USE OF AN EMERGENCY CALL-BOX SYSTEM ON AN URBAN FREEWAY

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This is a report on experience with a push-button call-box system installed on an 11-mile section of I-45 in Houston. The system is composed of 65 master and 80 secondary boxes spaced at ¼-mile intervals on the freeway and a receiving console located at the Houston Police Department. Stranded motorists may send requests for 4 types of aid: police, ambulance, fire, and service. Use data for a 6-month period were available for this study. During this period, 1,025 calls were placed for a daily average of 5.6 calls and a use rate of 6.3 calls per million vehicle-miles. Rate of use of a given box was found to be a function of the distance to alternate assistance. One-third of the calling motorists had left the scene before service arrived. Use and driver interview data indicated that driver understanding and acceptance of the system were not complete. More than one-third of the disabled motorists were not aware of the system, while another one-third indicated that they did not use the system because of the costs ($6.00 to $18.50, depending on service required) involved when requesting service.

•AS urban freeway mileage and use increase, more attention is being focused on the operational efficiency of freeways. One of the greatest losses in efficiency on urban freeways results from disabled vehicles in moving-traffic lanes. During peak periods, a vehicle disability has far-reaching impact. The effect on traffic operations is merely 1 aspect of the problem. The presence of a disabled vehicle on the freeway also increases the accident potential both at the scene and in the traffic congestion upstream.

An emergency call-box (ECB) system is 1 means of addressing the disabled vehicle problem (1, 2). In addition to enhancing the safety and reducing the impact on traffic of disabled vehicles by expedient removal, it provides a convenience to motorists in need of assistance. An ECB system provides the stranded motorist with a communication link to needed assistance, with the net result of reducing the time required to obtain assistance and move from the freeway.

The Texas Highway Department designed and installed an experimental ECB system on Interstate 45 in Houston in 1969. The Texas Transportation Institute (TTI) was requested to evaluate the system (3). This report presents the use experience from the TTI study.

SYSTEM DESCRIPTION

The system was installed on an 11-mile section of I-45 from Scott Street to Little York Road in Houston (Fig. 1). Call boxes are spaced at approximate ¼-mile intervals and are located so that a stranded motorist is not required to cross main-lane traffic to place a call. Thus, a typical location has 4 call boxes on each shoulder in each direction of travel.

The system, using battery-powered radio call boxes, consists of 65 master transmitter units and 80 secondary (slave) units. Slave units depend on an interconnected

Sponsored by Committee on Communications and presented at the 50th Annual Meeting.

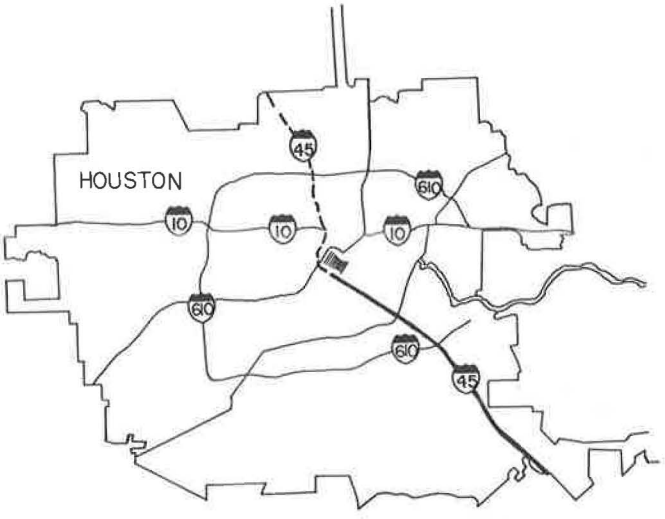

Figure 1. Location of emergency call-box system on I-45 in Houston.

master unit for signal transmission to the receiving unit located in the offices of the Houston Police Department. A master unit can support as many as 3 slave units. Each call-box installation (Fig. 2) has 4 buttons that are labeled "police," "ambulance," "fire," and "service" (tow truck). Provision is made for verification of calls through "message sent-message received" lights on the call-box face. These are activated when the radio message is transmitted and when acknowledgment is made from the receiving console. The boxes automatically place a check-in call once a day so that malfunctions can be located and corrected. Battery condition of the call box is indicated on the receiving console when any call is made. Tilting a call box causes the closure of a mercury switch in the box and a "tamper-knockdown" call is automatically placed.

