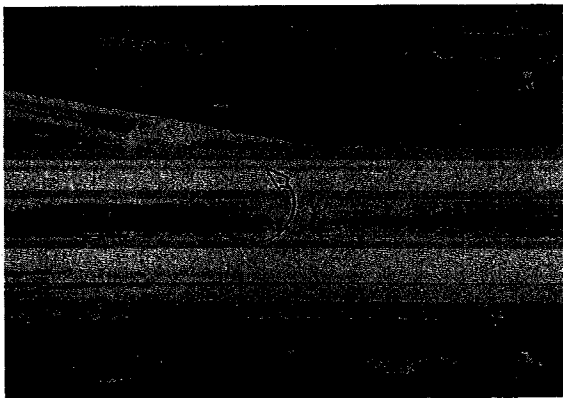
- ENTRANCE WHERE NO ENTRANCE RAMP EXISTS.

B

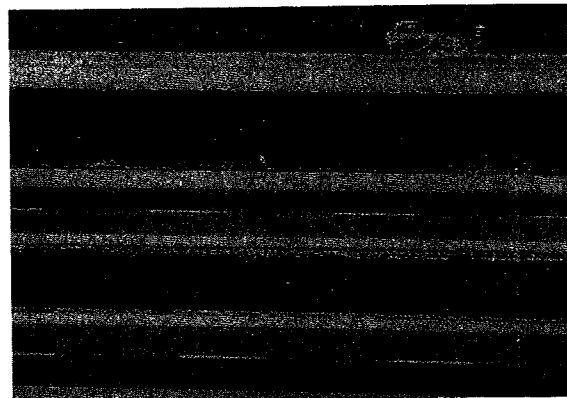
- UNATTENDED VEHICLE ON SHOULDER.

C

- EXIT WHERE NO EXIT RAMP EXISTS.



- MEDIAN CROSSING



- HITCH-HIKING

TYPES OF ACCESS VIOLATIONS

FIGURE 12

FIGURE 13

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

The frequency of these types of violations and their respective percentages are shown in Figure 14. 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. (See the photograph in Figure 11 of this type of violation.)

The number of violation locations shown in the Table of the Frequency of Types of Violation Locations, 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 was shown in the graph of the Extent of the Frequency of Access Violations (Figure 15). Noting that "often" was marked for 44 percent of the violation locations 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).

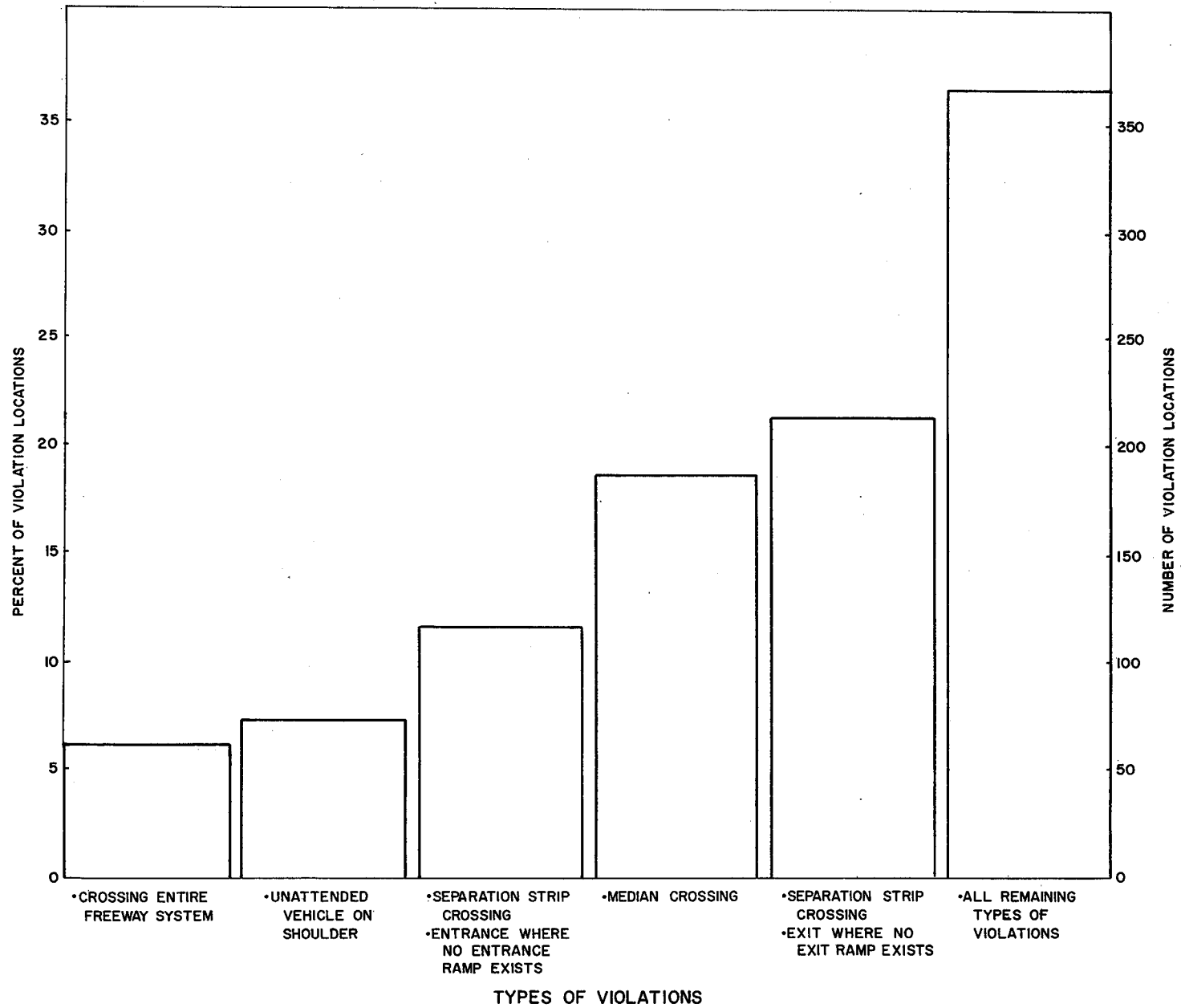
The primary cause of access violations was found to be that the violation route was the most convenient route. This generally resulted from one of the following two conditions:

1. There was no ramp available.
2. There was no grade separation available.

Figure 16 shows the frequency of the cause of access violations. Since two causes could be marked on the questionnaire for each violation, the sum of the percentages for all causes was greater than 100 percent.

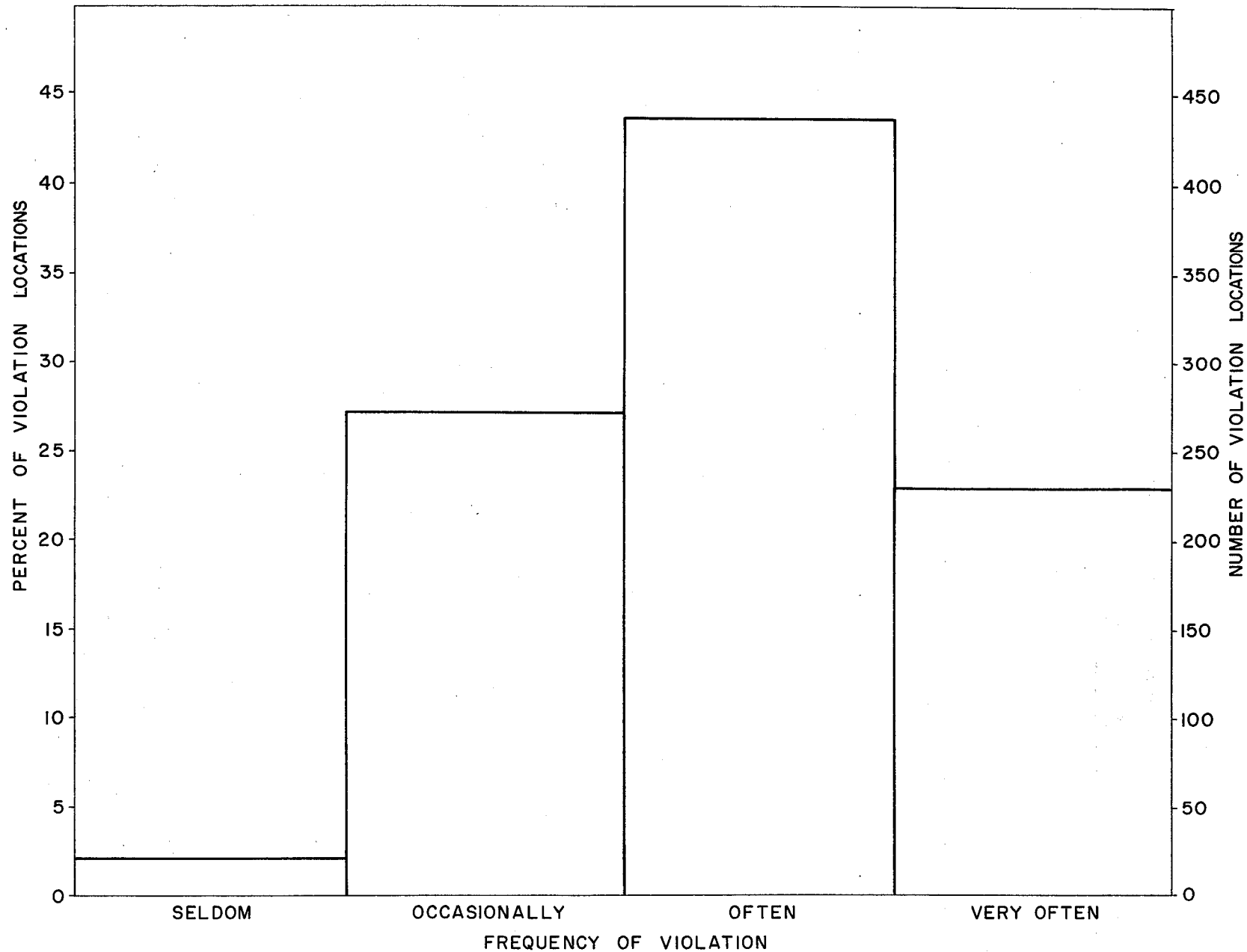
The greatest cause of violations was found to be that the violation route was the most convenient route. This cause of violation was indicated for over 52 percent of the violation locations.

