



CHAPTER IV

SERVICE CHARACTERISTICS OF PUBLIC TRANSPORT

This chapter deals with the service characteristics of the two modes of public transport in the study area. The variables discussed in this part of the research are those directly perceived by the user, and they reflect the quality of service of each mode : travel speed and en route delay of the vehicles, and waiting time of passengers.

Travel Time and Delay Studies

The objective of this investigation was to ascertain the amount of time required to traverse a specific route, or section of a route, by both modes of public transport : city buses and mini-buses. The survey data were recorded in detail as follows :

- (1) the time the vehicle passed each check point ;
- (2) the cause of delay and its duration ; and
- (3) the number of passengers boarding at each check point.

The observations were analyzed to obtain the travel time, running time, travel speed, and running speed. Travel speed was defined for this study as the speed of a city bus or a mini-bus including the effect of delay time anywhere along a route, but not including the walking and waiting times of passengers.

City Buses

At present, there are three different bus lines which serve the study area ; these routes were described in Chapter 2. The travel time and delay studies of city buses were conducted on weekdays in July 1975. In order to determine the variation of travel time of city buses at different times of day, 12 complete journeys (return trips) were observed for each bus line. The data form used for this study is shown in Appendix A, Table Ap/A 4. In this study, the cause of delay was divided into two categories as follows :

- (1) The delay due to the loading and unloading of passengers.
- (2) Other delays such as pedestrians crossing, signals, intersections, etc.

The number of check points of bus lines 1, 2, and 3 which were selected for this study are shown in Figs. 7, 8, and 9, respectively. The distances between check points were approximated from a large scale map (1:4,000) and are listed in Appendix C, Tables Ap/C1, Ap/C2, and Ap/C3 for bus lines 1,2,and 3, respectively. The data pertaining to travel time and delay with **their** analysis for each section between the check points of bus lines 1, 2, and 3 are compiled in Tables Ap/C 4, Ap/C 5, and Ap/C 6, respectively.

The variations of travel time and delay for the entire route of bus lines 1, 2, and 3 at different times of day are **summarized** in Tables 24, 25, and 26, respectively. The travel

Table 24 Results of Travel Time and Delay Studies of Bus Line 1

Starting time (hrs)	Travel time (min)	Delay (min)			Running time (min)	Travel speed (kph)	Running speed (kph)
		Load & Unload	Other	Total			
WB - Aueng Come Market to Suan Dork, Distance 20.32 km							
06.50	62.26	9.14	2.63	11.77	50.49	19.6	24.1
07.05 ¹	63.29	14.88	3.17	18.05	45.24	19.2	26.9
07.30	49.58	6.15	2.03	8.18	41.40	24.6	29.4
08.15	50.40	6.23	1.85	8.08	42.32	24.2	28.8
12.10 ²	44.14	3.24	1.64	4.88	39.26	27.6	31.0
12.50	50.92	4.07	1.28	5.35	45.57	23.9	26.7
13.05	44.32	2.48	2.44	4.92	39.40	27.5	30.9
13.20	48.91	3.26	1.45	4.71	44.20	24.9	27.6
14.35	49.28	4.37	0.96	5.33	43.95	24.7	27.7
15.20	59.07	7.64	1.60	9.24	49.83	20.6	24.4
16.05 ³	61.64	7.87	3.68	11.55	50.09	19.8	24.3
16.50	52.20	7.57	2.30	9.87	42.33	23.3	28.8
EB - Suan Dork to Aueng Come Market, Distance 16.16 km							
06.40	37.22	4.04	1.40	5.44	31.78	26.1	30.5
07.10 ¹	60.40	10.01	5.22	15.23	45.17	16.1	21.5
08.00	47.25	5.16	1.86	7.02	40.23	20.5	24.1
08.20	43.94	4.91	2.54	7.45	36.49	22.1	26.6
12.10	44.51	2.73	2.07	4.80	39.71	21.8	24.4
12.25	40.41	2.85	0.64	3.49	36.92	24.0	26.3
12.55	43.63	3.21	1.69	4.90	38.73	22.2	25.0
14.00 ²	39.89	3.49	1.75	5.24	34.65	24.3	28.0
15.10	47.64	4.57	1.44	6.01	41.63	20.4	23.3
15.25	43.61	4.68	1.99	6.67	36.94	22.2	26.2
15.50 ³	59.16	13.15	3.07	16.22	42.94	16.4	22.6
16.20	58.28	10.48	1.97	12.45	45.83	16.6	21.2

(1) AM Peak

(2) Off-Peak

(3) PM Peak

July 1975

Table 25 Results of Travel Time and Delay Studies of Bus Line 2

Starting time (hrs)	Travel time (hrs)	Delay (min)			Running time (min)	Travel speed (kph)	Running speed (kph)
		Load & Unload	Other	Total			
SB - P.Phun Jet Camp to Distillery, Distance 12.55 km							
07.05 ¹	47.87	5.45	0.35	5.80	42.07	15.7	17.9
07.25	35.66	4.39	0.57	4.96	30.70	21.1	24.5
07.45	32.85	3.5	0.92	4.42	28.43	22.9	26.5
08.15	30.85	3.44	0.07	3.51	27.34	24.4	27.5
11.00	32.29	1.34	0.35	1.69	30.60	23.3	24.6
11.25 ²	28.16	2.12	0.27	2.39	25.77	26.7	29.2
11.50	33.07	2.38	0.85	3.23	29.84	22.8	25.2
12.10	31.20	2.53	1.00	3.53	27.67	24.1	27.2
14.55	31.12	1.83	0.91	2.74	28.38	24.2	26.5
15.25	35.29	3.33	0.62	3.95	31.34	21.3	24.0
15.50 ³	36.16	5.54	0.10	5.64	30.52	20.8	24.7
16.20	32.61	2.31	1.05	3.36	29.25	23.1	25.7
NB - Distillery to P.Phun Jet Camp, Distance 11.77 km							
07.00	33.43	3.00	1.15	4.15	29.28	21.1	24.1
07.25	33.52	4.62	1.81	6.43	27.09	21.1	26.1
07.45 ¹	47.22	2.45	2.83	5.28	41.94	15.0	16.8
08.10	34.72	3.96	0.77	4.73	29.99	20.3	23.5
*11.05	32.23	2.69	0.90	3.59	28.64	23.2	26.1
*11.25	30.67	2.73	0.72	3.45	27.22	24.3	27.4
*11.45	30.35	1.74	0.40	2.14	28.21	25.0	26.5
*12.10 ²	29.16	2.52	0.41	2.93	26.23	25.6	28.5
15.05	26.86	2.05	0.63	2.68	24.18	26.3	29.2
15.30	34.38	4.33	0.56	4.89	29.49	20.5	23.9
15.45 ³	42.47	6.33	0.56	6.89	35.58	16.6	19.8
16.05	35.87	5.72	0.70	6.42	29.45	19.7	24.0

* Distance 12.44 km

(1) AM Peak

(2) Off-Peak

(3) PM Peak

July 1975

Table 26 Results of Travel Time and Delay Studies of Bus Line 3

Starting time (hrs)	Travel time (min)	Delay (min)			Running time (min)	Travel speed (kph)	Running speed (kph)
		Load & Unload	Other	Total			
EB - Huey Kaeo to Railway Station, Distance 11.65 km							
07.05	38.72	5.95	0.99	6.94	31.78	18.1	22.0
07.20	39.93	6.08	4.70	10.78	29.15	17.5	24.0
07.50 ¹	41.72	8.47	2.07	10.54	31.18	16.8	22.4
08.20	31.59	2.31	0.71	3.02	28.57	22.1	24.5
09.30	33.42	5.08	0.97	6.05	27.37	20.9	25.5
09.45 ²	26.51	1.90	0.45	2.35	24.16	26.4	28.9
11.20	34.95	5.93	1.41	7.34	27.61	20.0	25.3
13.10	32.45	3.98	0.52	4.50	27.95	21.5	25.0
14.45	27.55	1.32	0.68	2.00	25.55	25.4	27.4
15.05	30.00	3.38	0.37	3.75	26.25	23.3	26.6
15.50	47.48	13.49	0.90	14.39	33.09	14.7	21.1
16.10 ³	47.70	12.07	0.28	12.35	35.35	14.6	19.8
WB - Railway Station to Huey Kaeo, Distance 12.45 km							
07.00	40.46	7.35	0.57	7.92	32.54	18.5	23.0
07.15 ¹	49.88	6.12	1.11	7.23	42.65	15.0	17.5
08.00	34.80	4.56	1.35	5.91	28.89	21.5	25.9
08.25	39.48	6.15	0.93	7.08	32.40	18.9	23.1
09.50	37.65	2.68	1.07	3.75	33.90	19.8	22.0
10.20 ²	31.68	1.83	1.05	2.88	28.80	23.6	25.9
12.20	35.35	4.70	1.17	5.87	29.48	21.1	25.3
12.45	33.51	3.41	0.36	3.77	29.74	22.3	25.1
15.00	37.82	6.18	0.81	6.99	30.83	19.8	24.2
15.20	37.49	4.22	0.49	4.71	32.78	19.9	22.8
15.40 ³	50.97	12.65	0.95	13.60	37.37	14.7	20.0
15.45	48.18	10.33	0.74	11.07	37.11	15.5	20.1

