

# Cost Effectiveness of Freeway Courtesy Patrols in Houston

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Traffic incidents, whether due to accidents or stalled vehicles, are a major cause of congestion on urban freeways. Besides causing inconvenience to motorists, incidents also create safety hazards on the freeway. To enhance safety and to provide assistance and security to motorists, District 12 of the Texas State Department of Highways and Public Transportation has been operating a motorist courtesy patrol on some Houston freeways. A questionnaire study and a cost-effectiveness analysis were used to evaluate the operation of the patrol. The questionnaire study indicated that motorists aided by the patrol were overwhelmingly in favor of continuation of the program. The cost-effectiveness analysis showed the patrol to have a benefit-cost ratio of 2 to 1. Several additional qualitative benefits are discussed.

The need to provide assistance to stranded motorists arrived with the invention of the automobile. The expected number of motorists that need assistance, both on and off the freeway, increases as either average daily traffic increases or average trip length decreases (1). Large volumes of traffic and short trips are typical on freeways in large urban areas. Motorists who are forced to stop on the roadway because of either a stalled vehicle or an accident are one of the major causes of congestion on these freeways. Motorists involved in an incident may require one or any combination of the following needs for aid (2):

1. Service, i.e., for flat tires, mechanical and electrical problems, fuel, oil, or water, and towing;
2. Police;
3. Ambulance;
4. Fire; and
5. Information, either general information or emergency traffic routing.

An individual who is confronted with a stop because of an incident is generally unprepared to immediately cope with even the simplest of situations. Usually the only problem that the average motorist is capable of

dealing with by himself is that of changing a flat tire, but some motorists may be incapable of doing even that. A few motorists might be able to take care of some of their other needs if they carried appropriate items or material for dealing with these problems. Clearly, the typical disabled motorist needs assistance.

Safety problems also arise as a result of stops on the freeway (2). These include motorists

1. Crossing operating lanes,
2. Wandering on highway shoulders,
3. Hitchhiking to seek help,
4. Leaving abandoned vehicles in or partially in operating lanes,
5. Climbing roadway protection fences, and
6. Attempting self-help (improper use of jack, touching hot engine components).

A motorist aid system does not eliminate all safety problems but should reduce their severity and frequency of occurrence. The major cause of these safety problems is the concern the motorist experiences when confronted with an unexpected breakdown in an unfamiliar environment. With the passage of time, presence of darkness, or remoteness of setting, this concern may turn to fear and cause the motorist to behave in an irrational manner. To reduce or eliminate this feeling, the motorist must have confidence that aid will come. District 12 of the Texas State Department of Highways and Public Transportation (TSDHPT) has implemented a courtesy patrol on selected freeways in the city of Houston to deal with the emergency needs of motorists and the problems that arise as a result of these needs.

## COURTESY PATROL PROGRAM

### Objectives

The primary objectives of the courtesy patrol program in the Houston area are to provide safety, assistance, and security for motorists using the freeways. These objectives are accomplished by

1. Assisting the stranded motorist in restoring the

disabled vehicle to an operable condition,

2. Summoning additional aid for problems the patrol cannot correct,

3. Removing hazardous objects from the roadway,

4. Performing minor maintenance operations on roadside signs and lights,

5. Directing traffic in a safe and expedient manner in emergency situations, and

6. Operating in a prompt and dependable manner so as to instill a feeling of security in motorists.

If these tasks are carried out, benefits accrue to motorists, the TSDHPT, and the police department, and safety is improved. The courtesy patrol (a) saves motorists the expense of calling a private service, (b) reduces waiting time of stranded motorists, (c) provides a sense of security to motorists, and (d) reduces delay time to those involved in incidents as well as to those not directly involved by removing incidents and directing traffic through or around incident areas. The TSDHPT benefits through public relations and through time savings to other TSDHPT employees because the courtesy patrol performs functions that are normally done by other TSDHPT employees.

The police department benefits because of reductions in (a) police patrol time spent on nonpolice functions

Figure 1. Routes of the courtesy patrol vehicles.