The curve in Figure 17 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



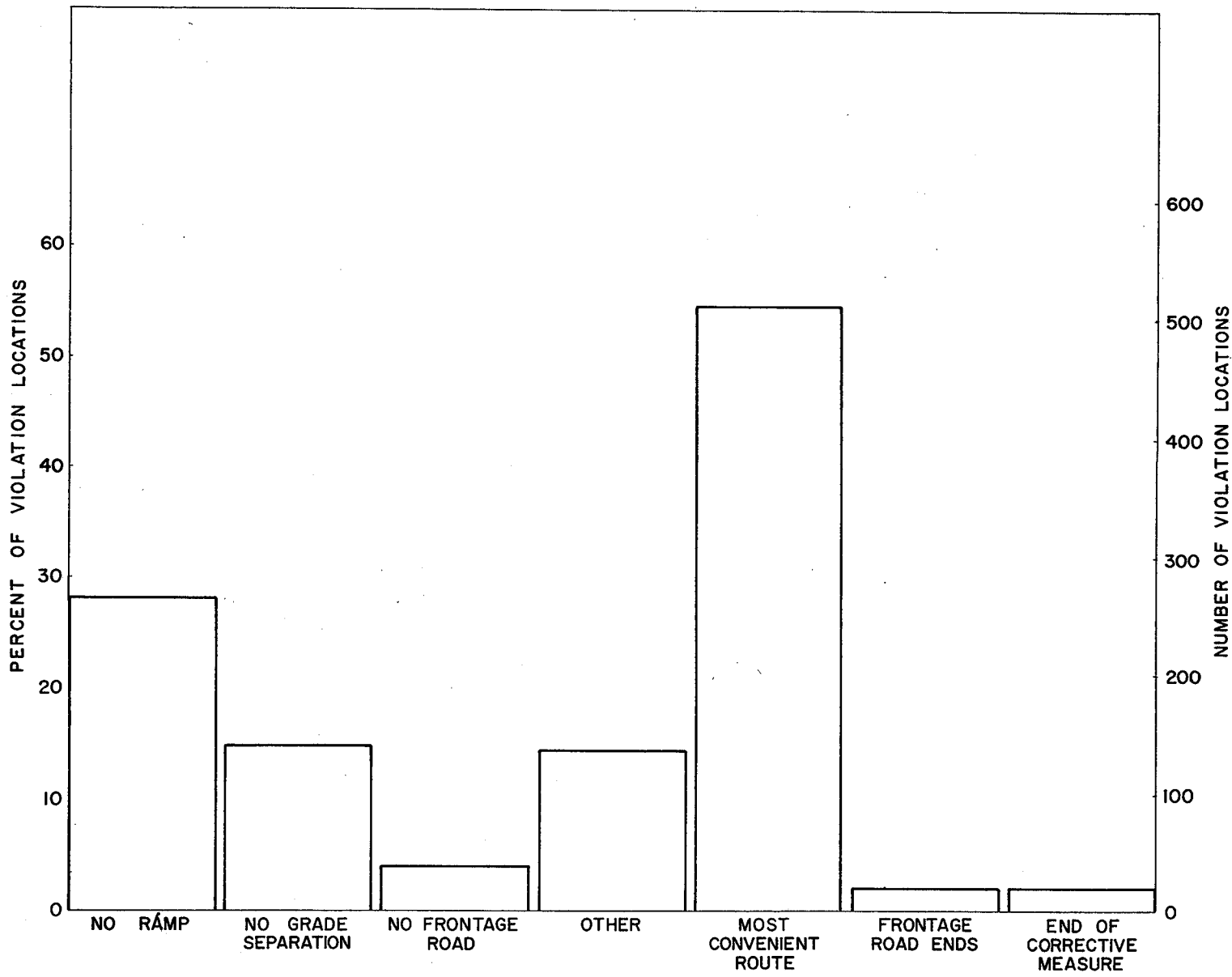
FREQUENCY OF MAJOR TYPES OF VIOLATIONS

FIGURE 14



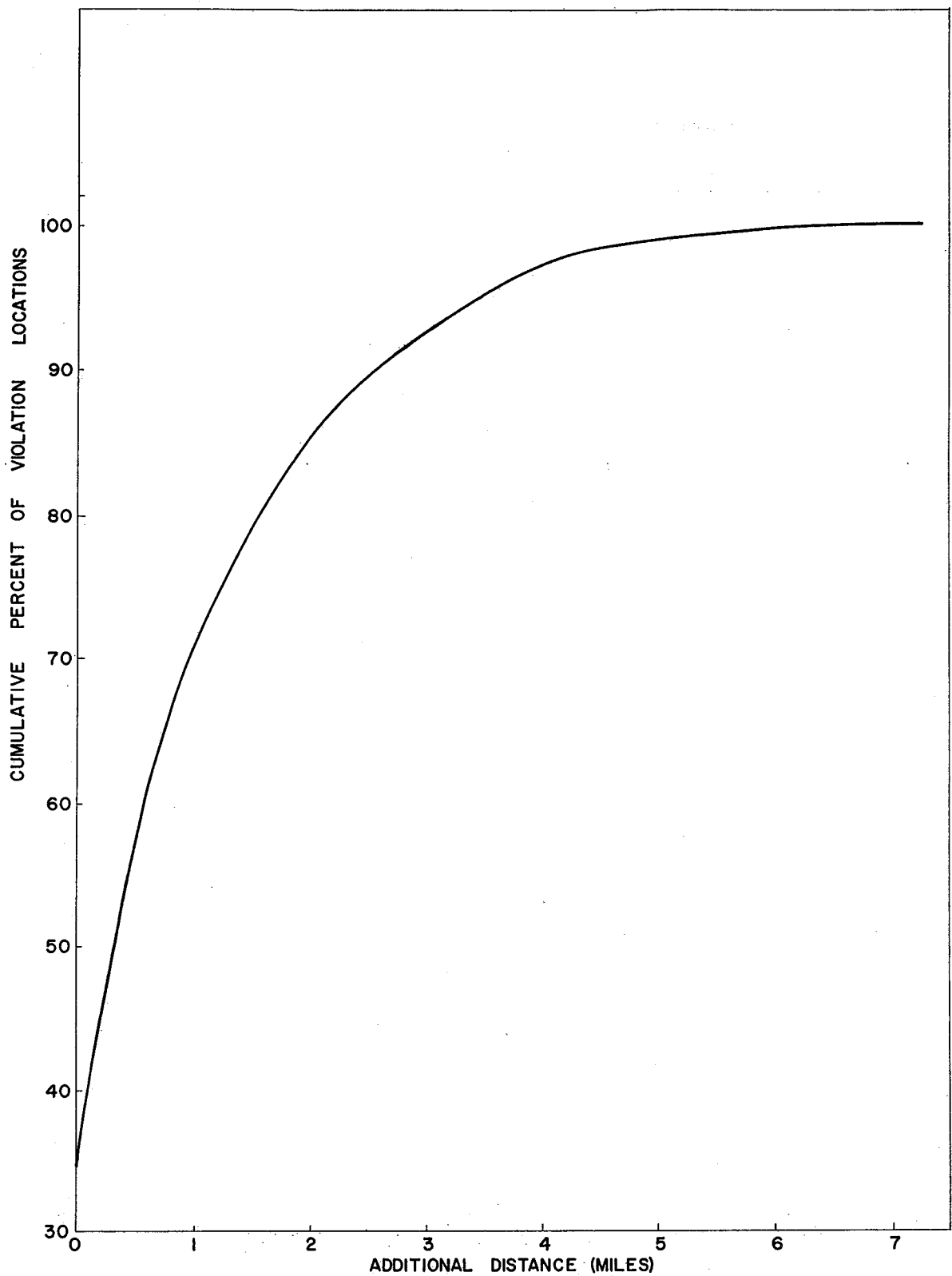
EXTENT OF THE FREQUENCY OF VIOLATIONS

FIGURE 15



CAUSES OF VIOLATIONS
FREQUENCY OF CAUSES OF VIOLATIONS

FIGURE 16



RELATIONSHIP BETWEEN ADDITIONAL DISTANCE
AND CAUSE, MOST CONVENIENT ROUTE

FIGURE 17

legal route meant that the violator could have exited from the freeway before reaching this point, driven the remainder of the distance on the frontage road, and traveled no farther than 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., 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.

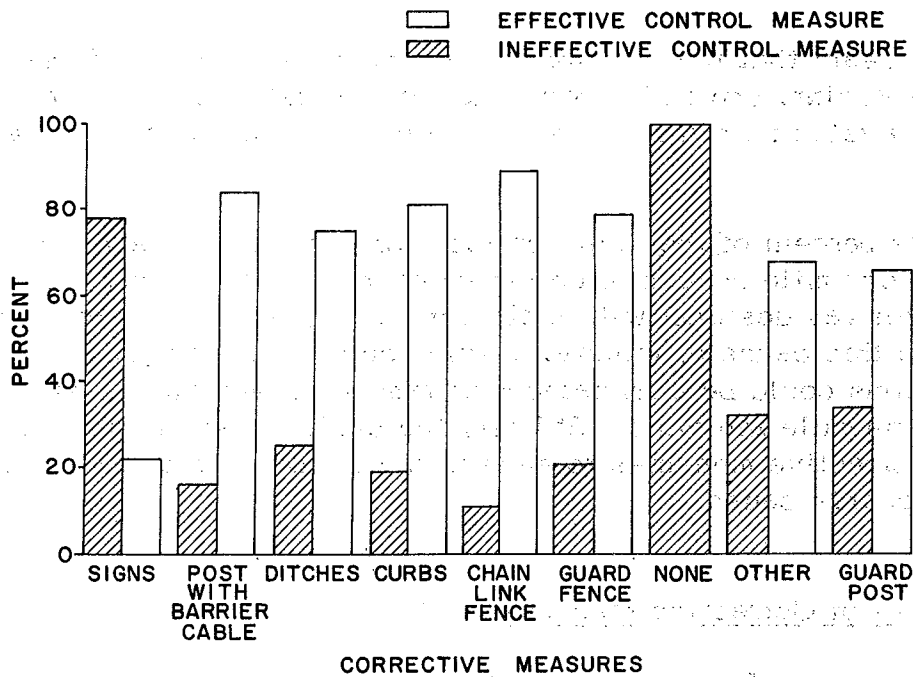
Effectiveness of Corrective Measures

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 under the titling Frequency of Corrective Measures in Figure 18. Note that the sum of the percentages for the bars doesn't equal 100 percent since up to three corrective measures could be marked for one violation.