(1) AM Peak

(2) Off-Peak

(3) PM Peak

July 1975

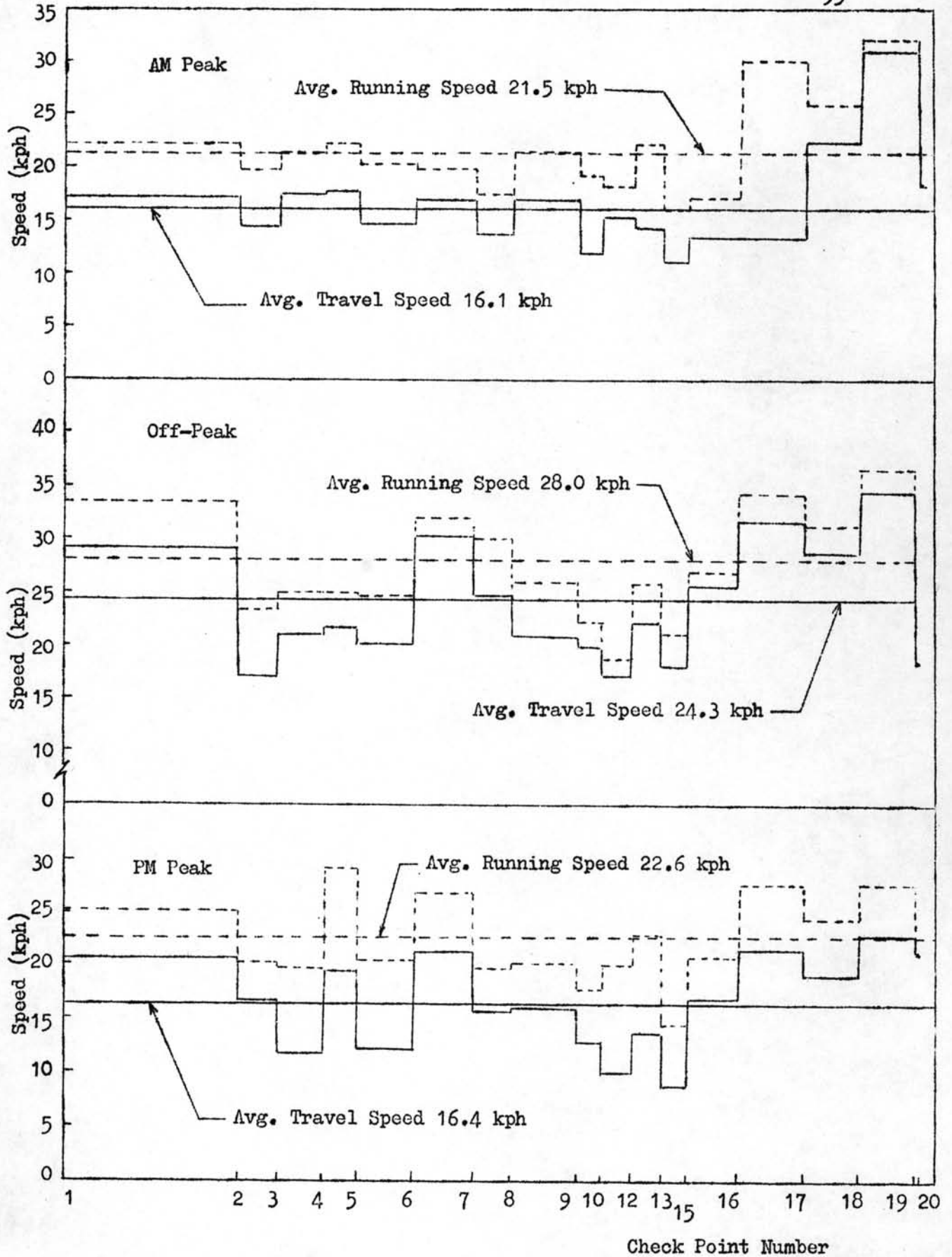


Fig. 30 Travel Speed and Running Speed: Bus Line 1, EB-Movement

