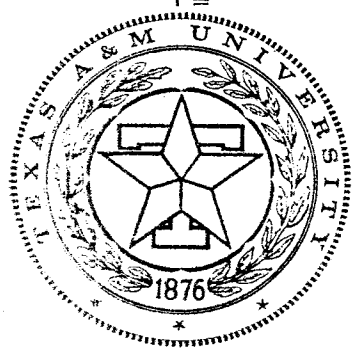

TEXAS
TRANSPORTATION
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TEXAS
HIGHWAY
DEPARTMENT

COOPERATIVE
RESEARCH

ACCIDENT REPORTING AND CLEARANCE PROCEDURES ON THE GULF FREEWAY

in cooperation with the
Department of Transportation
Federal Highway Administration
Bureau of Public Roads

RESEARCH REPORT 139-1
STUDY 2-8-69-139
FREEWAY CONTROL AND INFORMATION SYSTEMS

ACCIDENT REPORTING AND CLEARANCE PROCEDURES ON THE GULF FREEWAY

by

Merrell E. Goolsby

Research Report Number 139-1

Freeway Control and Information Systems
Research Study Number 2-8-69-139

Sponsored by
The Texas Highway Department
In Cooperation with the
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Federal Highway Administration
Bureau of Public Roads

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

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The opinions, findings, and conclusions expressed in this report are those of the author and not necessarily those of the Bureau of Public Roads.

INTRODUCTION

Land transportation experienced one of its greatest advances with the emergence of the concept of access controlled highways--freeways. A traffic facility capable of high volume, high speed movement of motor vehicles became a reality at a time when urban areas were being choked by the motor vehicle. The freeway concept proved so successful that today every major metropolitan area is dependent upon freeways to satisfy a significant portion of the transportation demand. The National System of Interstate and Defense Highways contributed to the emergence of the vast network of rural and urban freeways now in existence.

However, freeways were found to have limitations. It was discovered that during peak periods a freeway could overload itself. This problem led to the development of ramp control systems as a means of controlling demand. The metering of freeway entrance ramps proved to be an effective means of improving the operational efficiency of an overcapacitated freeway. Freeway control systems can now prevent the breakdown of a freeway under "normal" conditions. However, they cannot adequately control demand under "abnormal" conditions such as accidents or lane blockages.

To broaden the application of real-time freeway operations systems the Texas Transportation Institute, with the support of the Texas Highway Department and the U.S. Department of Transportation, began a research project entitled "Freeway Control and Information Systems." This project is an outgrowth of previous research on the Gulf Freeway in Houston,

which culminated in an operational freeway control system.

One of the objectives of the current research is the study of reduced capacity situations and the development of control plans and procedures to minimize the adverse effects of such capacity reductions. These studies are divided into two general areas: (1) development and testing of control and communications systems for reduced capacity operation, and (2) formulation and evaluation of procedures for the clearing of disabled vehicles from the freeway. This report concerns the latter.

BACKGROUND

There are two general causes of congestion at a reduced capacity scene: (1) the physical blockage of traffic lanes, and (2) the distraction of the motorists, called a "gapers block," created by the activity around an incident. Congestion continues even after the removal of the disabled vehicles from the moving lanes to the freeway shoulder. Mayor Louie Welch of Houston recognizes the seriousness of this problem at accident scenes as reported in the Houston Post of February 14, 1968: "Mayor Welch urged transportation experts..to figure out a way to screen freeway accidents from public view. 'Rubber neckers compound the accident figures by causing more pileups...'"

The problem discussed in this report is the removal of disabled vehicles from the roadway after the arrival of a police unit. Relatively minor adjustments in police procedures employed in handling disabled vehicles can yield major benefits in improved traffic operations and traffic safety. This report focuses attention on accidents, since they are the most common occurrence requiring police aid, although the application of these techniques to other incidents should not be overlooked.

STUDY SITE

The Gulf Freeway in Houston was selected for this study because of the research and surveillance facilities existing. The Gulf Freeway Surveillance and Control System includes entrance ramp signals, a digital process control computer, and a fourteen-camera closed-circuit television surveillance system (Figure 1). Since the installation of the television system in 1967, the Houston Police Department has maintained a patrolman and a base station police radio in the surveillance center to detect and report incidents requiring police assistance. The study was conducted on the six-mile section of the Gulf Freeway within the video surveillance system. The Gulf Freeway is a six-lane facility with a capacity of 6000 vehicles per hour (or 100 per minute) in each direction of flow.