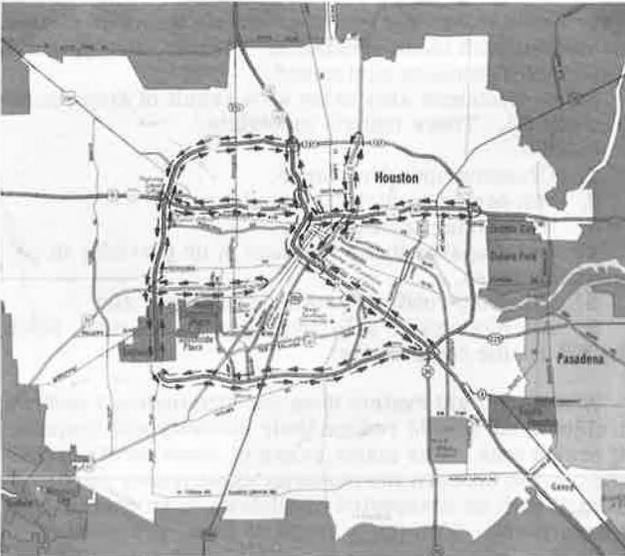


Figure 2. Courtesy patrol vehicle.



and (b) requests for aid that require no police function.

Safety is improved by (a) reducing accidents through early removal of debris and incidents, (b) reducing pedestrian movement on freeways, and (c) protecting stranded motorists while repairs are being made.

### Description

#### Operation and Equipment

Originally, the courtesy patrol consisted of one vehicle operating on a 24-hour basis, 7 days a week. The patrol worked in three 8-hour shifts: 8 a.m. to 4 p.m., 4 p.m. to midnight, and midnight to 8 a.m. One man was on duty during each of these three shifts, and a fourth man was employed as an extra operator. In July 1972, the patrol was expanded to two pickup trucks because of the increasing demands on the services that the patrol was providing. A supervisor's pickup was used as an extra vehicle until a backup truck could be added. Currently, two men ride in each truck, thus requiring a 12-man crew to operate the patrol. The 8 a.m. to 4 p.m. shift was discontinued on weekdays on December 12, 1973, because of the energy crisis.

Emergency vehicle service is provided on 103 km (64 miles) of Houston freeways. Areas that the patrol covers include parts of loop I-610 and, inside the loop, freeways I-10, I-45, and US-59. Figure 1 shows the routes of the patrol vehicles. The 1972 ADT on each freeway was more than 91 000 vehicles/day (3). Patrol vehicles carry the following equipment:

1. One two-way radio,
2. Two flashing and one revolving amber lights per vehicle,
3. Eight flares and one case of fuses,
4. Nineteen liters (5 gal) of gasoline,
5. Nineteen liters (5 gal) of water,
6. One bumper jack,
7. One 1.1-Mg (1 $\frac{1}{4}$ -ton) floor jack,
8. One 1.1-kg (2 $\frac{1}{2}$ -lb) and one 2.3-kg (5-lb) CO<sub>2</sub> fire extinguisher,
9. Two red flags,
10. One cross lug wrench,
11. One battery charger,
12. Miscellaneous mechanic's tools,
13. One shovel and one broom,
14. Six traffic cones, and
15. Absorb-all.

The vehicles are also equipped with push bumpers to move disabled vehicles from the main lanes to the shoulder. Figure 2 shows one of the patrol vehicles currently being used in Houston.

#### Services Provided

The patrol provides services that directly benefit motorists in need of aid, the State Department of Highways and Public Transportation, the Houston Police Department, and motorists who may not need aid themselves. Table 1 gives totals, percentages, and averages of the services rendered by the Houston courtesy patrol for different time periods during 1973. These data were taken from logbooks that were kept by the vehicle operators.