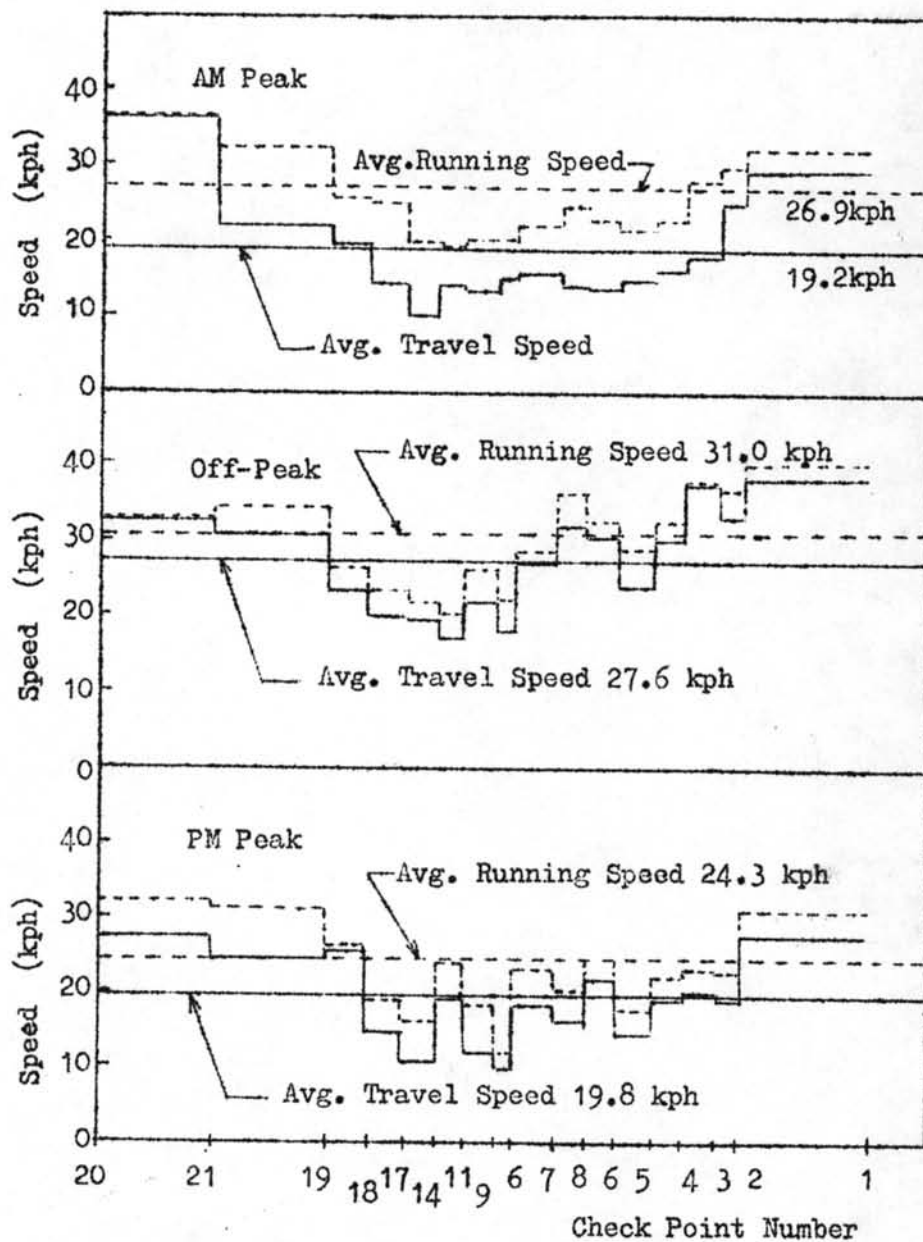


Fig. 31 Travel Speed and Running Speed: Bus Line 1, WB-Movement

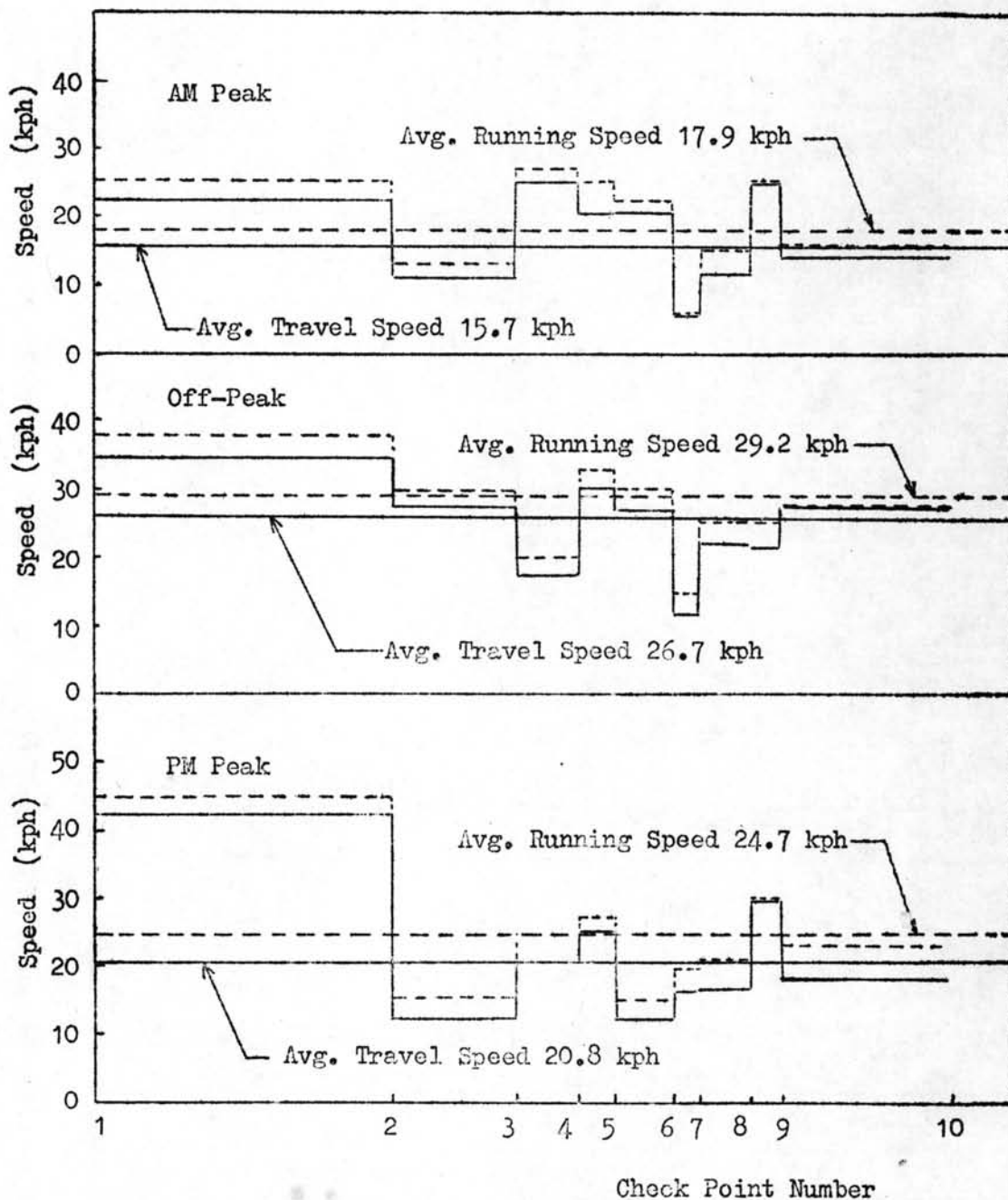
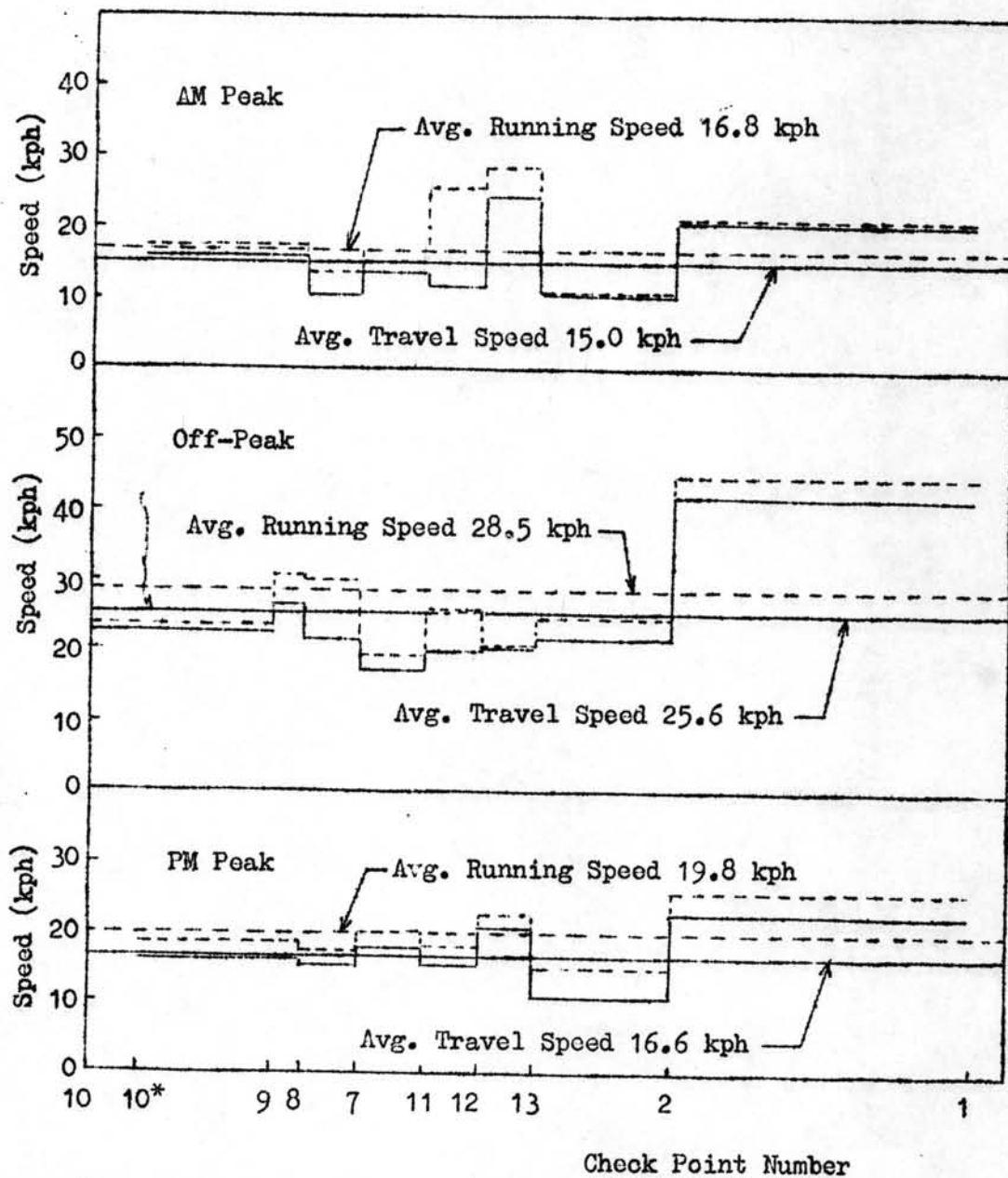