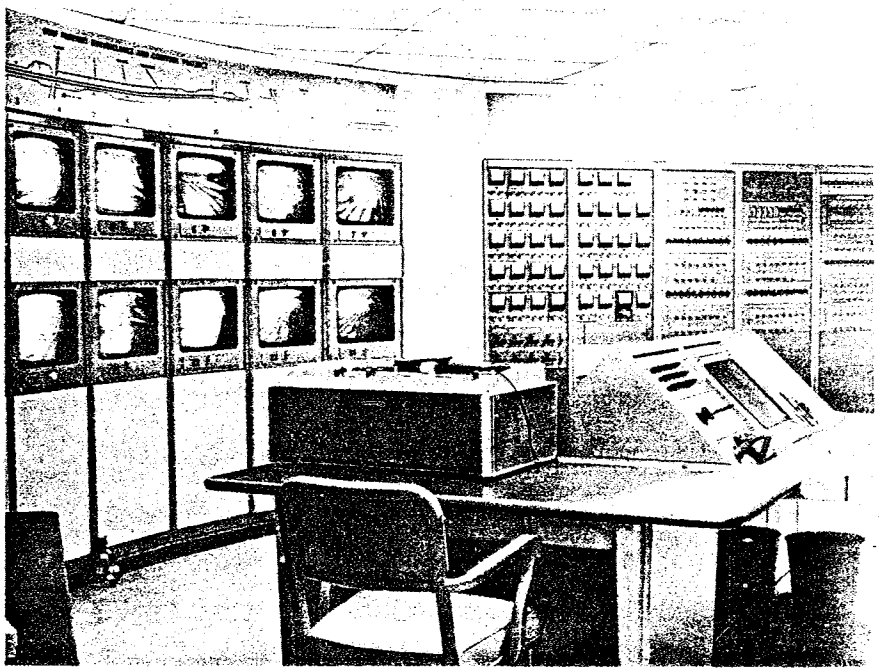


FIGURE 1. Gulf Freeway Surveillance and Control Center.

EFFECT OF ACCIDENTS

The first step in this study was to determine the effect on flow of two situations: (1) an accident blocking one traffic lane as shown in Figure 2, and; (2) vehicles involved in an accident parked on the freeway shoulder as shown in Figure 3.

Flow rates were measured for each of these conditions utilizing a video tape recorder interfaced with the television cameras on the freeway. It was possible to record from any one of the fourteen cameras through a video switcher in the control center. When an incident was observed, the video tape recorder was activated immediately. The data were tabulated at a later time by replaying the video tape. This data collection technique provided a flexible and accurate means of studying an elusive and unscheduled event.

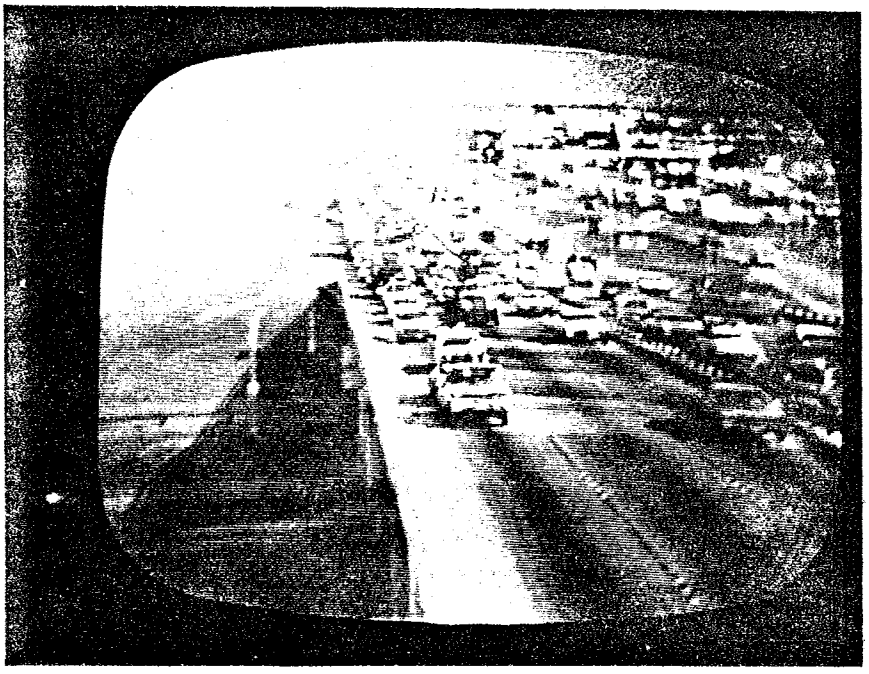


FIGURE 2. Accident blocking outside lane.