#### Method of Study

This paper presents an estimate of the cost effectiveness of the Houston courtesy patrol during 1973. The evaluation was done in three parts. First, responses to a

questionnaire given motorists who were helped by the patrol were evaluated. The second phase of the analysis compared the benefits resulting from operation of the patrol to costs necessary to provide them. Finally, the intangible benefits resulting from operation of the courtesy patrol were addressed.

#### QUESTIONNAIRE STUDY

After the courtesy patrol had been in operation for a short time, a questionnaire was distributed to all motorists who were helped by the patrol during the 8-month period from March to October during 1973. The questionnaire was designed and administered by members of the Texas State Department of Highways and Public Transportation. A total of 1429 motorists filled out the questionnaire and returned it to the department. Responses to the questionnaire are necessarily biased because all respondents were assisted by the patrol. Only those questionnaires that were returned are considered in this analysis. Responses to the questionnaire are not comparable to data in Table 1 because the patrol performs many functions other than assisting disabled motorists. The five questions that appeared on the questionnaire and a brief summary of the responses to each are as follows:

1. About how long had you waited before the courtesy patrol arrived? Of the motorists who responded, 47 percent replied they had to wait less than 5 min for service, 74 percent less than 15 min, 90 percent less than 30 min, and 96 percent less than an hour.

2. What caused your problem, flat tire, out of gas, mechanical, other? The purpose of this question was to determine what type of aid the motorist needed. Replies indicated that 24 percent of the people helped had flat tires, 28 percent were out of gas, 30 percent had mechanical difficulty, and the remaining 18 percent had other problems.

3. Did this service help you? Of the motorists that returned the questionnaire, 94 percent replied that it did. The four people whom the patrol did not help commented that either they were not in need of aid or that help was already on the way. Six percent of the respondents did not answer this question.

4. This service is paid for out of the taxes you pay. Do you recommend that it be continued? The responses to this question were very similar to those of question three. Ninety-four percent of the motorists answered yes, and only three individuals answered no. Six percent of the respondents did not answer this question.

5. Comments. Because of the many different responses to this question, the replies were categorized into very favorable, favorable, unfavorable, and no comment. Very favorable comments included "excellent service," "very good service, should be continued," "the best program ever," "there should be more programs of this sort," and "this is a great service for women traveling by themselves." Some also gave detailed accounts of exactly what their problems were and how the State Department of Highways and Public Transportation in Texas should be commended for providing the service. Favorable comments were typically "thank you," "good program," and "your men were very helpful and courteous." Unfavorable comments were those that contained any negative response to the patrol. Thirty-five percent of the motorists responded very favorably, 26 percent were favorable, and 39 percent offered no comments. None of the motorists listed any unfavorable comments.

#### COST EFFECTIVENESS OF 24-HOUR OPERATION

All costs associated with the operation of the courtesy patrol were relatively easy to determine, but some of the benefits were rather difficult to quantify. The approach selected was to quantify those benefits that could readily be evaluated and to describe the additional non-priceable benefits that make the service more effective. The benefits that could be priced were used in a benefit-cost analysis to determine the effectiveness of the courtesy patrol.

##### Costs

The cost to operate the patrol in 1973 on a 24-h basis was computed by using data supplied by District 12 of the Texas State Department of Highways and Public Transportation. The annual cost to operate the patrol was found to be \$229 400. A breakdown of these costs is given in Table 2.

##### Benefits

The quantifiable benefits of the Houston courtesy patrol were stratified by whether they benefited the motorist, the TSDHPT, or safety.

##### Motorist Related

Motorist-related benefits are those that save the motorist the expense of calling a service facility. The courtesy patrol provides several services that a motorist would normally obtain from a service facility. Data given in Table 3, from the courtesy patrol's logbooks, show the total services of this type that were performed by the patrol in 1973.

The savings in expenses to a stranded motorist were assumed to be the cost of obtaining aid from service facilities. The Houston office of the American Automobile Association (AAA) was contacted and, in turn, furnished the following cost information typically incurred by motorists for aid requests in the Houston area.