Fig. 32 Travel Speed and Running Speed: Bus Line 2, SB-Movement



* Due to the time restrictions on the one-way street system

Fig. 33 Travel Speed and Running Speed: Bus Line 2, NB-Movement

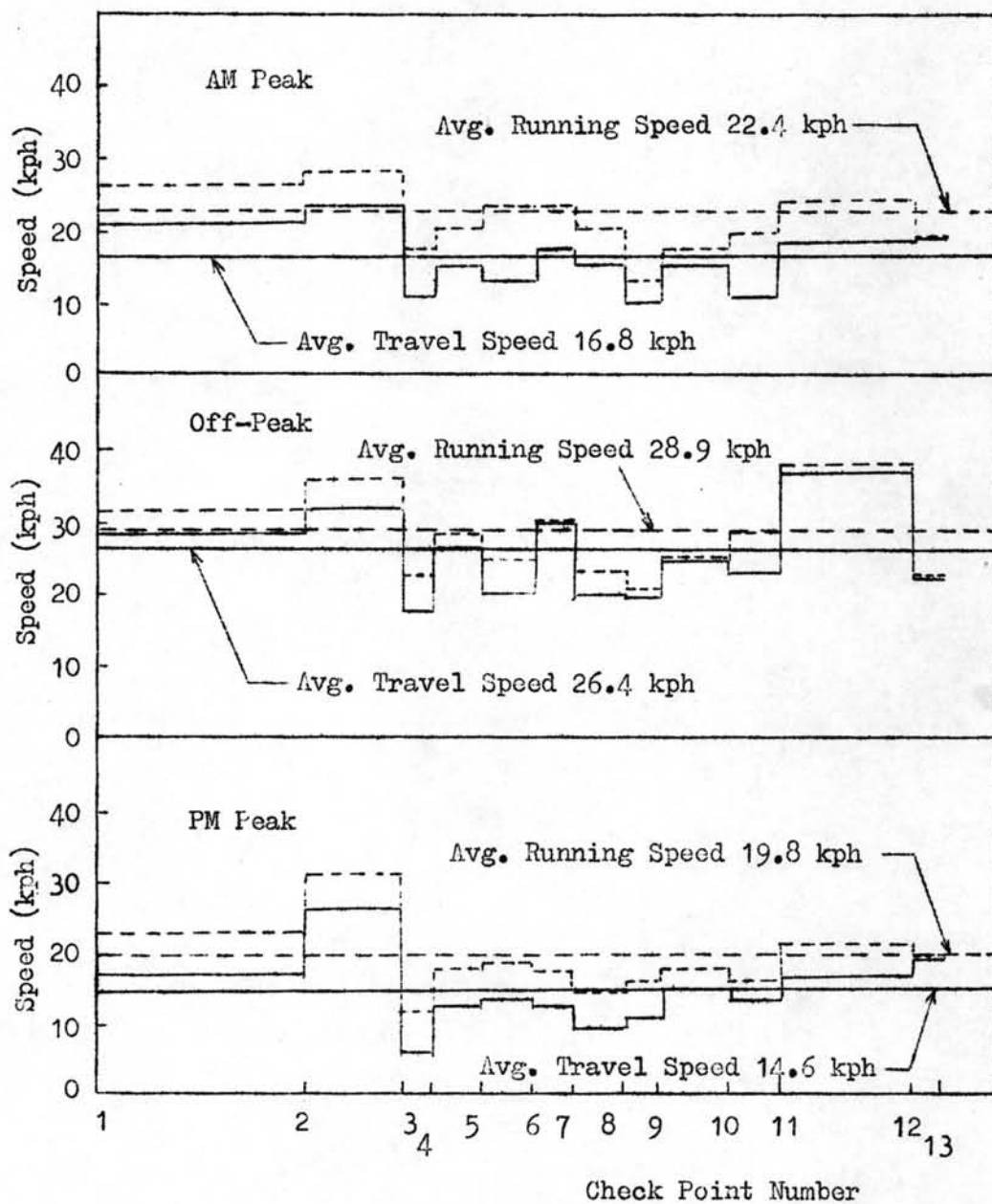


Fig. 34 Travel Speed and Running Speed: Bus Line 3, EB-Movement

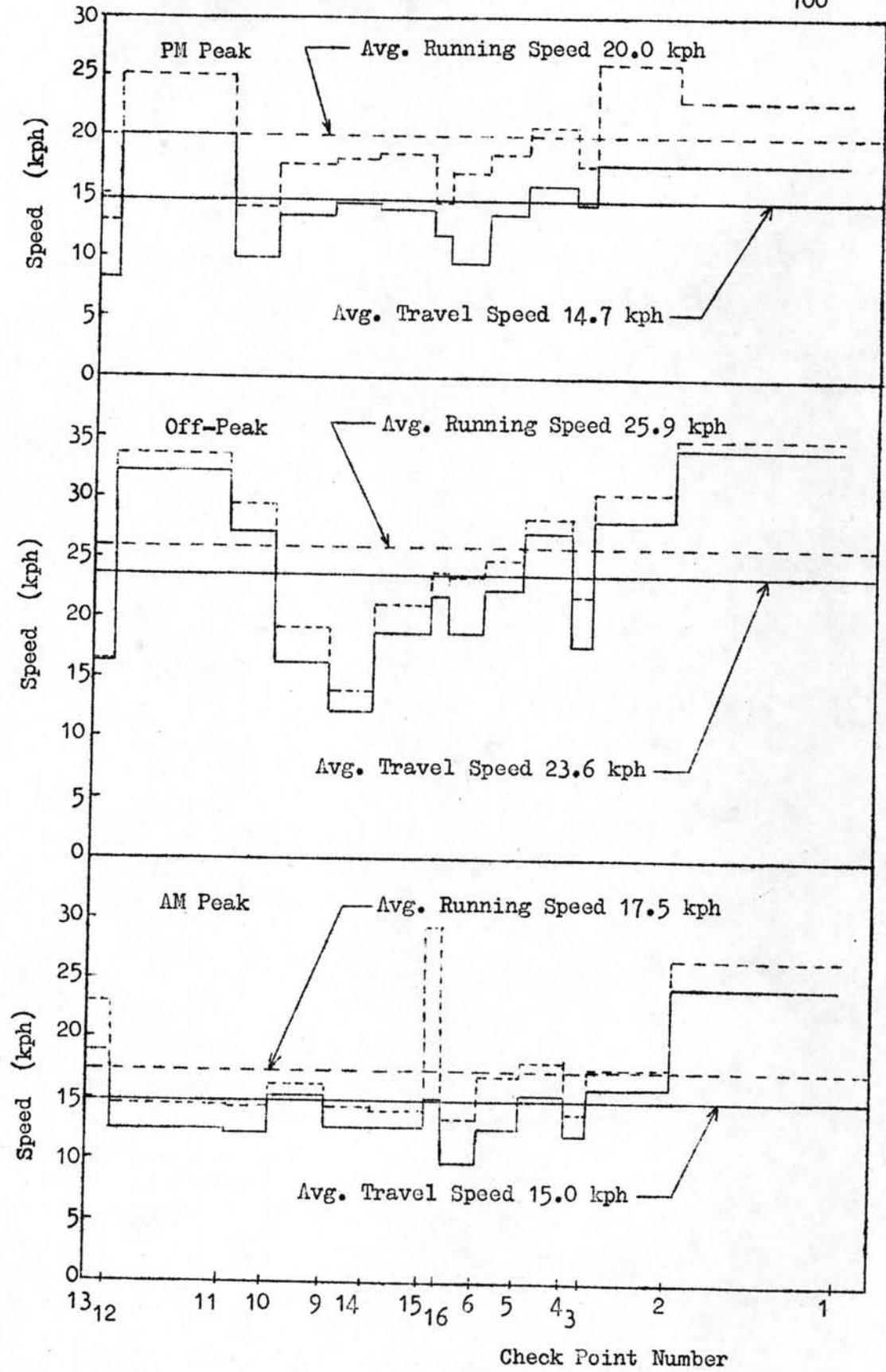


Fig. 35 Travel Speed and Running Speed: Bus Line 3, WB-Movement

speed and running speed along these routes for each direction of travel were plotted only for the A.M. peak, off-peak, and P.M. peak periods; these are shown in Figs. 30 to 35, inclusive. From these graphs it can be seen that the travel speeds for the entire route of each bus line during the two peak periods were different from those of the off-peak periods. The plot of speed along the length of each of the three bus routes tends to be U-shaped. This is probably attributable to the termini of each bus route being situated in outlying areas and a central portion of each route passing through the congested central business district.

The studies indicate that the delays encountered along the routes are mostly due to the loading and unloading of passengers; this amounts to about 70 to 80 percent of the total delay.

The total time lost through delays ranges from 15 to 30 percent within the CBD, and from 5 to 15 percent of the travel time for those portions of the routes lying outside the CBD. Running time in the CBD, therefore, is 70 to 85 percent of the travel time; on the route segments outside the CBD it is 85 to 95 percent of the travel time.