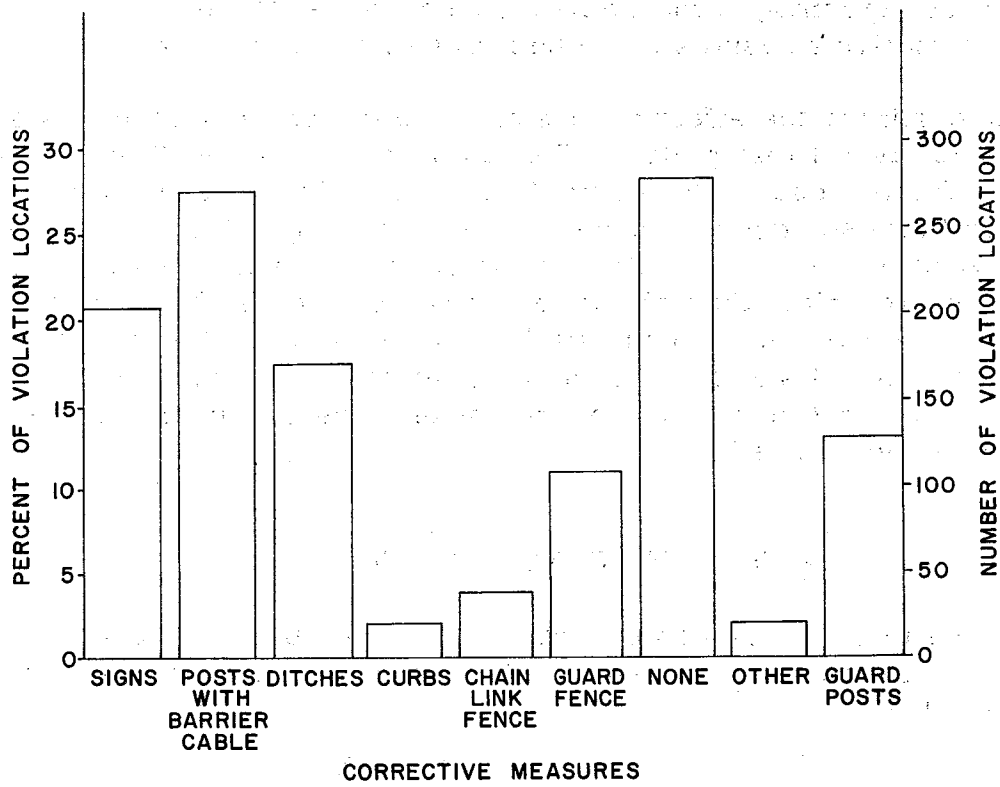
Determining the effectiveness of these corrective measures was the third objective of this project. This is shown in Figure 18 as a graph titled Effectiveness of Corrective Measures. This graph shows the percentage that each corrective measure was rated as effective and ineffective. It is interesting to note that the corrective measure signs were ineffective more often than effective, 78 percent versus 22 percent. Curbs, chain-link fences, and posts with barrier cable showed a very high effectiveness ratio. It should be noted from the Frequency of Corrective Measures graph (Figure 18) that the sample size for curbs and chain link fences was very small.

ADDITIONAL CONSIDERATIONS

Since this project was a pilot study on the subject of access violations, the following additional results are presented to furnish a more complete background.



**EFFECTIVENESS OF CORRECTIVE MEASURES
(OPINIONS OF FIELD PERSONNEL)**



FREQUENCY OF CORRECTIVE MEASURES

FIGURE 18

Types of Access Violators

The access violator was cataloged into three types: pedestrian, vehicle, and animal since the type "Other" was not marked on any questionnaire. The frequency of Violations by Violator graph (Appendix B) showed the frequency of each of the types of violators with the vehicle accounting for 94 percent. The Frequency of Violations by a Specific Group graph (Appendix B) showed 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

The Frequency of the Purpose of Violations is shown in Appendix C. This graph shows the major purposes for access violations to be:

1. Egress from the freeway facility.
2. Access to the freeway facility.
3. A change of direction on the freeway facility.

These purposes substantiated the three major types of violations which are shown in the graph of the Frequency of the Major Type of Violations (Figure 14).

Average Daily Traffic

The graph in Appendix D-1 of the Frequency of Average Daily Traffic shows that 46 percent of the violation locations occurred on facilities with an average daily traffic of 5,000 to 9,999 vehicles. It should be noted that the sum of percentages of the bar graphs does not equal 100 percent because 163 (16.5 percent) of the questionnaires did not furnish a figure for average daily traffic. Only three violations were reported with an average daily traffic of greater than 30,000 vehicles.

The three major types of violations are correlated with average daily traffic in the graph in Appendix D-2. It should be noted that approximately 60 percent of the violation locations for each of the major causes took place on a facility with an average daily traffic of less than 6,000 vehicles.

Additional Distance to Go the Legal Route

The graph of the Relationship Between Additional Distance and All Violations (Appendix E) shows that 35 percent of the violation locations require no additional time to go the legal route. According to this graph, eighty percent of the violation locations occurred when the additional time required to go the legal route was less than five minutes.

Severity of Violations

The frequency of the severity of violations is shown in the graph in Appendix G-1. Dangerous was marked for almost 50 percent of the violation locations. An attempt was made to show that a greater percentage of relatively safe violations would occur than dangerous violations for the same additional time to go the legal route. The graph (Appendix G-2) of the Relationship between the Additional Time and Severity of Violation 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.

Next, an attempt was made to show that distance was this parameter. The graph of the Relationship between Additional Distance and Severity of Violation (Appendix G-3) shows that a greater percentage of relatively safe violations occurred than dangerous and very dangerous when the additional distance was between one-half mile and two miles. Up to one-half mile, there was practically no difference in the curves, and for distances further than two miles, a greater percentage of dangerous and very dangerous violations occurred than relatively safe violations. Note that this comparison was based on time percentages and not on the quantities.

Presence of Violations

The graph in Appendix H-1 illustrates the frequency of the presence of violation locations. The percentages of the four 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.

The graph of the Number of Existing Violation Locations Beginning in Past Years (Appendix H-2) shows the number of violations beginning on new facilities as they were opened to traffic for each of the past twelve years. On the same page, the graph of the cumulative number of these violation locations shows that these numbered over three hundred. The three hundred in existence should have totaled the eight hundred shown in the graph, Frequency of Presence of Violation Locations, in Appendix H-1. This did not result 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

The graph of the Frequency of Freeway Areas (Appendix I) showed that 75 percent of the violation locations reported occurred on rural freeway facilities and 25 percent on urban freeway facilities. This was anticipated for three reasons: (1) the heavy volumes on urban freeways tend to prevent violations, (2) many urban freeways have barrier curbs on frontage roads and a guard rail down the median which prevent violations, and (3) approximately 130 miles of urban freeways were studied in comparison with approximately 640 miles 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.

Accident History

The Frequency of Accident History graph (Appendix I) showed that a very small number of accidents have been attributed to access violations. It should be noted, however, that one fatality resulted from an access violation accident.

Profile

The graph of the Frequency of Profile (Appendix I) indicates that over 90 percent of the access violation locations occurred on relatively flat terrain.

Enforcement

The Frequency of Enforcement Ratings graph (Appendix I) illustrates the fact that the enforcement level for access violations was generally low. In less than twenty-five instances the enforcement level was rated as high.

Duration of Violation

The graph of the Frequency of Duration of Violation (Appendix J) shows that at 86 percent of the violation locations, less than five minutes was required for the execution of the violation maneuver. Since data were not collected using a continuous observation method, a breakdown of less than five minutes was impossible.

CONCLUSIONS

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

1. A total of twenty-eight separate types of access violations were observed and defined.
2. A total of 986 access violation locations were observed on approximately 770 miles 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 miles 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 miles 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 found to be:
 - 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.
 - 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: (1) pedestrian, (2) vehicle, and (3) animal. Of these three, 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 vehicles.
 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 were classed as relatively safe, dangerous, and very dangerous. The persons reporting the data indicated the following:
 - a. Relatively safe--24 percent of the violation locations.
 - b. Dangerous--49 percent of the violation locations.
 - c. Very dangerous--27 percent of the violation locations.

RECOMMENDATIONS

Recommendations for Additionas Studies

One of the Texas Highway Department Districts, when returning their 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. Possibly a detection device could be designed to collect these data. If the data show the extent and severity 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? The report "The Significance and Nature of Vehicle Encroachment on Medians of Divided Highways"² by John W. Hutchinson furnished encroachment 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 in which these posts are hit. 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 in Texas, 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 presently used in Maryland for limiting crossover usage to emergency vehicles is a radio operated median gate.³ Mr. Hutchinson states in his report² 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.

APPENDIX

APPENDIX A-1

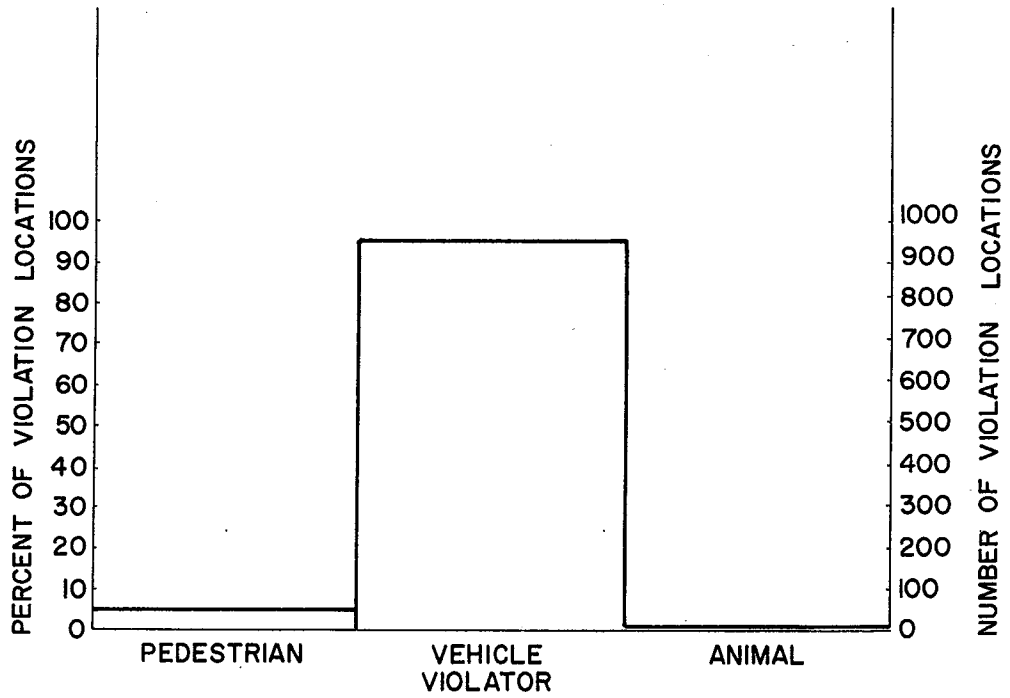
CODE OF DATA COLLECTION FORM

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=2
Col.	20-22	LOCATION TO NEAREST ACCESS IN TENTHS OF A MILE BLANK=UNKNOWN OR DOES NOT APPLY	
Col.	24	VIOLATOR	1=PEDESTRIAN 2=VEHICLE 3=ANIMAL 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	I=INCORRECT USE OF ENTRANCE RAMP
		B=SEPARATION STRIP CROSSING	J=INCORRECT USE OF EXIT RAMP
		C=NOSE CROSSING	K=ENTRANCE WHERE NO ENTRANCE RAMP EXISTS
		D=CROSSING ENTIRE FREEWAY SYSTEM	L=EXIT WHERE NO EXIT RAMP EXISTS
		E=UNATTENDED VEHICLE ON SHOULDER	M=WRONG WAY ON FRONTAGE ROAD
		F=PARKING ON MEDIAN	N=ANIMAL CROSSING
		G=HITCH-HIKING	O=LOADING OR UNLOADING PASSENGERS
		H=OTHER	
Col.	32	FREQUENCY OF VIOLATION	1=VERY OFTEN 2=OFTEN 3=OCCASIONALLY 4=SELDOM
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	5=MOST CONVENIENT ROUTE
		2=NO GRADE SEPARATION	6=FRONTAGE ROAD ENDS
		3=NO FRONTAGE ROAD	7=END OF CORRECTIVE MEASURE
		4=OTHER	
Col.	39-40	ADDITIONAL TIME IN MINUTES REQUIRED FOR LEGAL ROUTE ZEROS=NO ADDITIONAL TIME REQUIRED BLANK=DOES NOT APPLY	