1. The maximum allowable charge for towing service by law inside Houston's city limits is \$27.50. AAA receipts examined indicated that the maximum amount was generally charged.

2. There is a standard \$5 charge by service facilities for going to the aid of a motorist on the freeway. If the service vehicle has to travel more than 1.6 km (1 mile), this price may increase to \$10, which is the charge to go from a location on the Loop to downtown Houston. For analysis purposes, the minimum \$5 charge was assumed. This \$5 charge is additional to the cost of the service provided.

3. The average price to fix a flat tire is \$2.50.

4. The average price for regular gasoline in Houston (July 1974) is \$0.133/liter (\$0.507/gal).

Based on those costs for services in Houston and the authors' experience of service rates in other cities, the following additional costs were estimated:

1. The charge to start a car or charge a battery is at least \$1.50,

2. On the average, minor repairs to vehicles are at least \$5,

3. Loaning tools or issuing water might not require an additional charge, and

4. Pushing a car from traffic requires wrecker service.

Based on these data, the savings to the motorists serviced by the courtesy patrol in Houston during 1973 were computed and tabulated (Table 3). The results indicate that operation of the courtesy patrol saved stranded motorists \$40 161.

The courtesy patrol also reduces delay time of stranded motorists. The operation of the courtesy patrol enables the stranded motorist to receive aid faster than if no patrol vehicles were available. The savings in time to the motorist is a benefit of the courtesy patrol.

The average stopping times for disabled freeway motorists determined in a previous study conducted in Houston (4) are given in Table 4. Data from Table 4 were used to estimate an average stopped time per disabled vehicle of 49 min. Data given in Table 5, taken from the questionnaire evaluation, were used to estimate the average waiting time before a patrol vehicle arrived (12 min for each disabled motorist the patrol assisted). Previous studies in Houston (4, 5, 6, 7) indicate that 10 min is an acceptable estimate of the time required for aid service to be performed. Therefore, if courtesy patrol aid were obtained, the estimate of the average stopped time per disabled vehicle aided becomes 22 min. Thus, on the average, each motorist-related service the patrol performed saved a disabled motorist 27 min.

In 1973, the patrol performed 4568 motorist-related services. The total time savings to the vehicles involved is estimated as follows:

$$\text{Time savings} = (4568 \text{ services}) \times (27 \text{ min saved/service}) \\ \times (1 \text{ h}/60 \text{ min}) = 2056 \text{ vehicle-h} \quad (1)$$

Based on a 1969 economic study of the Gulf Freeway and the conservative estimate of 1.0 person/passenger vehicle, the cost per person-hour of travel based on 1967 data was determined to be \$2.92 (8). Assuming a conservative compound increase of 5 percent per year for 6 years and a more realistic value of 1.2 persons/passenger vehicle, the value of one vehicle-hour in 1973 would be \$4.69. By using this amount, the value of time savings to the disabled motorists helped by the patrol becomes

$$\text{Time savings} = (2056 \text{ vehicle-h}) \times (\$4.69/\text{vehicle-h}) = \$9643 \quad (2)$$

Through early removal of incidents from traffic lanes during the peak periods, the courtesy patrol reduces motorist delay time at certain incidents. Incidents, whether stalled vehicles or accidents, are a major cause of congestion on urban freeways. Incidents reduce the capacity of the roadway, and if the reduction in capacity reaches a point where the demand on the facility is greater than the available capacity, motorists experience considerable delay. During peak periods, Houston freeways operate at or near capacity; therefore, any incident that occurs then causes motorists to experience greater travel times. A previous study on the Gulf Freeway (7) indicated that an incident that blocked one lane of a three-lane freeway for 15 min during the peak period caused 690 vehicle-hours of delay for motorists. During 1973, the patrol pushed 119 vehicles from the traffic stream during the peak period. Using 690 vehicle-hours as a reasonable estimate of the savings per incident and using the value of time previously shown as \$4.69 per vehicle-hour yield the following estimate of monetary benefit resulting from the courtesy patrols assisting stranded motorists off the freeway main lanes during peak periods:

$$\text{Savings} = (119 \text{ services/year}) \times (690 \text{ vehicle-h/service}) \\ \times (\$4.69/\text{vehicle-h}) = \$385 096/\text{year} \quad (3)$$