The frequency distributions of the travel speed of city buses in and around the CBD were plotted and are shown in Figs. 36 and 37. From these graphs, it can be seen that the deviation of the travel speed of city buses along Tapae Road in the CBD

from the average travel speed of 17 kph is very small. Considering the geometry of the streets within the city walls, travel speeds vary to a larger degree with an average of about 21 kph. The average travel speed on the radial routes within the study area (but bounded by the super-highway, as shown in Fig. 4) is 26 kph on Cherg Doy Road; for Charoen Muang Road it is 24 kph; for Huey Kaeo Road it is 29 kph; and 18 kph on Fang Road. The travel speeds on these radial roads have a considerable range of values, as can be seen for Huey Kaeo Road especially. These frequency distributions represent one symptom of the condition of traffic in the study area : the travel speed remains about the same all day and there are only small differences between the peak and the off-peak periods in the CBD. Within the city walls (outside the CBD), and along radial routes in the study area, the travel speeds observed in the peak and off-peak periods are considerably different. The travel speed on radial routes in the study area, but situated beyond the super-highway, usually lies between 30 and 40 kph.

Mini-Buses

Because of the flexibility in routing of mini-buses, ordinary survey methods could not be applied, and special techniques were developed. Travel time and delay studies were obtained

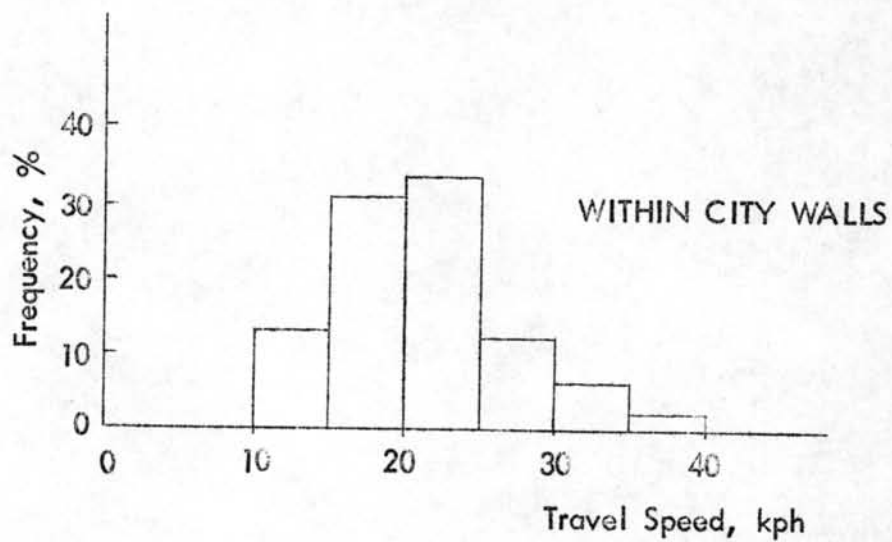
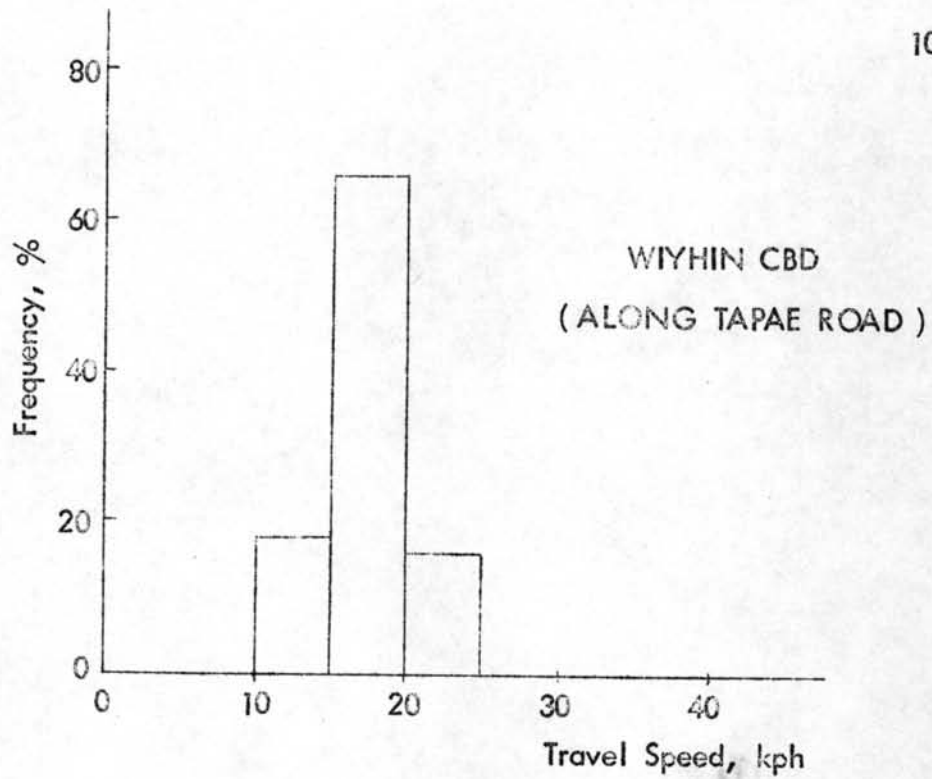


Fig. 36 Frequency Distribution of the Travel Speed of City Buses

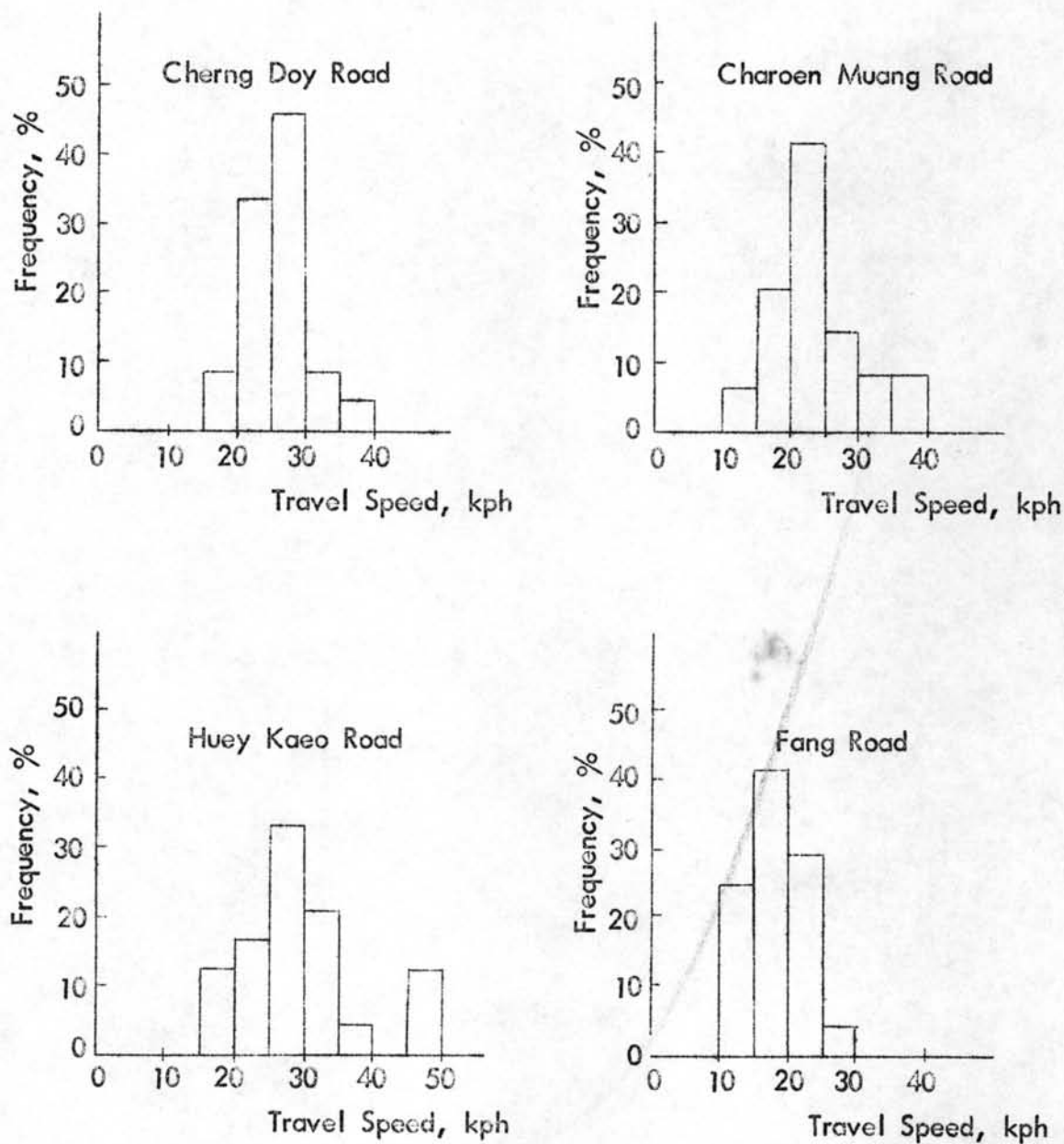


Fig. 37 Frequency Distribution of the Travel Speed of City Buses on Radial Routes Within the Study Area (but bounded by the super-highway)