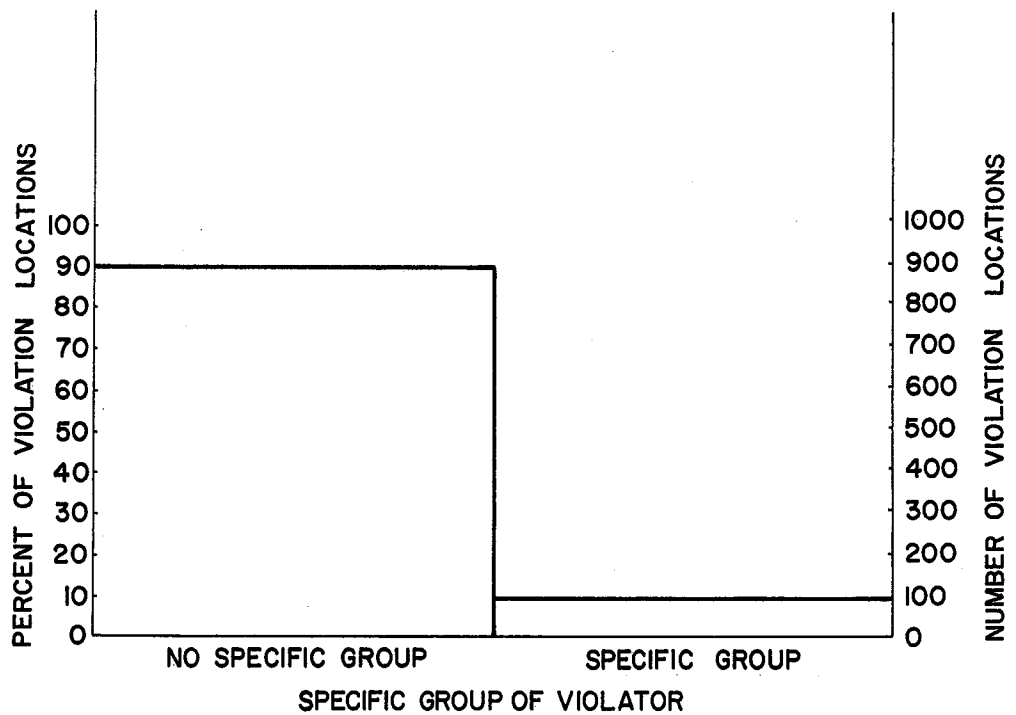
APPENDIX A-2

CODE OF DATA COLLECTION FORM (CON'T)

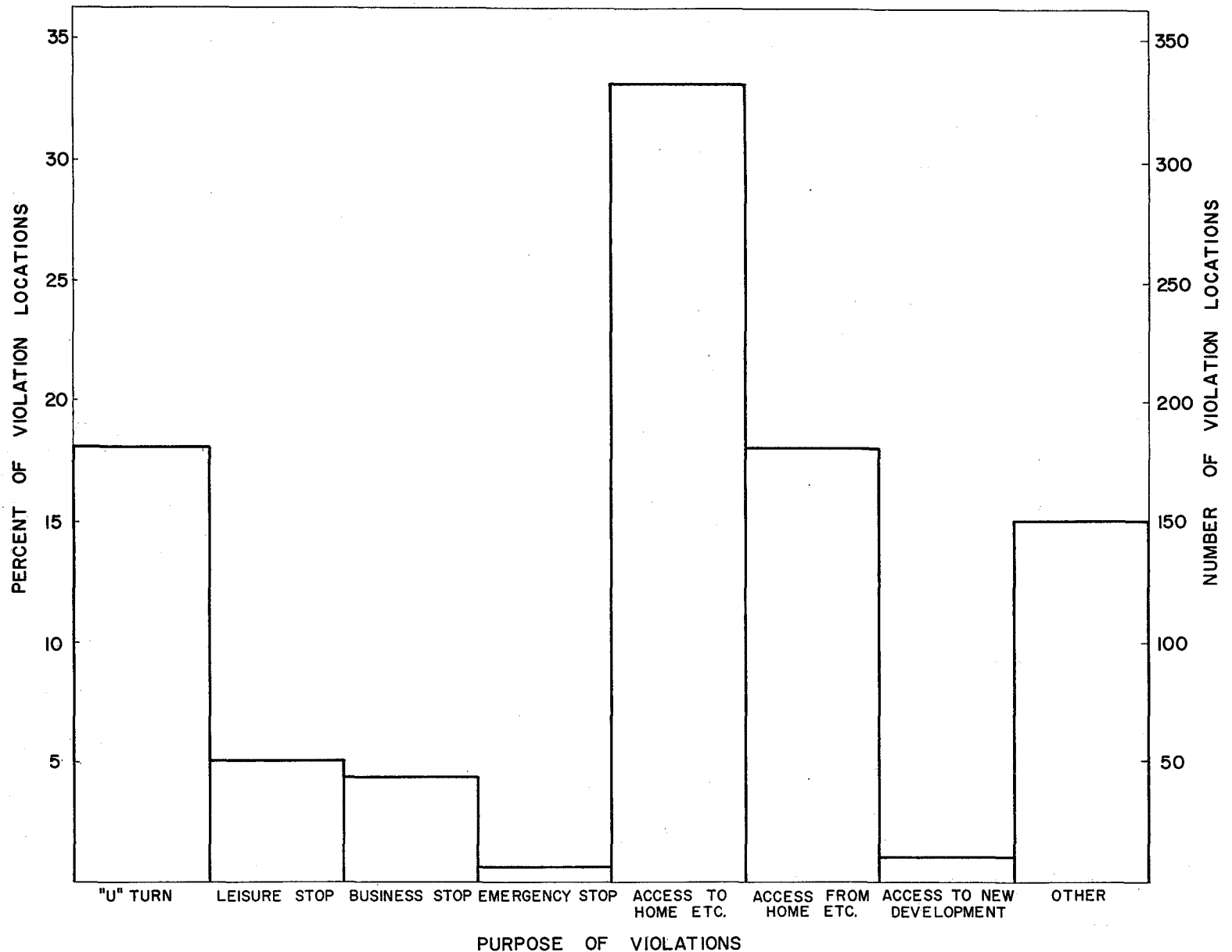
Col.	42-44	ADDITIONAL DISTANCE TO TENTHS OF A MILE REQUIRED FOR LEGAL ROUTE ZEROS=NO ADDITIONAL DISTANCE REQUIRED	BLANK=DOES NOT APPLY
Col.	46	DURATION OF VIOLATION	1=LESS THAN 5 MINUTES 2=5 TO 15 MINUTES 3=15 MINUTES TO 1 HOUR
			4=1 HOUR TO 5 HOURS 5=OVER 5 HOURS 6=VARIABLE
Col.	48	SEVERITY OF VIOLATION	
		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	CORRECTIVE MEASURES	
	55	0=UNKNOWN	5=CHAIN LINK FENCES
	58	1=SIGNS	6=GUARD FENCES
		2=POSTS WITH BARRIER CABLE	7=NONE
		3=DITCHES	8=OTHER
		4=CURBS	9=GUARD POSTS
Col.	53	EFFECTIVENESS OF CORRECTIVE MEASURES	
	56	0=UNKNOWN	
	59	1=EFFECTIVE	
		2=INEFFECTIVE	
Col.	64	SUGGESTED CORRECTIVE CONTROL MEASURES	
		1=NO SUGGESTIONS	2=SUGGESTED CONTROL MEASURES
Col.	66	VIOLATION ELIMINATED OR STILL IN EXISTANCE	
		1=VIOLATION STILL IN EXISTANCE	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