The receiving console is located in the Houston Police Department headquarters where it is attended by a police dispatcher. The console unit decodes radio calls as well as records and displays the information received. Features of the console include

Figure 2. Typical call-box installation.

TABLE 1

DISTRIBUTION OF CALLS FOR DAYS OF WEEK

Day of Week	Number	Percent
Sunday	144	14.0
Monday	122	11.9
Tuesday	156	15.2
Wednesday	151	14.7
Thursday	183	17.9
Friday	140	13.7
Saturday	129	12.6

TABLE 2

DISTRIBUTION OF CALLS FOR PERIODS OF DAY

Period of Day	Number	Percent
12 - 2 a.m.	56	5.6
2 - 4	21	2.1
4 - 6	20	1.9
6 - 8	108	10.8
8 - 10	94	9.3
10 - 12	79	7.8
12 - 2 p.m.	87	8.6
2 - 4	108	10.6
4 - 6	166	16.5
6 - 8	127	12.7
8 - 10	75	7.4
10 - 12	66	6.5

indicator lights that give a visual display of the call, printed tape record of calls, audible alarm actuated by a call, and signal wave form recorder for use by maintenance personnel.

DATA COLLECTION

Data from 4 sources are used in this report: (a) police records of ECB use and accidents, (b) traffic volume counts, (c) stopped vehicle study, and (d) continuous surveillance study.

A call-box use log, maintained by the Houston Police Department and available for a 6-month period, contains the following information for each call placed: box number, service requested, time call was placed, time service arrived, and disposition of call. Police records of reported accidents were also used to correlate with ECB use.

A complete description of the traffic flow pattern in the call-box section was assembled from machine and manual traffic counts. From these data, it was possible to determine volume patterns and total travel (vehicle-miles) by sections on the freeway.

Stopped-vehicle studies were conducted for 1 week before and 1 week after installation of the call-box system. Data were collected by patrols on all vehicles stopped on the freeway main lanes and shoulders.[1] The patrols operated on 15-min frequencies for 24 hours per day. Drivers of attended vehicles were asked questions relating to their stops and the call-box system.

A continuous surveillance study of an elevated section of the freeway was conducted to gain an understanding of driver actions. Observers were stationed in 2 buildings overlooking a 1.3-mile section of the freeway on weekdays between 7:00 a.m. and 7:00 p. m. for a 3-week period after installation of the ECB system.

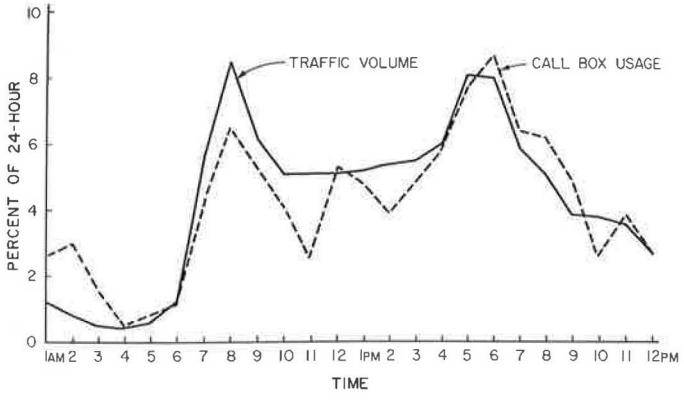

Figure 3. Weekday distribution of box usage and traffic.