by selecting numerous check points in the study area. The array of 64 check points is shown in Appendix C, Fig. Ap/C 1. The survey was conducted during the daytime hours in December 1975. The causes of delay identified in this study were taken to be the same as those for the city-bus study, but cruising delay was added to the measurements. The data form for this study is shown in Appendix A, Table Ap/A 5. The data, with their analyses of travel time and delay at various times of day, are compiled in Appendix C, Table Ap/C 7. From these data, it can be seen that mini-buses mostly operated between the CBD and the area in the vicinity of the city walls. The results show that the travel speed of mini-buses in the study area is substantially the same at all times of the day. The average travel speed in the city center on Witchayanond Road is about 15 to 20 kph. On Tapae Road, the travel speed is nearly the same as generally found on streets within the city walls: averaging about 23 to 25 kph. However, the frequency distribution of the travel speed of mini-buses in the CBD (along Tapae Road) is much more restricted than that observed for route segments within the city walls, as shown in Fig. 38. These travel speed distributions are similar to those observed for city buses, as shown in Fig. 36. The travel speed tends to be high on some radial routes, such as Huey Kaeo Road and Fang Road, where the travel speed is typically 35 to 40 kph.

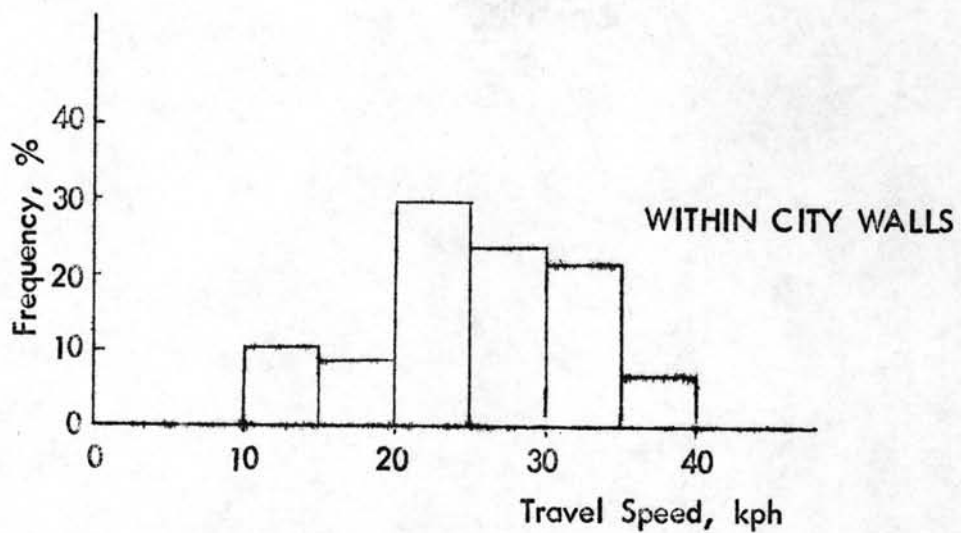
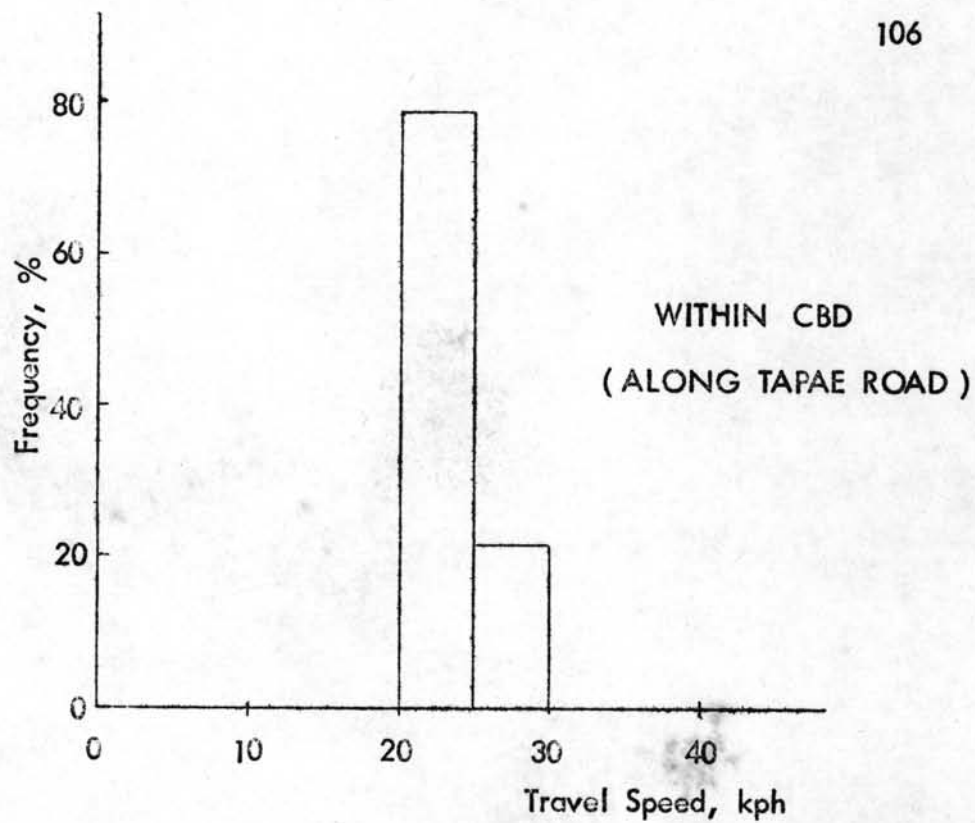


Fig. 38 Frequency Distribution of the Travel Speed of Mini-Buses

The travel speeds of mini-buses were found to be generally higher than those of city buses. The results show that the percentages of each of the three causes of delay encountered along the route are nearly the same all day ; on average 57 percent of the total delay is due to loading and unloading, 6 percent, goes to cruising delay, and 37 percent results from other assorted causes. The total time lost through delays ranges from 10 to 13 percent of the travel time in the study area.

Waiting Time Investigation

The objective of this part of the study was to determine the waiting time of prospective passengers wishing to board mini-buses or city buses. The data form used for this investigation is shown in Appendix A, Table Ap/A 6.

City Buses

A survey of the waiting time of city-bus passengers was performed on 30th May 1975, from 07.00 to 17.00 hrs. The bus stop selected for this survey is located in the city center on Tapae Road. It was selected because it is a boarding stop for all three bus lines. The location of this bus stop is nearly at the middle of each bus route. In this investigation, a total of 337 passengers were observed. Of these, 146, 89, and 102

passengers were waiting for bus lines 1, 2, and 3, respectively. Figs. 39, 40, and 41 show the histograms of waiting time of passengers for bus lines 1, 2, and 3, respectively; the field data and analyses are compiled in Appendix C, Tables Ap/C 8 to Ap/C 10.

In analyzing the data, the observation periods were divided into three time intervals : AM peak (07.00 - 09.00 hrs), off-peak (09.00 - 15.00 hrs), and PM peak (15.00 - 17.00 hrs). The results show that the mean waiting time of passengers during the off-peak period is somewhat higher than in either of the two peak periods. The time lost by passengers waiting for bus line 1 is less than that lost waiting for bus lines 2 and 3. This may be explained partly by the large number of buses in the line 1 fleet, most of which are new equipment. From cumulative curves of waiting time of passengers for each bus line, the median waiting times at the three observation periods were found to be about the same: 4.0 minutes, 6.0 minutes, and 6.3 minutes for boarding bus lines 1, 2, and 3, respectively. The maximum waiting times of city-bus passengers were found to be 13.5 minutes, 16.5 minutes, and 17.5 minutes for boarding bus lines 1, 2, and 3, respectively. The pattern of superior service offered by bus line 1 (compared to the other two lines) is evident in both the median waiting time results and the maximum waiting time results.