The courtesy patrol benefits the Texas State Department of Highways and Public Transportation by saving other employees' time. In the absence of the courtesy patrol, the TSDHPT would have to use other personnel to perform some of the services the patrol currently provides. Before the patrol began operation, the maintenance sections in District 12 had to deal with requests for aid or repair work made at night. Since the operation of the patrol was initiated, each of the four maintenance sections in the city feels that they save an average of \$400 per month in time alone. Thus, the annual savings can be conservatively estimated as

$$\text{Savings} = (\$400/\text{month/section}) \times (4 \text{ sections}) \times (12 \text{ months/year}) \\ = \$19 200/\text{year} \quad (4)$$

The safety-related benefits of the courtesy patrol include a reduction in the number of accidents due to early removal of debris and incidents. The services provided by the courtesy patrol make Houston freeways a safer place to drive. Kuprijanow (1) estimated that 10 stops/km (16 stops/mile) per day could be expected on a freeway with an ADT of 75 000 and an average trip length of 16 km (10 miles). Of these, 42 percent of the total are emergency stops (1), which require services of the highway patrol, private operators of tow services, ambulance services, or local fire departments. Because the ADT on the Houston freeways serviced by the patrol was between 90 000 and 160 000, 10 stops/km (16 stops/mile) is considered to be a conservative estimate of the number of stops per day in the patrol area. Because of the lack of data, 16 km (10 miles) was assumed to be a conservative estimate of the average trip length on the freeways serviced by the patrol. Based on these assumptions, the number of emergency stops that would be expected in the 103-km (64-mile) section of Houston freeways covered by the courtesy patrol is

$$\text{Number of emergency stops} = (10 \text{ stops/km/day}) \times 0.42 \\ \times (103 \text{ km patrolled}) \\ \times (365 \text{ days/year}) \\ = 157 899 \text{ emergency stops/year} \quad (5)$$

Goolsby (4) observed 27 000 emergency stops in a 17.7-km (11-mile) section of freeway in Houston during 1 year. This stoppage rate would result in 157 120 emergency stops per year in a 103-km (64-mile) section. Because of the favorable comparison of the results of the two references, 157 000 is considered a good estimate of emergency stops in the patrol section during 1973.

Each emergency stop has the possibility of causing a secondary accident, i.e., an accident involving a stopped, parked, or disabled vehicle. Data supplied by the Gulf Freeway Surveillance and Control Center indicated that, during 1973, there were 144 accidents of this type in the patrol section. Data taken from logbooks show that the courtesy patrol assisted more than 8000 disabled motorists during this same time period. Because of the safety aspect of courtesy patrol service (flashing lights, quicker service, experienced operators), no secondary accidents were reported when the patrol assisted disabled motorists. In contrast, a statistical analysis conducted by the authors showed that in a random sample of 8000 unaided emergency stops some secondary accidents would have been expected to occur. Because all secondary accidents in the patrol section occurred when courtesy patrol aid was not provided, the estimated number of secondary accidents per unserved emergency stop can be computed as follows:

Table 1. Services rendered by the courtesy patrol during 1973.