USE CHARACTERISTICS

During the 6 months of operation of the call-box system, 1,025 calls were placed for an average of 5.6 calls per day. Of the calls placed, 685 were classified as confirmed calls; that is, the person placing the call was at the scene when service arrived. The other 340 calls were classified as gone-on-arrival calls.

TABLE 3

SERVICES REQUESTED BY SYSTEM USERS

Service Requested	Confirmed		Gone on Arrival	
	Number	Percent	Number	Percent
Service	401	58.5	190	55.9
Police	237	34.6	123	36.2
Ambulance	32	4.7	15	4.4
Fire	15	2.2	12	3.5

Distribution of all calls by day of week and hour of day is given in Tables 1 and 2. Figure 3 shows the hourly distribution of calls to the distribution of traffic. Types of calls placed are given in Table 3.

Stopped-vehicle studies determined the reasons for vehicle stops on the freeway. The reasons for stopping given by vehicle drivers, who could have used call-box, are given in Table 4. Not included are reasons for a significant number of miscellaneous, voluntary stops, such as checking vehicle, securing load, or reading map, which do not involve disabled vehicles. The nature of disability resulting in use of the call-box system is given in Table 5. A comparison of data given in Tables 4 and 5 gives an indication of relative use of the call box for categories of stops. Reporting of accidents accounted for the greatest use of the ECB.

FACTORS INFLUENCING USE

Need for and use of the system are influenced by a number of factors such as accessibility of assistance, personal danger, convenience, degree of emergency, and exposure to the system (traffic volume). It was possible to quantify two of these factors in this study: accessibility of assistance and exposure to the system. The relationship of use to accessibility of assistance and exposure to the system are given in Table 6. The same data are shown in Figure 4 in terms of use rate (call per million vehicles) and distance to alternate aid. A least squares analysis resulted in the regression line shown. The correlation coefficient was 0.81, whereas the standard error of the estimate was 6.42 (hundred feet).

Because an ECB system is not designed as an isolated point installation but rather as a continuous system, the use data are more meaningful by sections than by individual box locations. Therefore, 3 essentially homogeneous sections of the freeway totaling 10.16 miles were selected. Total travel in the section served by the call-box system was 840,000 vehicle-miles on an average weekday. Expanding this for the 6-month study period yields 145 million vehicle-miles, for a call-box use rate of 6.3 calls per million vehicle-miles on the freeway main lanes. Use data for 6 months are expressed in terms of a rate (calls per million vehicle-miles) for the 3 sections given in Table 7.

The first section contains the downtown interchange and elevated freeway from Dowling Street to Quitman Street. It is difficult for a stranded motorist to reach alternate aid in this section, which has an average walking distance to assistance of 1,900 ft. The second section, called urban, includes the freeway from Quitman Street to the I-610 interchange and requires an average walk to assistance of 750 ft. The suburban sec-

TABLE 4

REASONS FOR STOPS AS OBSERVED IN PATROL STUDY

Reason For Stop	Number	Percent
Gas	131	19.0
Tire	207	30.2
Mechanical	299	43.5
Accident	50	7.3
Ambulance	0	0.0
Fire	0	0.0

TABLE 5

NATURE OF TROUBLE FOR CALL-BOX USERS

Nature of Trouble	Number	Percent
Gas	155	25.1
Tire	72	11.6
Mechanical	177	28.6
Accident	192	31.0
Other	23	3.7