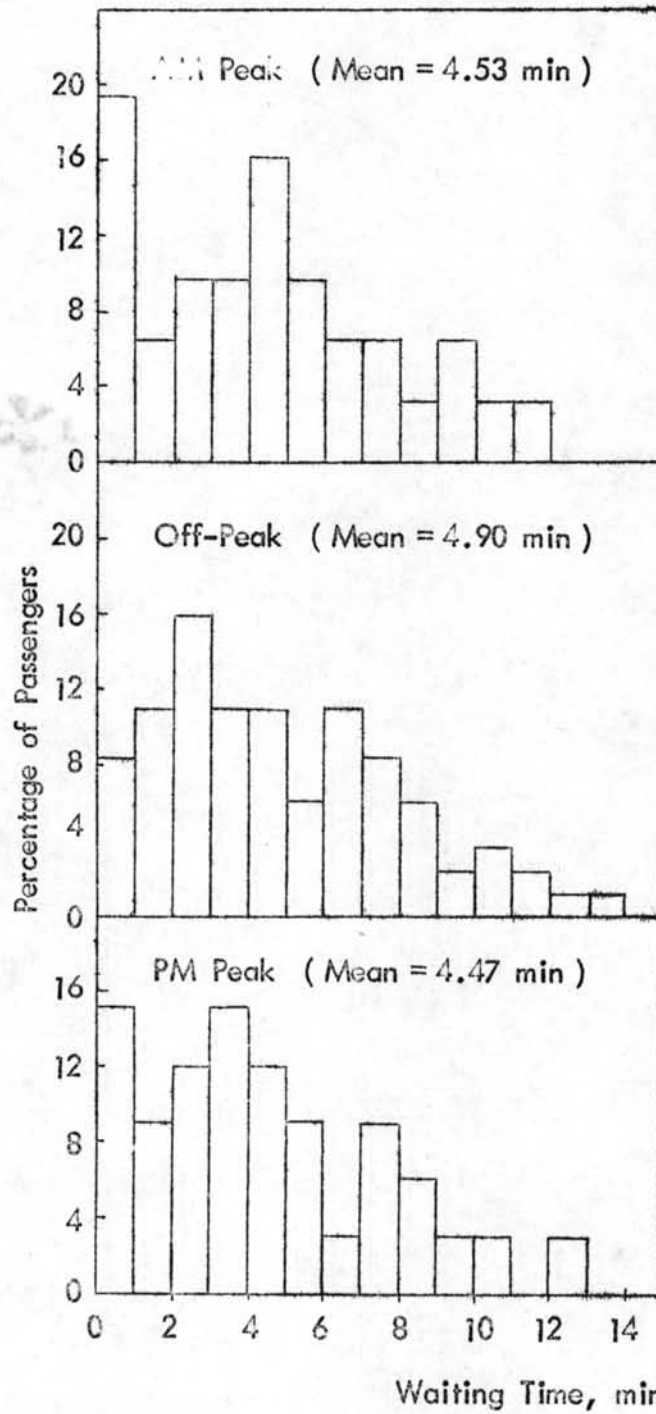


Fig. 39 Histograms of Waiting Time of Passengers
Wishing to Board Bus Line 1

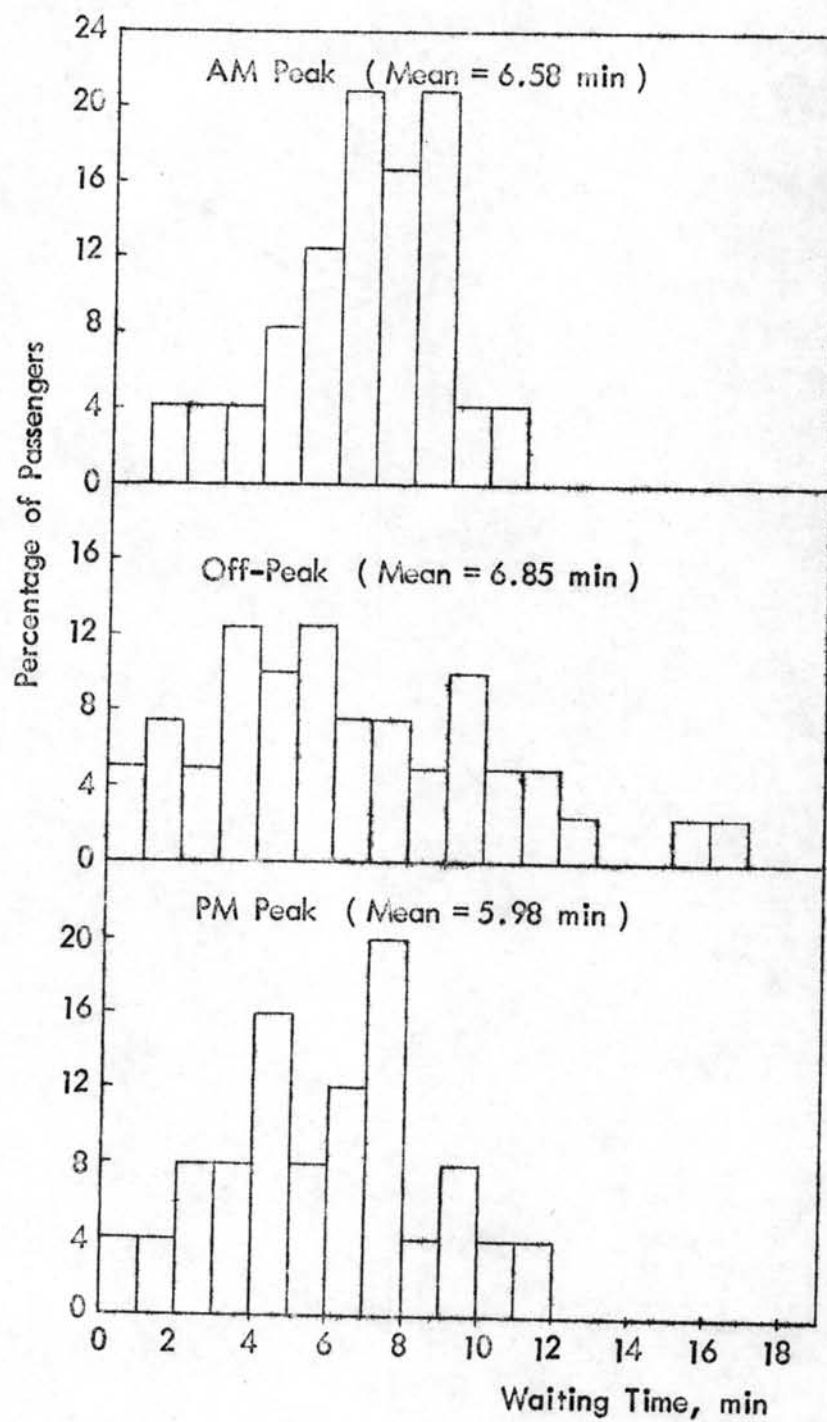


Fig. 40 Histograms of Waiting Time of Passengers Wishing to Board Bus Line 2

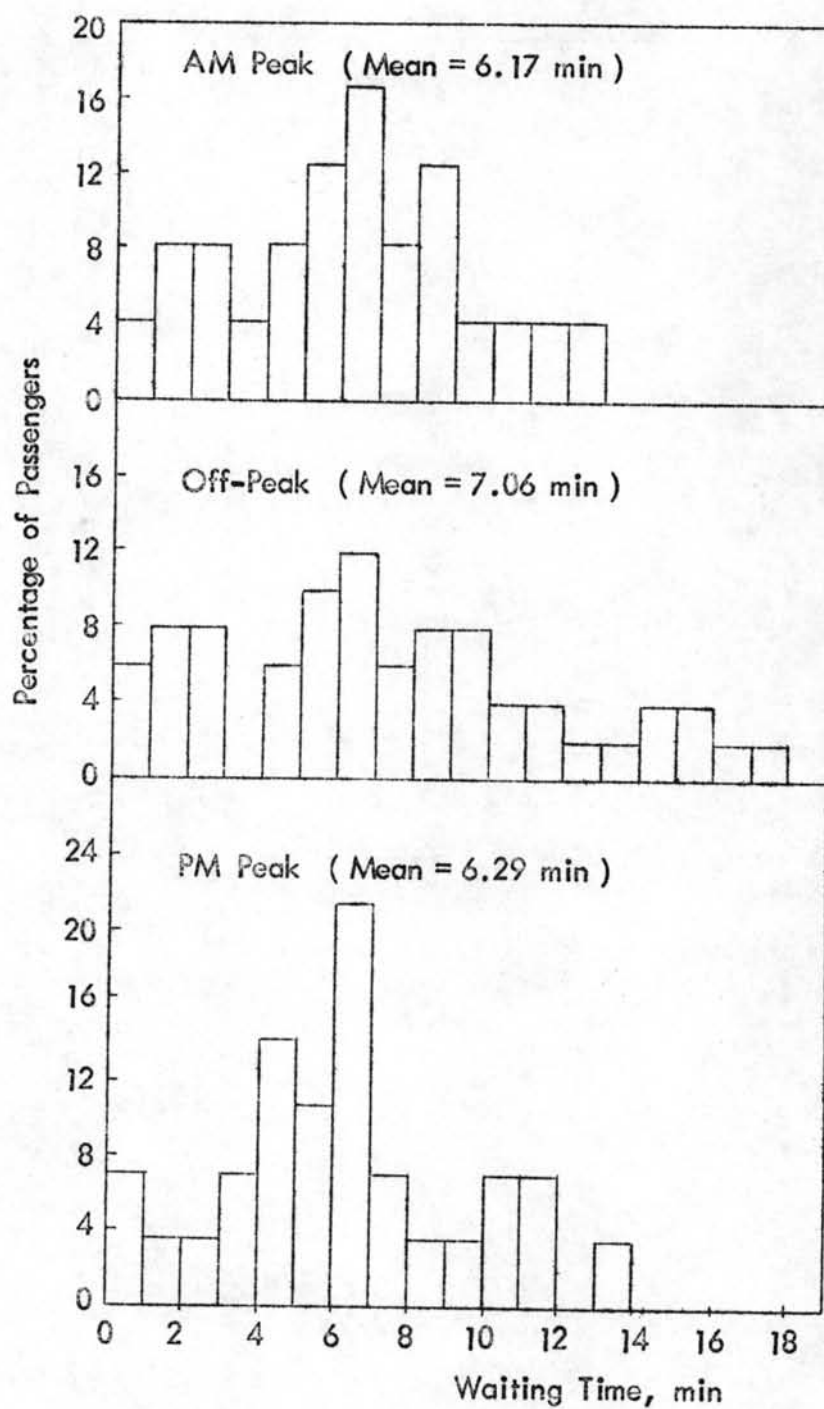


Fig. 41 Histograms of Waiting Time of Passengers Wishing to Board Bus Line 3



Mini-Buses

A survey of the waiting time of mini-bus passengers was performed on weekdays in December 1975. The collection of data was divided into two parts as follows :

- (1) the waiting time of passengers wishing to board mini-buses from the city center to the outlying area.
- (2) the waiting time on the reverse journey (outlying area to city center).

To study the first item, the survey took place at a loading area at Warorot Market in the city center. The method used to collect the data was the same as that employed for city-bus passengers. The total outward-bound passengers observed in this part of the investigation was 196 passengers. The data and analyses are summarized in Table Ap/C 11; histograms of these data are shown in Fig. 42. The results show that the mean waiting time of mini-bus passengers in the city center during the three observation periods was nearly the same. For the grouped data from the three periods, the mean waiting time was found to be 23 seconds, and the median waiting time was found to be 15 seconds. It can be seen that the waiting time of mini-bus passengers is very much lower than that of city-bus passengers.