Service Rendered	1973 Total	Percentage of Total	Average			Total					Peak Period	
			Daily	Weekday	Weekend	Midnight to 7 a.m.	7 to 9 a.m.	9 a.m. to 4 p.m.	4 to 6 p.m.	6 p.m. to midnight	Total	Percent
Removed debris or hazard	3 261	26.2	8.9	9.2	8.2	1321	164	979	255	542	237	7.2
Issued gas	1 217	9.7	3.3	3.4	3.2	301	72	356	155	333	178	14.1
Controlled traffic	1 119	9.0	3.1	3.1	3.0	271	62	345	133	308	149	13.3
Pushed from traffic	572	4.6	1.3	1.2	1.4	100	46	185	96	145	119	20.8
Changed tire	546	4.4	1.5	1.1	2.5	130	35	196	50	135	57	10.4
Lent tools	696	5.6	1.9	1.8	2.1	174	31	210	81	200	83	11.9
Issued water	405	3.3	1.1	1.1	1.1	64	24	136	71	110	67	16.5
Took to phone	201	1.6	0.6	0.6	0.5	32	17	73	33	46	45	22.3
Took to service station	357	2.9	1.0	1.0	0.9	82	23	129	38	85	44	12.3
Charged battery	205	1.7	0.6	0.6	0.5	46	0	84	7	68	6	2.9
Made call for motorist	365	3.0	1.0	0.9	1.3	80	15	114	45	111	47	12.8
Made minor repair to vehicle	220	1.8	0.6	0.6	0.7	30	13	94	25	58	37	16.8
Started vehicle	707	5.7	1.9	2.0	1.8	131	67	221	98	190	134	18.9
Reported stall	196	1.6	0.5	0.5	0.7	126	1	26	12	31	8	4.0
Reported accident to police	452	3.6	1.2	1.2	1.3	91	29	121	86	125	92	20.3
Reported debris	81	0.7	0.2	0.2	0.3	23	2	31	5	20	5	6.1
Reported abandoned vehicle	222	1.8	0.6	0.6	0.6	76	16	60	25	45	35	15.7
Called wrecker	258	2.1	0.7	0.7	0.8	46	12	67	53	80	46	17.8
Reported damage to facilities	560	4.5	1.5	1.3	2.1	243	16	126	24	151	17	3.0
Repaired facilities	370	3.0	1.0	0.9	1.2	202	13	79	17	59	19	5.1
Gave directions	140	1.1	0.4	0.3	0.5	42	3	49	14	32	7	5.0
Put fire out	21	0.1	0.1	0.1	0.1	4	1	5	7	4	5	23.8
Other	257	2.1	0.7	0.7	0.8	48	25	92	36	56	41	15.9
Totals	12 428	100	33.7	33.1	35.6	3663	687	3778	1366	2934	1468	

Table 2. Cost to operate courtesy patrol in 1973.

Item	Monthly Cost (\$)	Annual Cost (\$)
Administration	1 500	18 000
Labor (12 man-years)	14 500	174 000
Vehicle operating expense and depreciation	2 400	28 800
Materials and supplies	720	8 600
Total	19 120	229 400

Table 3. Motorist savings gained by not having to request aid from a private business in 1973.

Service	No. of Services	Cost per Service (\$)	Annual Savings (\$)
Issued gas	1217	0.507 + 5	6 702
Pushed from traffic	572	27.50	15 730
Changed tire	546	2.50 + 5	4 095
Lent tools	696	5	3 480
Issued water	405	5	2 025
Charged battery	205	1.50 + 5	1 333
Made minor repair to vehicle	220	5.00 + 5	2 200
Started vehicle	707	1.50 + 5	4 596
Total	4568		40 161

Table 4. Average stopped times before the courtesy patrol began operation.

Reason for Stop	No. of Stops	Average Stopped Time (min)	Total Stopped Time (min)
Gas	131	30.9	4 047.9
Tire	207	41.4	8 569.8
Mechanical	299	82.3	24 607.7
Accident	50	72.6	3 630.0
Other	194	14.6	2 832.4
Total	881		43 687.8

Table 5. Average waiting time for courtesy patrol aid based on estimates by stranded motorists the patrol assisted during 1973.

Waiting Time (min)	Number (N)	Midpoint (X <sub>i</sub> )	X <sub>i</sub> × N (min)
<5	600	2.5	1 500
5 to 15	347	10.0	3 470
15 to 30	214	22.5	4 815
30 to 60	71	45.0	3 195
>60	50	60.0	3 000
Total	1282		15 980

Table 6. Benefits of the courtesy patrol in 1973.