TABLE 6

MAIN-LANE CALL BOX USE RELATED TO DISTANCE TO ALTERNATE AID AND TRAFFIC VOLUME

Box	Distance to Alternate Aid (ft)	6-month Volume (millions)	Number of Calls (6 months)	Rate (calls/million vehicles)
10	200	23.23	19	0.82
11	300	24.91	20	0.80
12	300	13.46	14	1.04
13	1,700	6.57	21	3.20
14	1,700	6.89	24	3.49
15	3,100	13.46	51	3.79
16	3,000	13.46	59	4.38
17	1,700	13.46	49	3.64
18	800	13.46	45	3.35
19	1,000	5.16	9	1.75
20	1,000	4.72	4	0.85
21	1,700	10.12	29	2.90
22	1,700	7.98	36	4.53
23	1,200	7.98	33	4.14
24	1,700	10.12	21	2.07
25	1,100	7.98	22	2.76
26	900	10.12	49	4.85
27	2,600	4.67	23	4.89
28	2,000	7.66	32	4.18
29	4,000	4.67	28	5.96
30	3,300	7.66	26	3.38
31	2,200	18.16	47	2.58
32	400	16.73	18	1.08
33	200	16.73	15	0.90
34	200	16.57	13	0.78
35	500	15.29	11	0.72
36	900	16.18	30	1.85
37	1,100	9.08	21	2.31
38	1,100	15.06	43	2.85
39	1,200	15.06	18	1.19
40	100	12.26	7	0.57
41	500	10.21	7	0.69
42	800	9.37	6	0.64
43	500	9.37	8	0.85
44	600	9.53	10	1.05
45	700	9.53	9	0.95
46	200	8.02	2	0.25
47	200	8.02	10	1.25
48	300	8.48	10	1.18
49	400	6.38	9	1.41
50	100	6.77	3	0.44

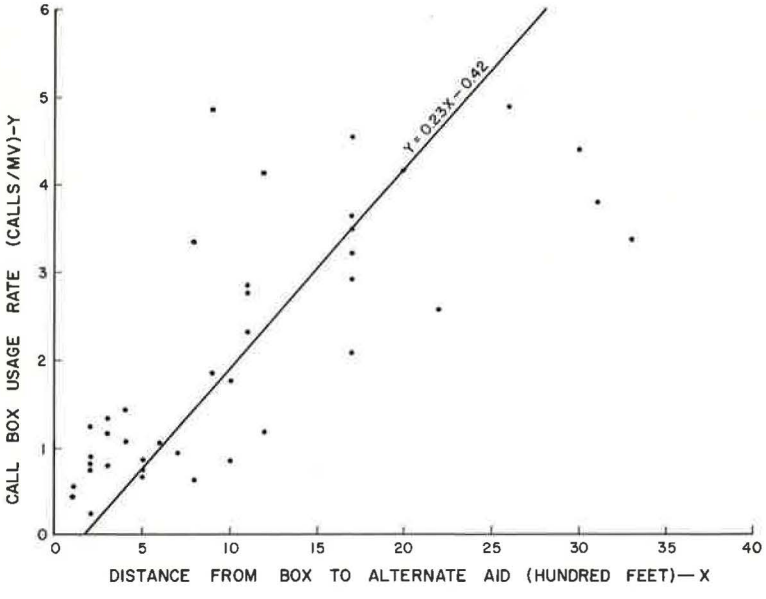

Figure 4. Relationship of call-box usage to distance to alternate aid.

TABLE 7

COMPARISON OF BOX USE BY FREEWAY SECTIONS

Section	Length (miles)	6-month Travel (million vehicle-miles)	Number of Calls (6 months)	Rate (calls/million vehicle-miles)
Elevated and interchange (boxes 13-30)	3.34	48.3	561	11.6
Urban (boxes 31-36)	2.20	34.6	134	3.9
Suburban (boxes 37-50)	4.62	44.3	163	3.7

tion includes the freeway from I-610 to the Houston city limits and requires an average walk to assistance of 560 ft. This comparison of use rates suggests that the need for a call-box system is 3 times greater in the elevated-interchange section than in the other sections.

USER ACCEPTANCE AND UNDERSTANDING

The key person in the function of an emergency call-box system is the user. Therefore, it is important to investigate his understanding of the purpose of the system and how to use it. Questions were asked of stopped-vehicle drivers encountered in the patrol study, and driver actions were recorded during the continuous surveillance study in an attempt to determine driver understanding and acceptance of the call-box system.