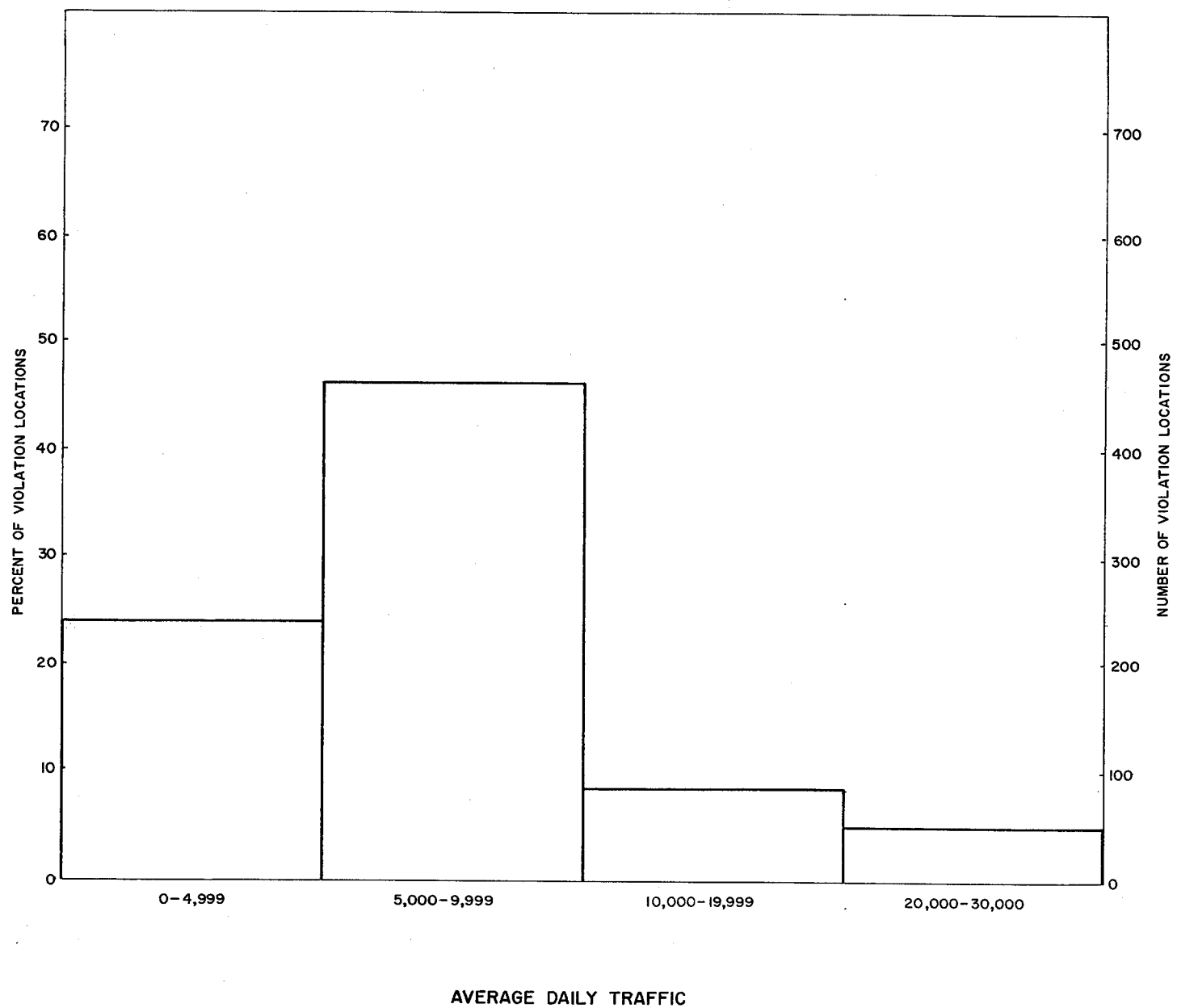
FREQUENCY OF VIOLATIONS BY VIOLATOR



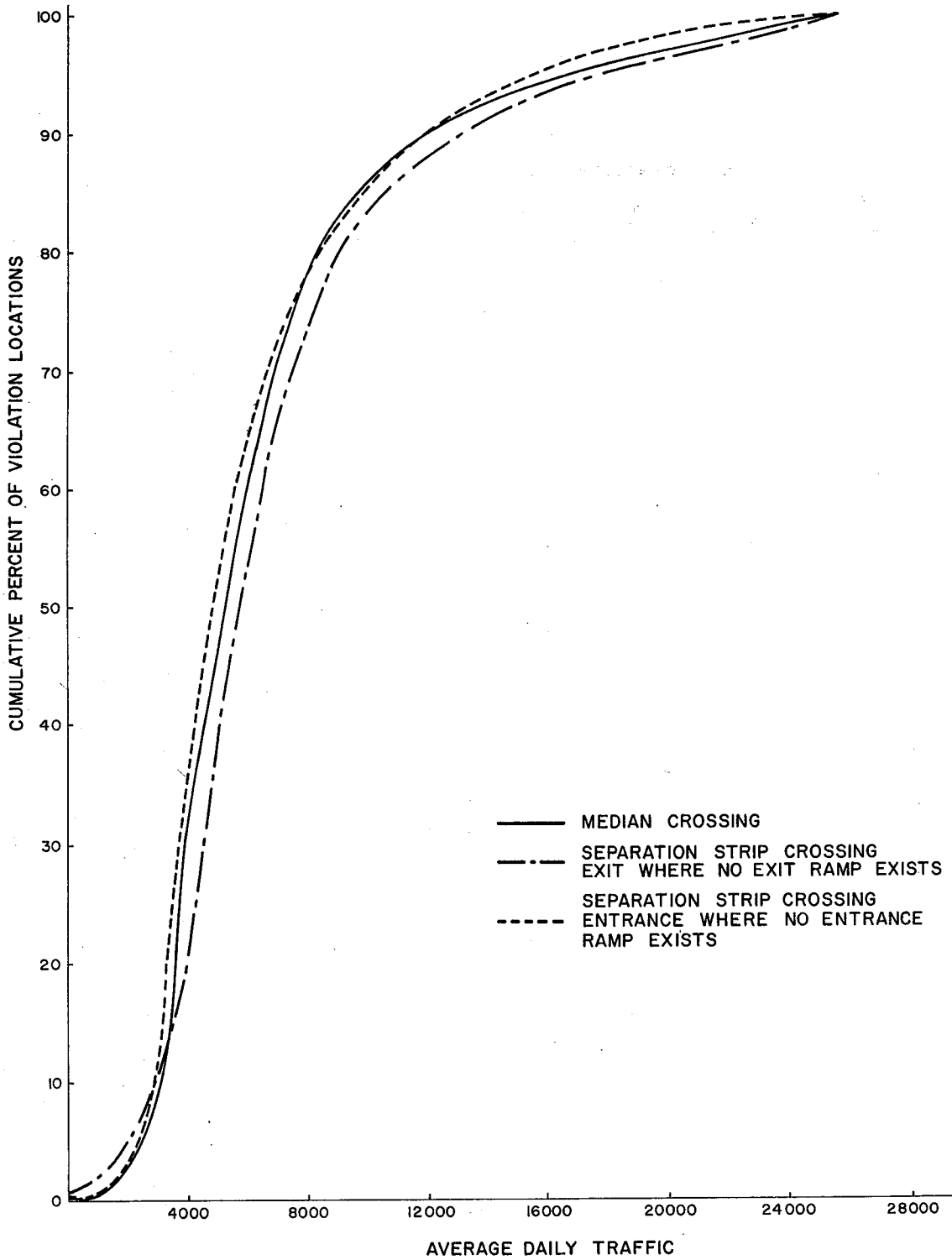
FREQUENCY OF VIOLATIONS BY A SPECIFIC GROUP