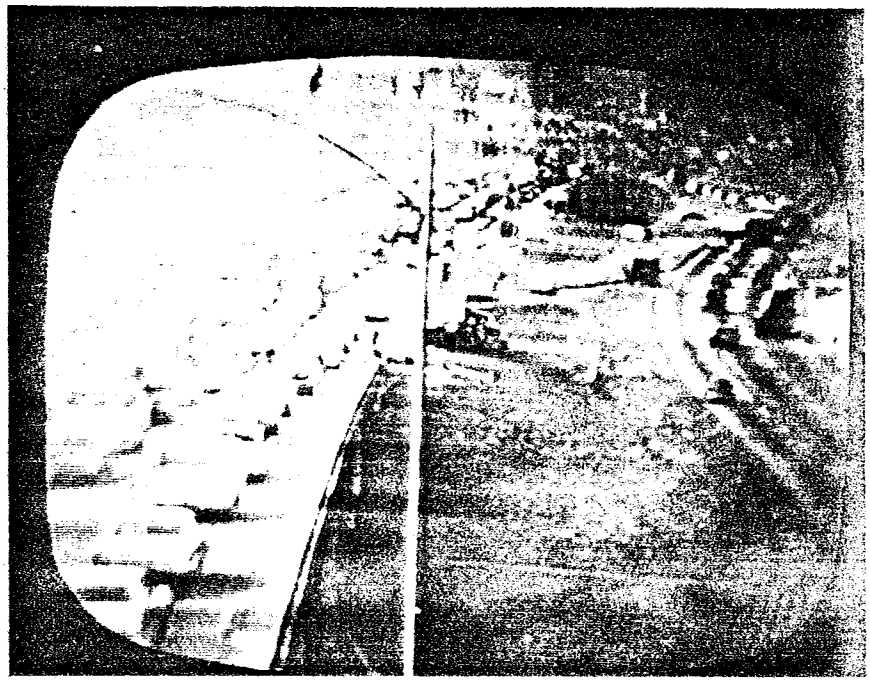


FIGURE 3. Investigation of accident on freeway shoulder.

To provide a frame-of-reference for the flow data collected at accident scenes, the distribution of one minute volumes was measured under normal peak period conditions. Figure 4 shows this distribution which indicates an average flow of 92.7 vehicles per minute. Note the use of the following notations for the figures in this report: n is sample size, $\bar{x}$ is the arithmetic mean, and σ is standard deviation.

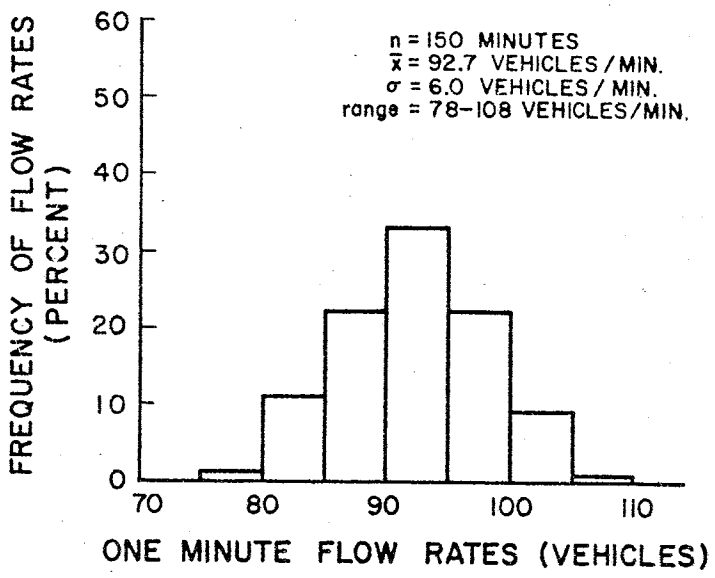


FIGURE 4. DISTRIBUTION OF ONE MINUTE FLOW RATES, NORMAL CONDITIONS.