Interviewed drivers were asked why they did not use the ECB. These responses are given in Table 8. Over one-third said that they either were not aware of or had forgotten about the call-box system. Another one-third indicated that they did not use the system because of the cost involved. A list of service charges is posted on each box (Table 9).

The continuous surveillance study, a summary of which is given in Table 10, found that only 20 percent of the disabled motorists requiring assistance even looked at a call box at close range. There are 3 possible reasons why a motorist would not even look at the call boxes: (a) He already knew about the system and rejected the alternative of using it because of cost or his ability to correct the problem; (b) he did not know of its existence; or (c) he did not know the call box could be used for obtaining gas or wrecker service. It was not feasible in this study to determine which of the 3 reasons was predominant.

The manner in which calls were placed is given in Table 11. The average number of times a button was pressed for a single call was 3.5 with 21 callers passing the button more than 15 times. There are 2 possible reasons for this repeated placing of calls. The police dispatcher may have been delayed in actuating the "message received" signal to the user, or the user merely wanted to make certain of his call for help by placing repeated calls.

The use log shows that some users of the system make a request for the wrong assistance. Of the 685 confirmed calls, 77 needed a different service than that requested. Thus, 11 percent of the users apparently did not understand how to request aid properly. The greatest number of er-

TABLE 8

REASONS DRIVERS DID NOT USE CALL BOX

Reason	Number	Percent
Not aware	21	31.8
Forgot about it	4	6.1
Costs too much	23	34.9
No chance	14	21.2
Unable or unwilling to leave vehicle	4	6.0

TABLE 9

SERVICE CHARGES POSTED ON CALL BOXES

Service	Charge
Remove vehicle from freeway	$ 6.00
Gasoline service after removal from freeway	6.00 (plus cost of gas)
Tire change after removal from freeway	8.50
Remove vehicle to area[a] designated by owner	12.50
Move vehicle to area[a] designated by owner after removal from freeway and release	18.50

[a]Area within Houston city limits.

TABLE 10

INITIAL ACTIONS OF DRIVERS NEEDING ASSISTANCE

Initial Action	Number	Percent
Used call box	7	13.5
Looked at call box but did not use	4	7.7
Walked to help	11	21.1
Caught ride	4	7.7
Assisted by passing motorist	26	50.0
Total	52	100.0

TABLE 11

DISTRIBUTION OF NUMBER OF TIMES CALL PLACED FOR SAME INCIDENT

Number of Calls	Frequency	Percent
1 to 2	353	52.3
3 to 4	170	25.3
5 to 6	71	10.6
7 to 8	29	4.2
9 to 10	12	1.8
Greater than 10	39	5.8

roneous calls was made for police when service was the aid needed.

It is difficult to determine whether the driving population understands the purpose and operation of the ECB system, because a comparison of those needing a particular service and those requesting it via the ECB system is not readily obtainable. The best means available for comparing actual needs to system use was through an analysis of accident records. Texas law requires that accidents resulting in damage greater than $25 be reported to the police. Documentation of all accidents occurring in the call-box section is available in police accident files, while the use log reveals how many of them were reported on the system.

During the 6-month study period, 470 accidents occurred in the call-box section, of which 192 (41 percent) were reported on call boxes. Because there is no user charge for reporting an accident, it is suspected that those electing not to use it did not know of the system or had a more convenient means of reporting the accident.

SUMMARY OF FINDINGS

1. Approximately 5.6 calls per day were placed on the system for a use rate of 6.3 calls per million vehicle-miles of travel.
2. Use was 3 times greater in the elevated interchange section than in the urban or suburban sections.
3. Thirty-eight percent of interviewed stopped motorists were unaware of the call-box system on the facility where their vehicles were disabled.
4. Use of individual boxes was influenced by the distance to alternate assistance.
5. Eleven percent of the system users placed a call for the wrong assistance.

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