Benefit	Estimated Annual Saving (\$)
Saves motorist expense of calling private service	40 161
Reduces delay time to motorists in need of aid	9 643
Reduces delay time to motorists on freeway	385 096
Saving to Texas State Department of Highways and Public Transportation	19 200
Reduction in accidents	5 152
Total	459 252

$$\text{Rate} = (144 \text{ secondary accidents in the patrol section}) \div (157\,000 \text{ emergency stops} - 8000 \text{ serviced emergency stops}) = 0.000\,97 \text{ secondary accident/un serviced emergency stop} \quad (6)$$

If we assume that the accident rate given in equation 6 is a reasonable estimate, then the number of secondary accidents that would have occurred if the courtesy patrol had not provided aid for the 8000 disabled motorists it helped during 1973 can be calculated as follows:

$$\begin{aligned} \text{Secondary accidents} &= (0.00097 \text{ secondary accident/} \\ &\quad \text{unserved emergency stop}) \\ &\quad \times (8000 \text{ served stops}) \\ &= 8 \text{ secondary accidents that did not occur} \end{aligned} \quad (7)$$

Burke (9) determined accident costs for three types of accidents. It was assumed that in the eight secondary accidents only two cars would have been involved and that only property damage would have occurred. Using Burke's figure of \$307/vehicle for a property damage accident in 1972 and assuming a 5 percent inflation rate per year yield the following cost for eight secondary accidents in 1973:

$$(\$322/\text{vehicle}) \times (16 \text{ vehicles}) = \$5152 \quad (8)$$

Annual savings due to the reduction of eight secondary accidents is \$5152.

Services of the courtesy patrol also reduce the number of pedestrian accidents. Because the courtesy patrol provided aid to more than 8000 disabled motorists, the number of would-be pedestrians walking for aid services in the patrol area decreased. A California study (10) concluded that 43 percent of all the pedestrians struck on freeways were on the facility because their vehicle was either disabled or involved in a prior accident. Data from the Gulf Freeway Surveillance and Control Center showed that there were 34 pedestrian accidents in the patrol section during 1973. No pedestrian accidents were reported when courtesy patrol service was provided for disabled motorists; therefore, all pedestrian accidents that occurred were assumed to be the result of unserved stops. The estimated pedestrian accident rate is calculated as follows:

$$\begin{aligned} \text{Rate} &= [(34 \text{ total pedestrian accidents}) \times 43 \text{ percent}] \\ &\quad \div (157\,000 \text{ emergency stops} - 8000 \text{ served stops}) \\ &= 0.0001 \text{ pedestrian accident/unserved emergency stop} \end{aligned} \quad (9)$$

Based on the estimated accident rate, the number of pedestrian accidents that would have occurred in the patrol section if the patrol had not serviced the 8000 disabled motorists would have been less than one. Although the number of would-be pedestrians decreases, no reduction in number of pedestrian accidents occurs because of the low pedestrian accident rate. An estimated reduction in the number of accidents would occur if the patrol were able to assist more stranded motorists.

#### Comparison of Benefits and Costs

The cost to operate the patrol in 1973 was \$229 400. Monetary benefits of the patrol are given in Table 6 as \$459 252. The resulting benefit-cost ratio is

$$b/c = \$459\,252/\$229\,400 = 2 \quad (10)$$

This means that, for every dollar spent to provide courtesy patrol service on the Houston freeways during 1973, an estimated \$2 worth of benefits were gained by motorists or the Texas State Department of Highways and Public Transportation.

#### Additional Benefits

In addition to the quantifiable benefits that have already been discussed, the following nonpriceable benefits add to the effectiveness of the patrol.

#### Benefits to Motorists

The courtesy patrol provides a sense of security to motorists. Prompt, dependable service by the courtesy patrol creates a sense of security for stranded motorists. Knowing the patrol is on duty, motorists feel safer when their vehicles become disabled. This feeling of safety is intensified when trouble occurs late at night or when the vehicle operator is alone and in an unfamiliar area. Assigning a monetary value to this feeling would at best be arbitrary and is not considered in this report as such; however, it is recognized as a benefit that the patrol provides.