The physical blockage of one moving lane of traffic yielded the flow distribution shown in Figure 5. The average flow was 45.3 vehicles per minute or 49 percent of normal flow. The removal of the accident to the freeway shoulder resulted in the flow distribution shown in Figure 6. The presence of the accident on the shoulder and the inherent "gapers block" resulted in a flow of 72.8 vehicles per minute, only 78 percent of normal flow. To be assured the flow data were a measure of capacity rather than demand, only flow data collected when a queue existed upstream of the incident were used. No flow data were used when rain or wet pavement existed.

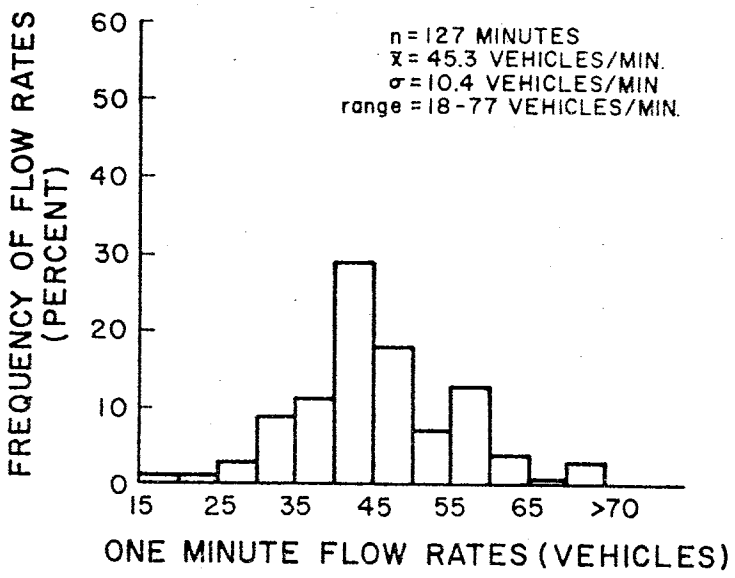


FIGURE 5. DISTRIBUTION OF ONE MINUTE FLOW RATES WITH ONE LANE OF THREE BLOCKED.

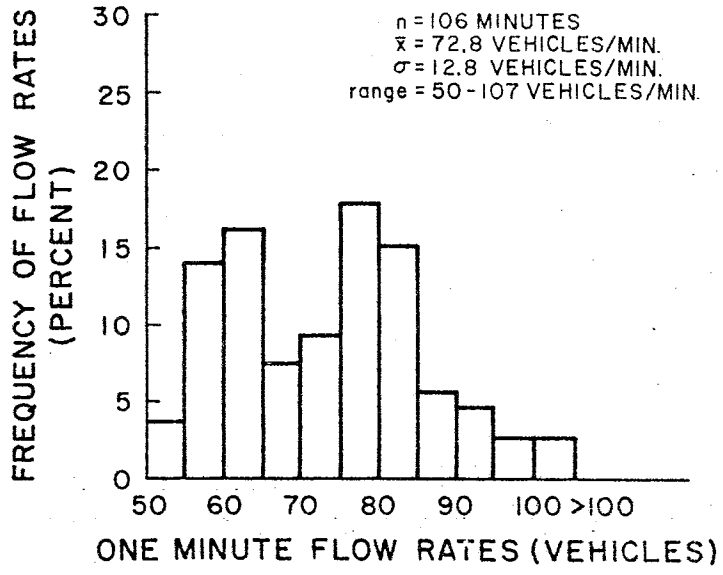


FIGURE 6. DISTRIBUTION OF ONE MINUTE FLOW RATES PAST ACCIDENT ON SHOULDER.