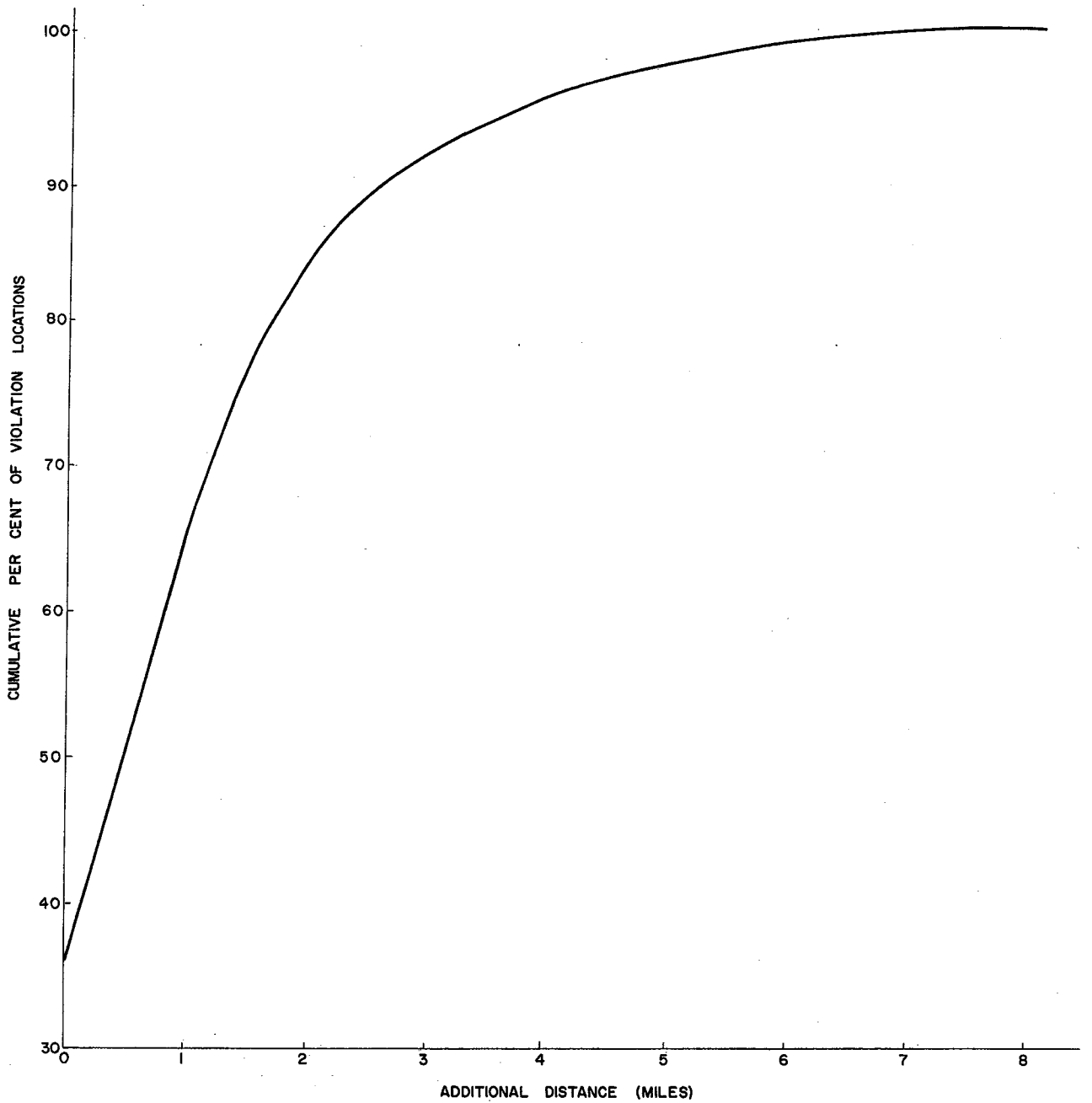
FREQUENCY OF PURPOSE OF VIOLATIONS



FREQUENCY OF AVERAGE DAILY TRAFFIC

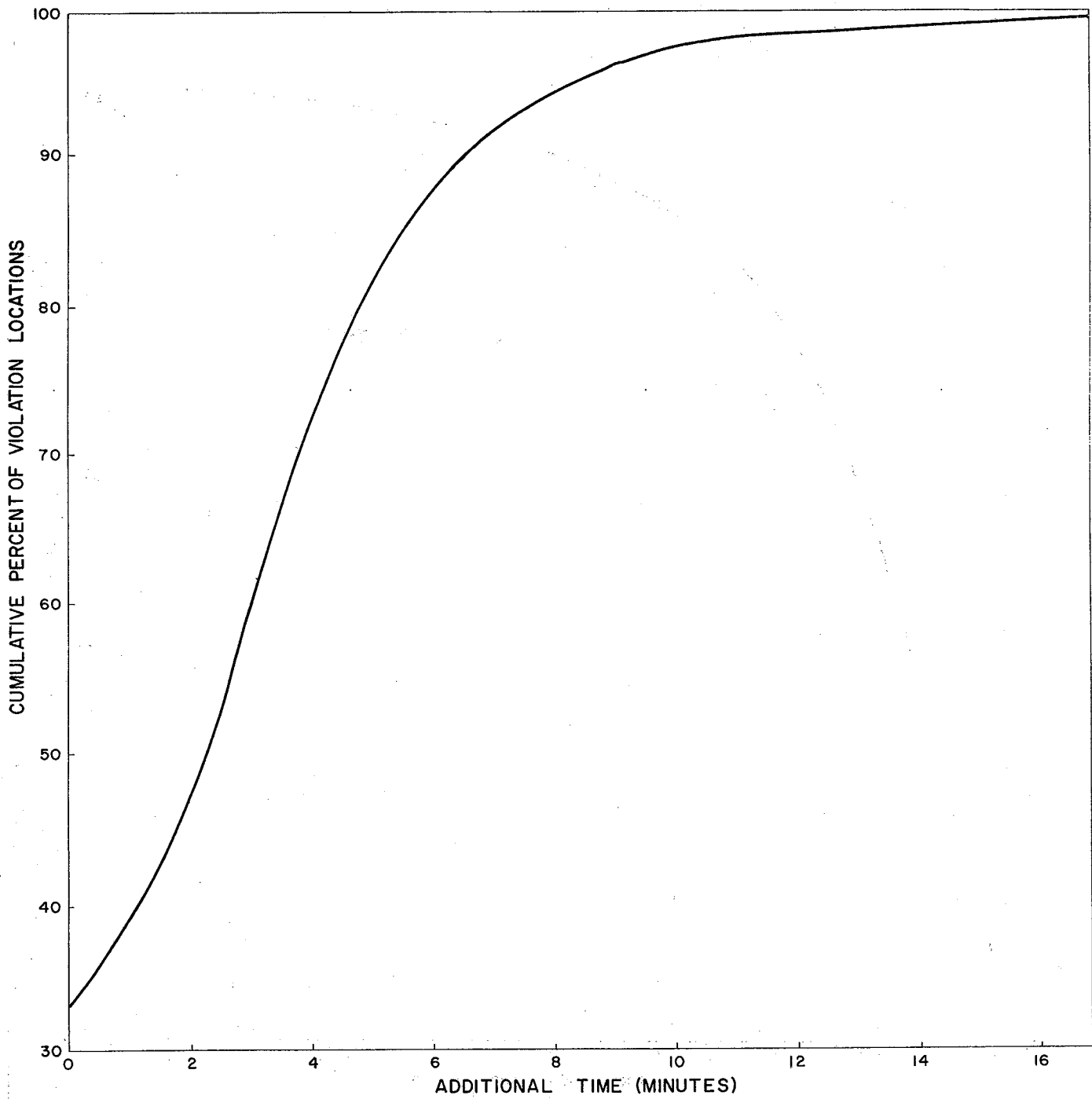


RELATIONSHIP BETWEEN AVERAGE DAILY TRAFFIC AND MAJOR TYPES OF VIOLATIONS



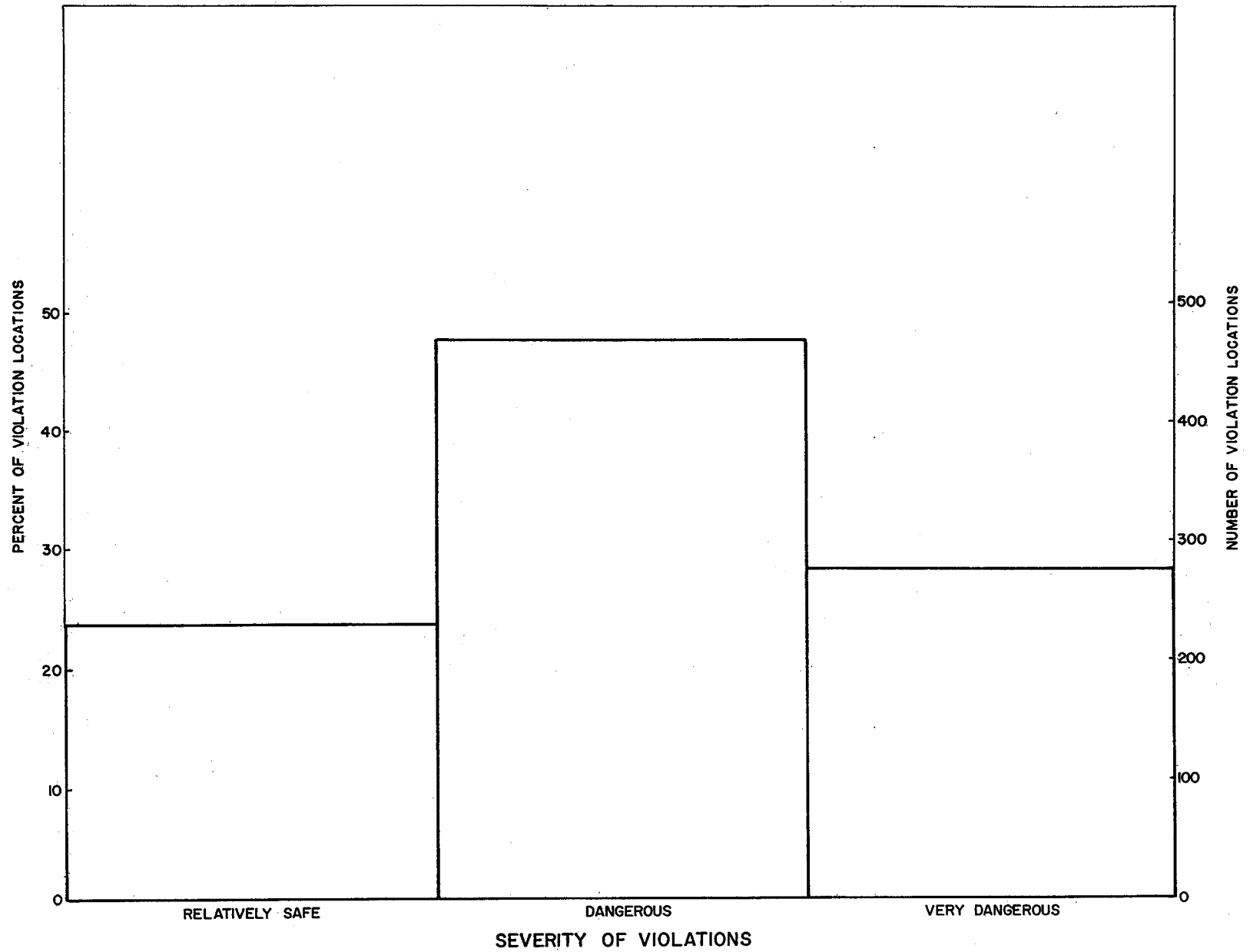
RELATIONSHIP BETWEEN ADDITIONAL DISTANCE
AND ALL VIOLATIONS

APPENDIX E

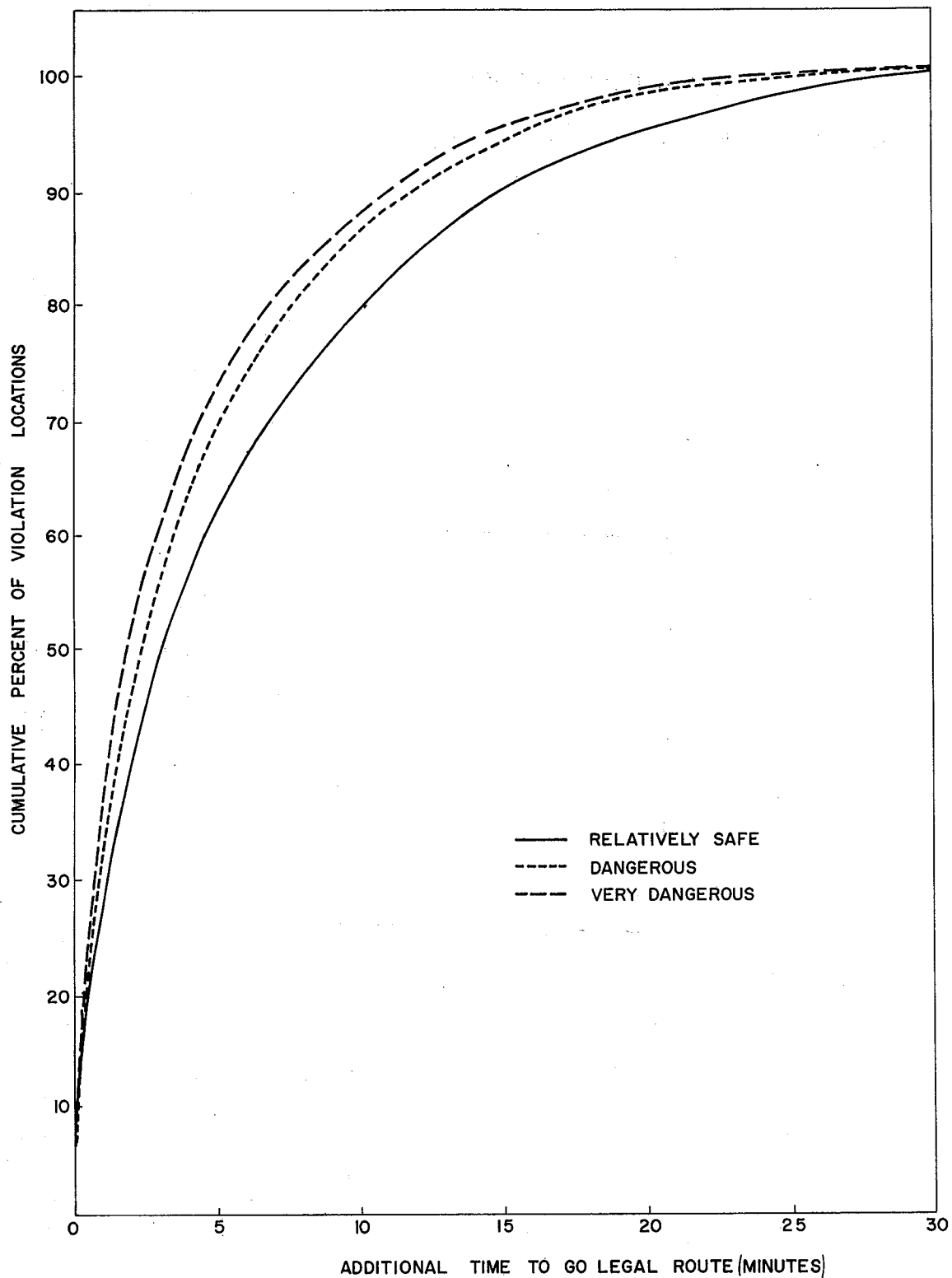


RELATIONSHIP BETWEEN ADDITIONAL
TIME AND ALL VIOLATIONS

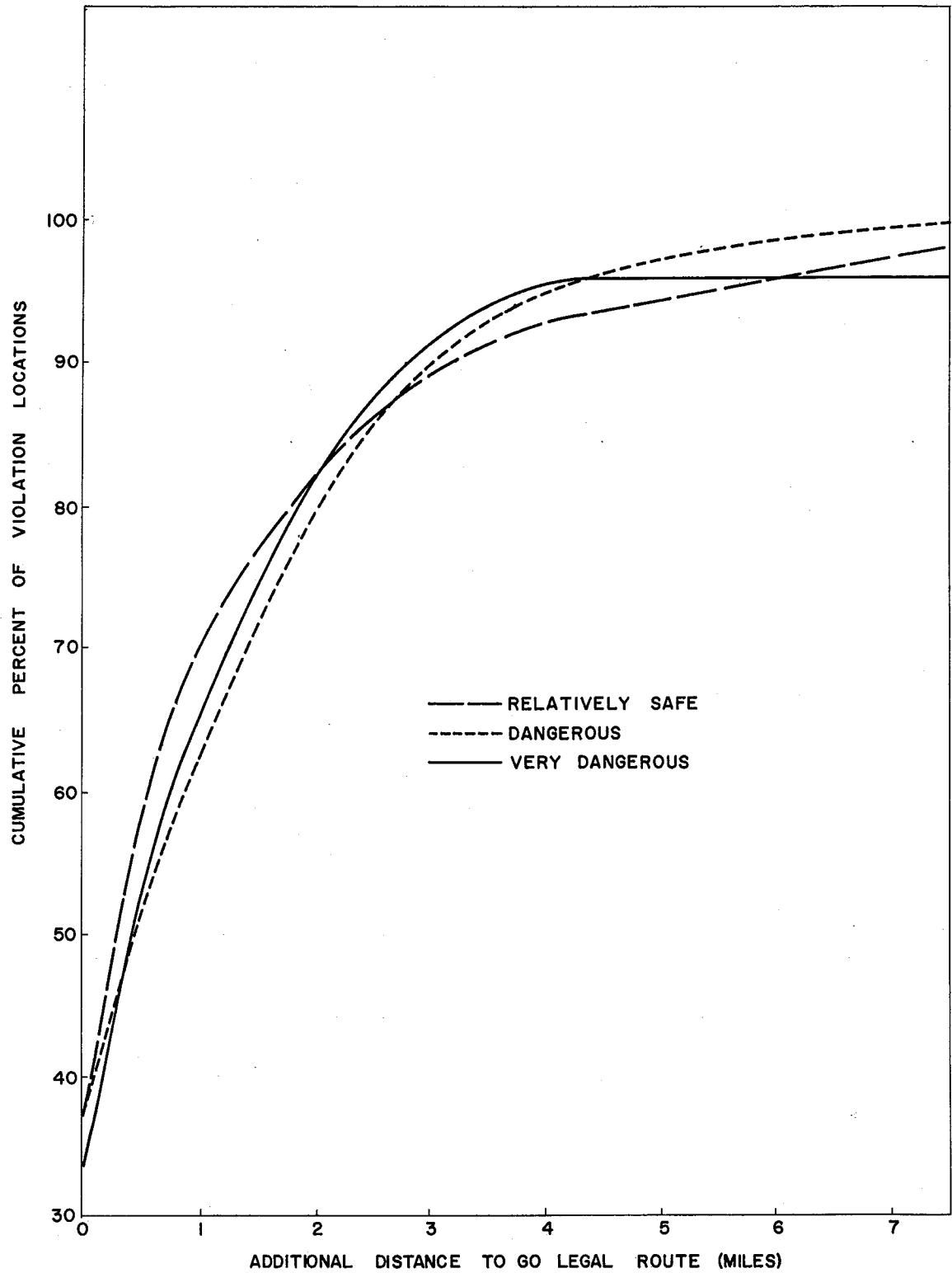
APPENDIX F



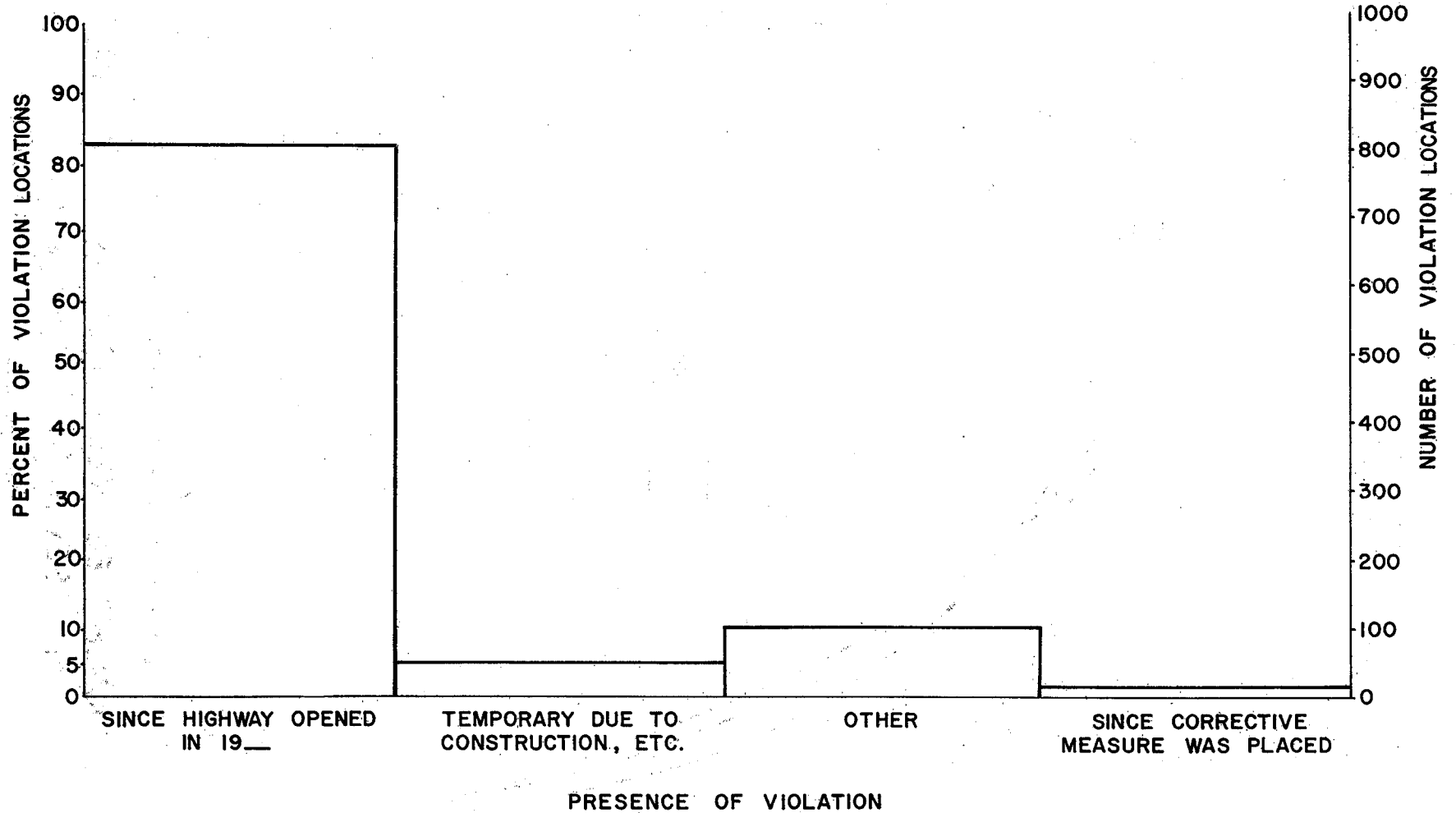
FREQUENCY OF THE SEVERITY OF VIOLATIONS