#### Benefits to Texas State Department of Highways and Public Transportation

Operation of the courtesy patrol improves public relations. The questionnaire survey indicated that nearly all of the people that the patrol helped thought that it was a worthwhile service and that it should be continued. No one interviewed made any negative comments about the operation of the patrol. This indicates that the courtesy patrol has helped to establish a favorable public image. American Oil Company operates a similar patrol in San Diego (6, 7) and feels that increased patronage of its dealers' fuel and service facilities as a result of the image they are creating justifies operation of the patrol.

#### Benefits to Houston Police Department

Operation of the courtesy patrol reduces the time spent by police patrols on nonpolice functions. Operation of the courtesy patrol reduces the demand for aid on the police patrols on the freeways. Ideally, the police department should be able to decrease the number of patrols because of decreased demand for their services; however, in Houston this has not been the case. Houston's freeways were patrolled by two motorcycle policemen, both before and after initiation of the courtesy patrol, but before the courtesy patrol began operation there were just that many more needs that the police patrols could not take care of. There are probably enough police-related needs on the freeways to keep two patrolmen busy. Because the number of police patrols was not reduced, no monetary savings can be attributed to the operation of the courtesy patrol; however, the courtesy patrol allowed the police patrols to spend more of their time on police-related work.

Another benefit to the police department is that the courtesy patrol reduces requests for aid that require no police function. A previous study indicated that between 55 and 85 percent of the requests for aid require no police function (2). It would be expected that the police department would be able to devote that much more time to problems for which it is needed. But, as the courtesy patrol is able to deal with so few of the total needs for assistance, a reduction in requests for police aid would be very difficult to determine.

#### SUMMARY

District 12 of the Texas State Department of Highways and Public Transportation provides courtesy patrol service for motorists on some of the freeways in Houston. The objectives of this patrol are to provide safety, assistance, and security for motorists using the freeways. To accomplish these objectives, the patrol provides services that directly benefit motorists in need of aid, motorists who are indirectly affected by incidents, the Houston Police Department, and other members of the Texas State Department of Highways and Public Transportation.

In 1973 the courtesy patrol in Houston performed 12 428 services. Of these, 4568 services benefited motorists in need of aid, 2017 services benefited motorists using the freeway who were indirectly affected by incidents, 1571 services benefited the Houston Police Department, and 4272 services benefited other members of the State Department of Highways and Public Transportation. A total of 1429 questionnaires were returned by disabled motorists who the patrol assisted during March through October 1973. The questionnaires were evaluated, and the results indicate that motorists who were aided by the patrol overwhelmingly favored continuation of the program.

This report estimates the cost effectiveness of the courtesy patrol in Houston. To do this required computing the costs to operate the patrol in 1973 based on data supplied by District 12 of the Texas State Department of Highways and Public Transportation. Estimated monetary benefits to motorists using Houston's freeways in 1973 were \$40 161 saved because the motorists did not have to request aid from a private service facility, \$9643 saved by the stranded motorists because of reduced waiting time for aid to arrive, and \$385 096 worth of time saved by other motorists due to early removal of incidents from traffic lanes during the peak periods. The Texas State Department of Highways and Public Transportation was able to save \$19 200 because maintenance personnel did not have to respond to aid calls at night. A \$5152 savings was attributed to the patrol as a result of a decreased number of secondary accidents. By comparing these estimated benefits to the cost necessary to provide them, a benefit-cost ratio of 2 to 1 was computed. In addition, the provision of a feeling of security to motorists and the creation of a favorable public image were considered intangible benefits of the patrol.

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The contents of this report reflect the view of the authors who are responsible for the facts and the accuracy of the data presented herein. The contents do not necessarily reflect the official views or policies of the Federal Highway Administration. This report does not constitute a standard, specification, or regulation.

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