The digital process control and data acquisition computer routinely provides a summary of system data for the morning peak period for the inbound freeway between State Highway 225 and Dumble Street. From a comparison of the system travel time data for normal days and accident days, an estimate of the indirect cost of a peak period accident can be made. An average AM peak period accident on the inbcund Gulf Freeway results in 340 vehicle-hours of measurable delay. Delay is used here to describe travel time in excess of normal. This delay figure is based on actual measurements made within the limits of the Gulf Freeway detection system. Substantial delay suffered in the queueing which continues upstream and outside of the detection system, and the delay caused by "gapers blocks" created in the outbound lanes are not included in the measurement. Therefore, it is not unreasonable to assume that this queueing could double the delay figures.

Using a value of $2.75 per hour for occupants of automobiles and $5.00 per hour for trucks, the delay of 340 vehicle-hours is equivalent to one thousand dollars. This conservative estimate of road-user cost exceeds in most cases the actual cost of damage to vehicles involved in a minor accident. Furthermore, the additional accident potential created by the congestion and instability in the traffic stream resulting from the incident must be recognized as a significant, though at present undetermined, cost to the motoring public.

POLICE ACTION

Study of daily incident logs maintained by the patrolman at the Gulf Freeway Surveillance and Control Center shows that an average minor acci-

dent directly affects traffic for 41 minutes. The sequence through which a minor (non-injury) accident progresses is listed below with the average time for execution of each step:

1. Detection and reporting of accidents to Police Dispatcher (1 Min).
2. Location, dispatch, and travel to accident scene of police unit (11 Min).
3. Clearing of accident from traveled lanes (4 Min).
4. Investigation of accident by police (24 1/2 Min).

It should be noted that the detection and reporting time is very short for the Gulf Freeway because of the existence of the television system and the presence of the police officer. Figures 7, 8, and 9 illustrate the data used in determining the average time for completion of the other steps. No attempt was made in this study to adjust the data for weather conditions, volume levels, or time of day. These factors contribute to the variance of the data.

Sixty percent of the total time is spent conducting the police investigation. This investigation is almost always conducted on the freeway shoulder, in view of traffic. Because of the detrimental effect on traffic flow, the question arises: Why is it necessary to conduct the investigation on the freeway shoulder? The removal of an accident by a police officer to a location out of view of the freeway would have the net effect of screening the accident scene and removing the "gapers block" for an average of 24 1/2 minutes. It would mean an increase in the flow passing the scene of 490 vehicles in the 24 1/2 minutes.

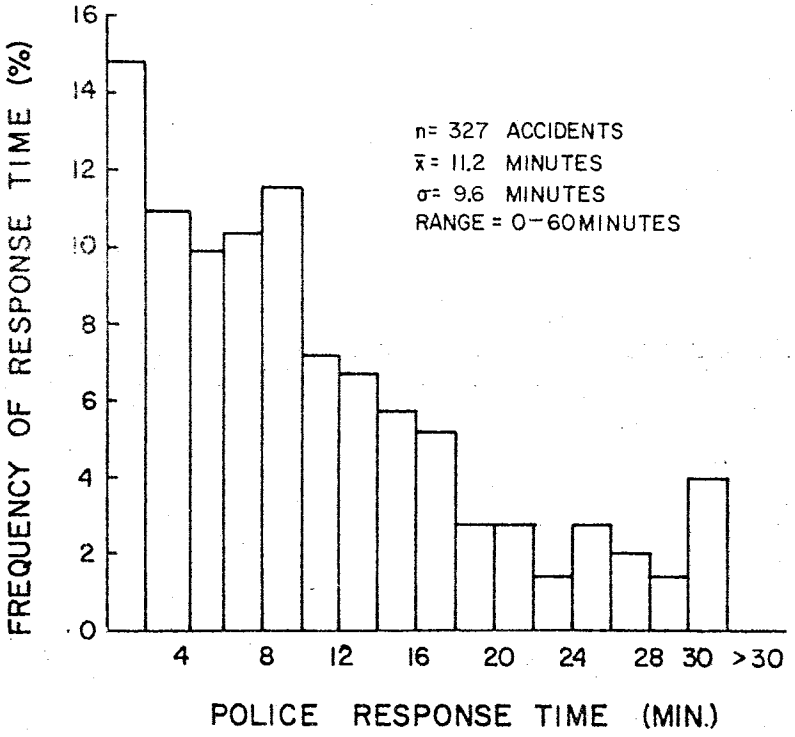


FIGURE 7. DISTRIBUTION OF POLICE RESPONSE TIME TO ACCIDENT.