RELATIONSHIP BETWEEN ADDITIONAL TIME AND SEVERITY OF VIOLATION

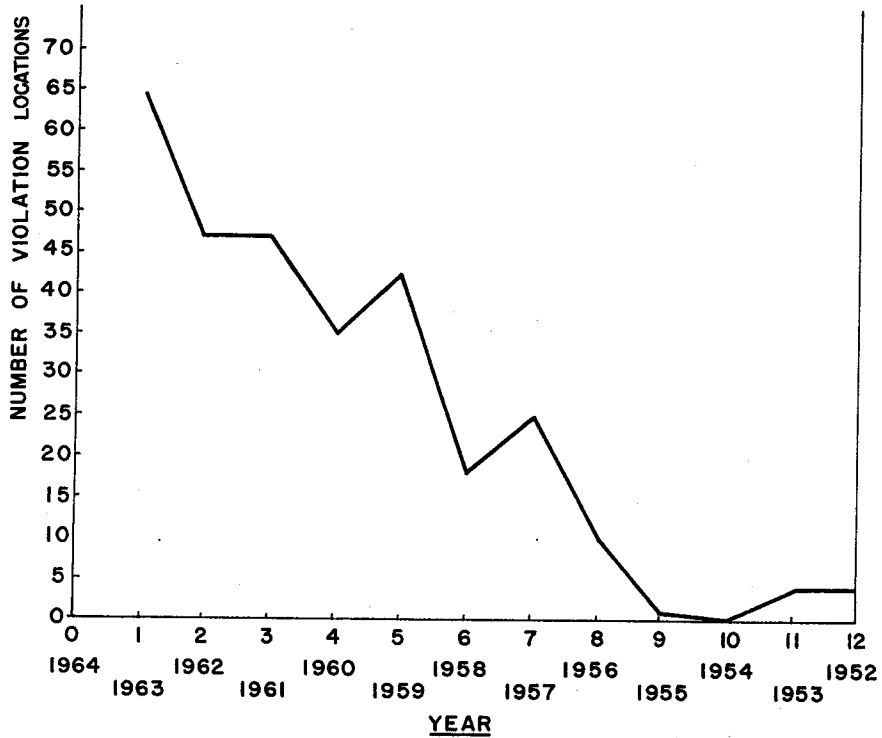


RELATIONSHIP BETWEEN ADDITIONAL DISTANCE AND SEVERITY OF VIOLATION

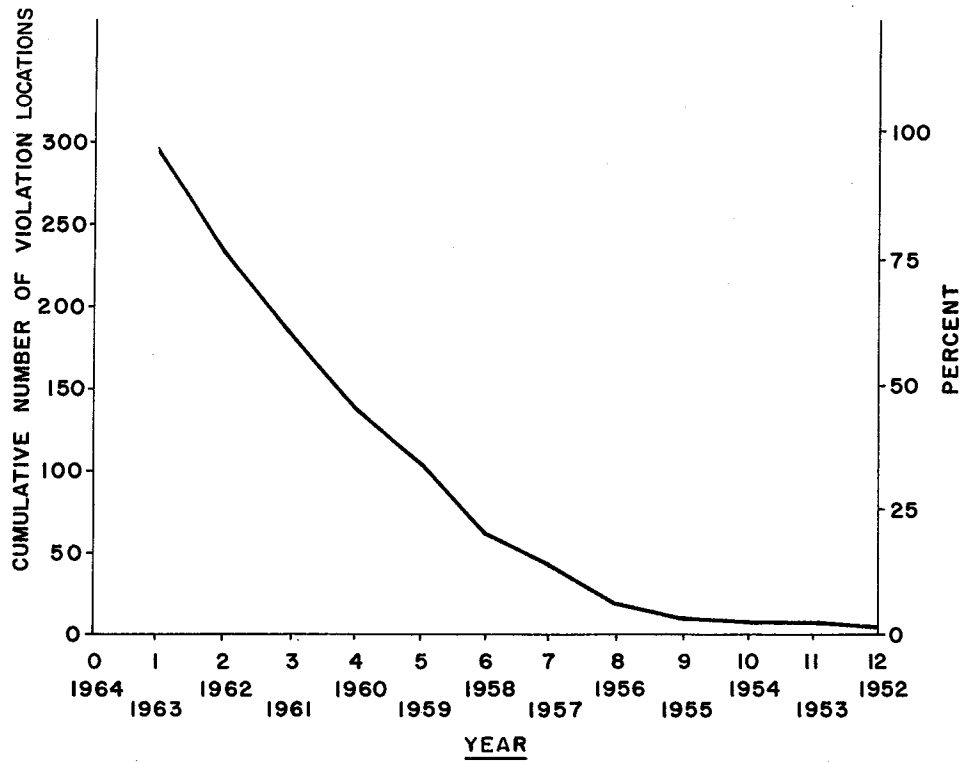


FREQUENCY OF PRESENCE OF VIOLATION LOCATIONS

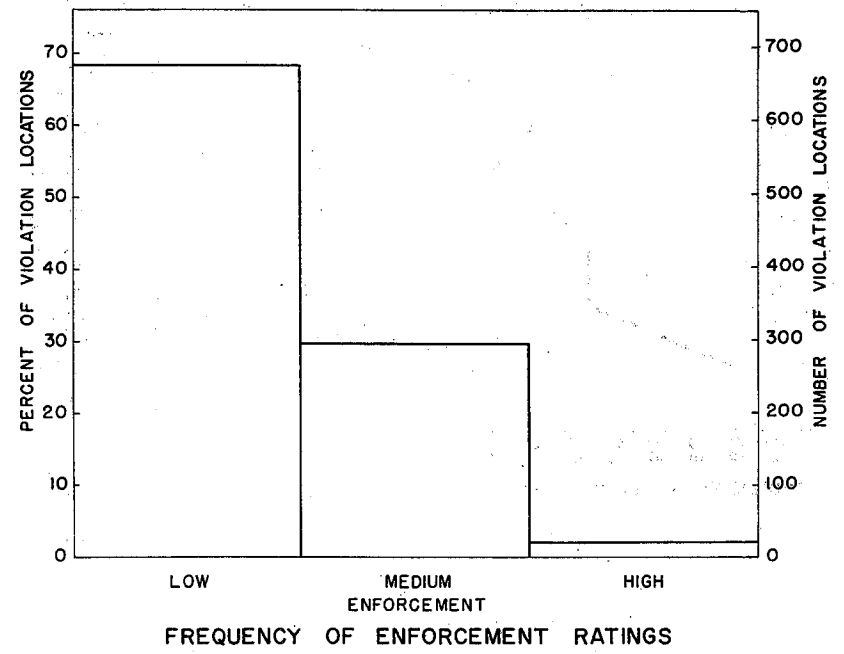
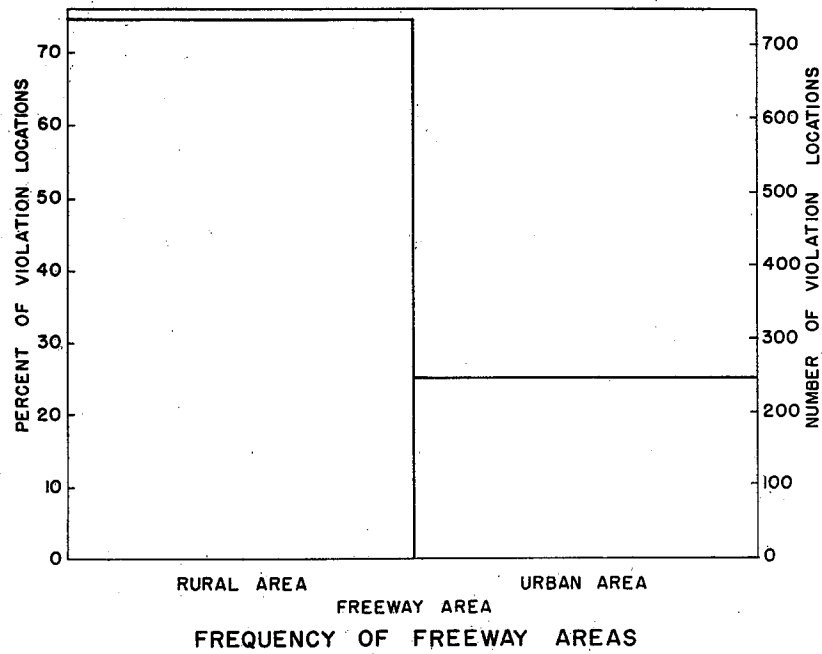
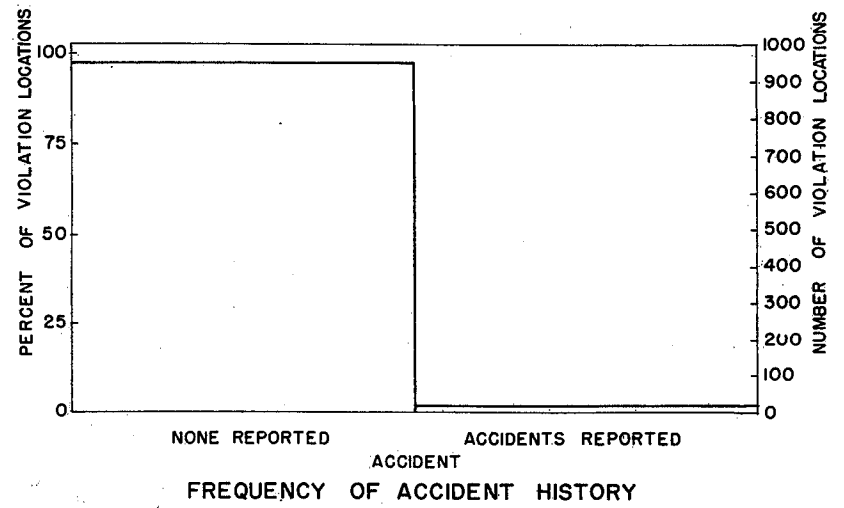
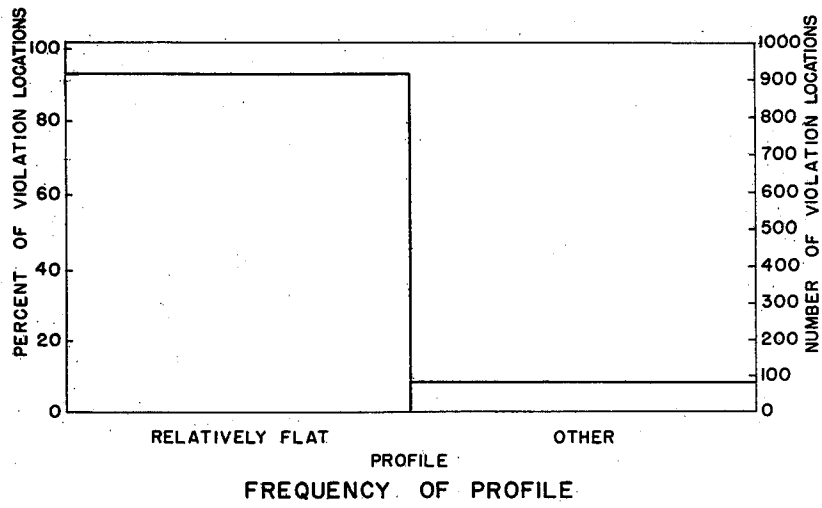
APPENDIX H-1



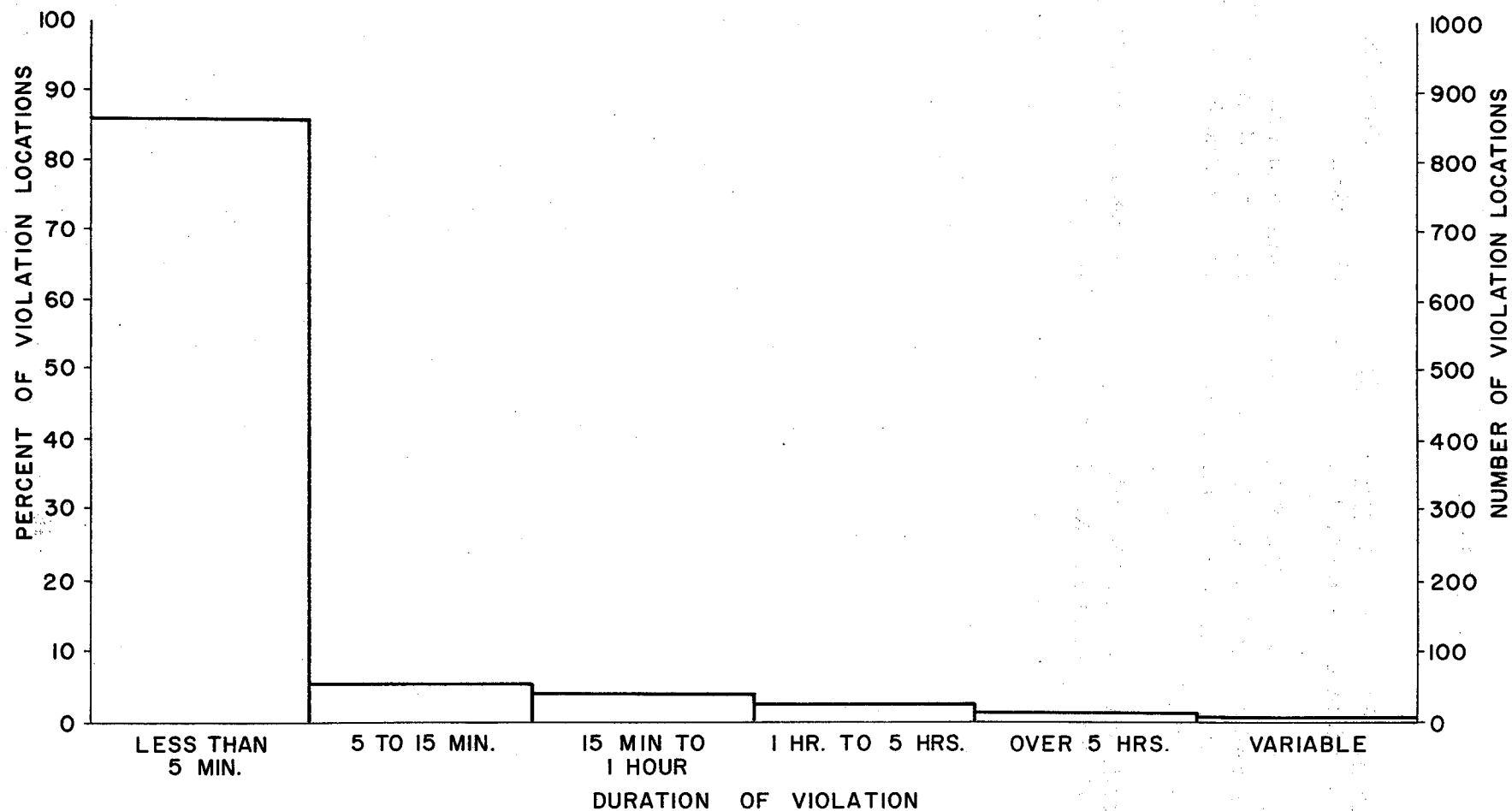
NUMBER OF EXISTING VIOLATION LOCATIONS BEGINNING IN PAST YEARS



CUMULATIVE NUMBER OF VIOLATION LOCATIONS



APPENDIX I



FREQUENCY OF DURATION OF VIOLATION

(LENGTH OF TIME REQUIRED TO ACCOMPLISH VIOLATION MANEUVER)

APPENDIX J

REFERENCES

1. Shoulder and Rest Area Procedure Guide, Committee on Shoulders and Medians, Highway Research Board, Bulletin 359, 1962.
2. Hutchinson, John W., "The Significance and Nature of Vehicle Encroachment on Medians of Divided Highways," University of Illinois, Urbana, Illinois, Civil Engineering Studies, Highway Engineering Series No.8, December, 1962.
3. Hallstead, William F., "Maryland Tries Radio-Operated Median Gates," Public Works, Volume 94, No. 7, page 78, July, 1963.