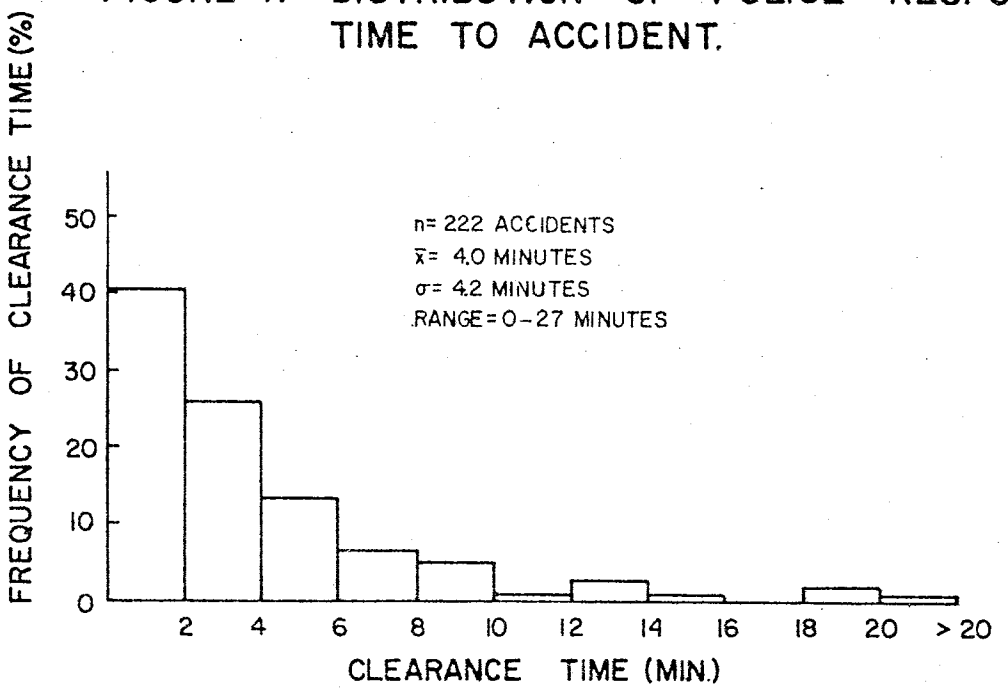


FIGURE 8. DISTRIBUTION OF TIME REQUIRED FOR POLICE TO CLEAR ACCIDENT FROM ROADWAY.

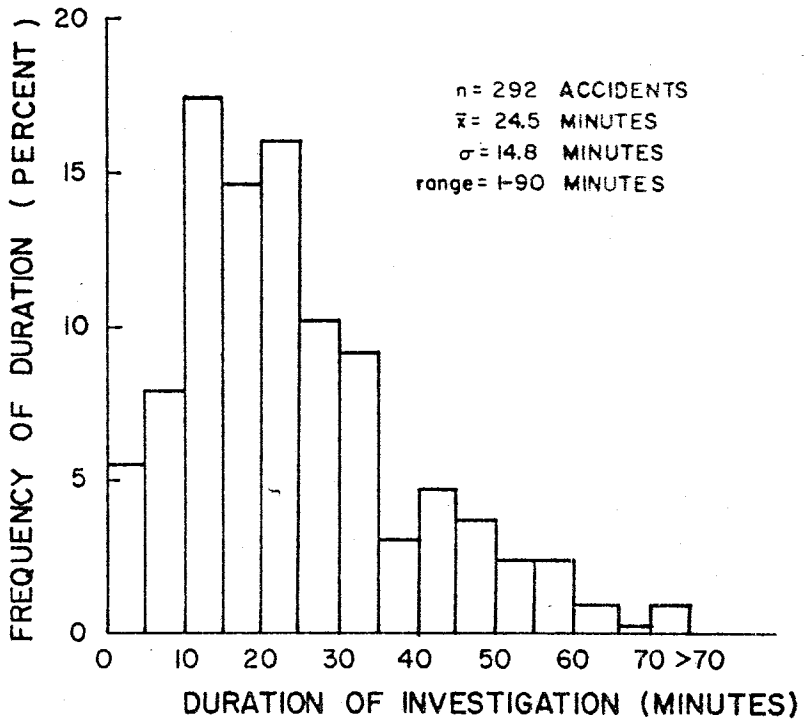
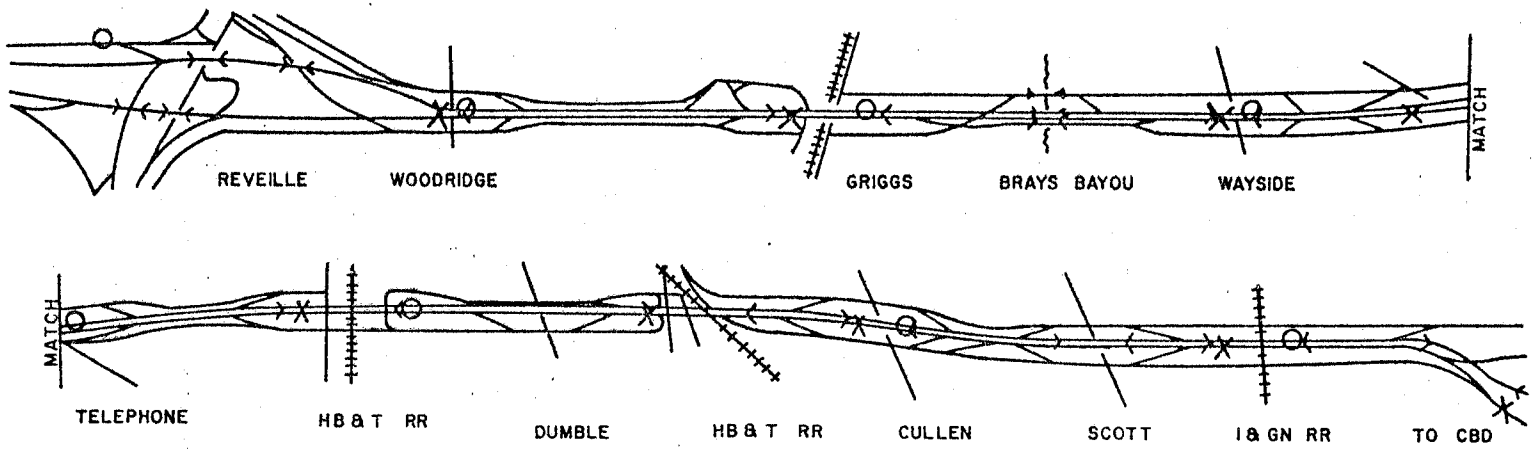


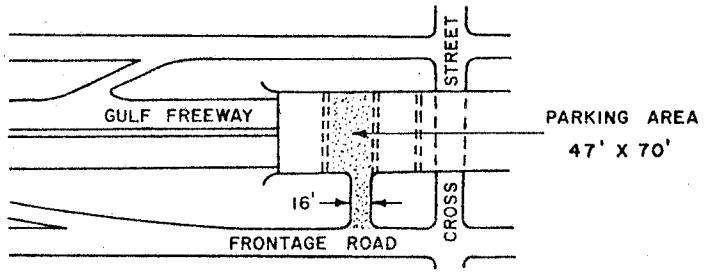
FIGURE 9. DISTRIBUTION OF TIMES FOR POLICE INVESTIGATIONS OF MINOR ACCIDENTS.

CONCLUSIONS

Significant traffic flow and safety improvements can be realized by police implementation of policies and procedures which expedite the removal of disabled vehicles from freeways. Further benefits can be gained by removing the vehicles to a location screened from the view of freeway drivers. Any policy which can reduce the time required for detection of an accident, dispatch and travel of police, and accident clearance from the

freeway, will achieve substantial gains in motorists' benefits. Such measures might include peak hour police patrols on freeways, accident removal vehicles assigned to freeways, and high priority handling of freeway incidents. A very significant gain would be accomplished by the implementation of a policy requiring the police investigation to be conducted at a screened location. Figure 10 illustrated a possible system of investigation sites on the Gulf Freeway which will, in effect, screen the incident. This plan utilizes the area under freeway structures as investigation sites where possible and would require a minimum of construction.





TYPICAL LAYOUT OF INVESTIGATION SITE

FIGURE 10. POSSIBLE LOCATIONS OF INVESTIGATION SITES ON GULF FREEWAY BETWEEN SOUTH LOOP AND DOWLING STREET.