To survey waiting times of prospective mini-bus passengers inward bound to the city center, the survey was subdivided into four sections, each associated with one of the four radial routes :

Fang Road, Charoen Muang Road, Huey Kaeo Road, and Chong Doy Road. The observer would represent himself as a prospective passenger. He decided upon, and kept in mind, a desired destination and waited for a mini-bus. The observer kept track of time from the instant of presenting himself at curbside until a mini-bus driver stopped nearby. At this point inquiry by the "passenger" was made and he noted this as the end of waiting time. Of course, some alibi was found for not boarding the mini-buses ! By this method, 20 passengers were observed during each peak period on each of the four radial routes. The data with their analyses are compiled in Tables Ap/C 12 to 15, and shown by the histograms in Figs. 43 to 46, inclusive. From these graphs, it can be seen that the mean waiting times of mini-bus passengers on the four radial routes, during the two peak periods, are but slightly different. However, the peak-period means are greatly different from the off-peak periods. This difference is consistent for the four sets of inbound mini-bus waiting time observations. The peak period inbound mean waiting time was found to be 0.53 minutes; for the off-peak period it was 1.07 minutes.

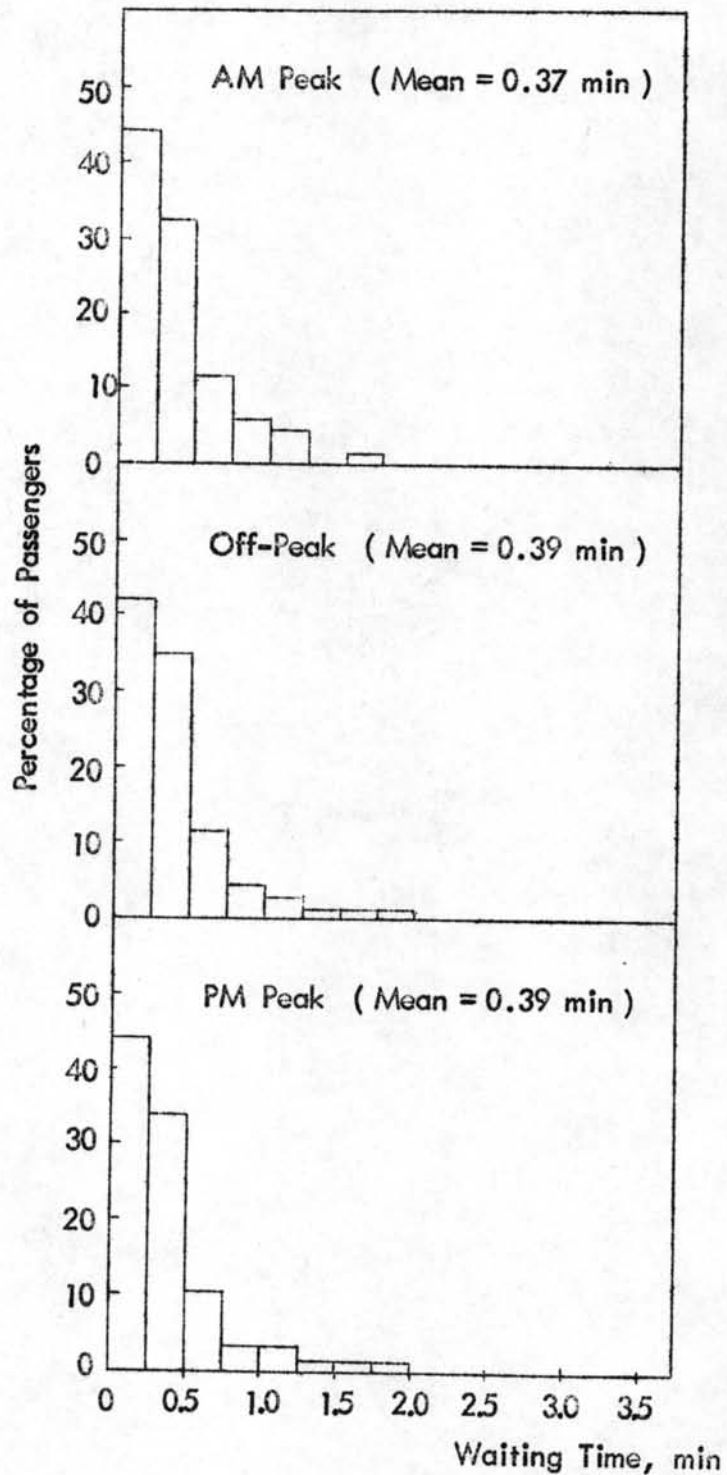


Fig. 42 Histograms of Waiting Time of Passengers Wishing to Board Mini-Bus from City Center to Outlying Area

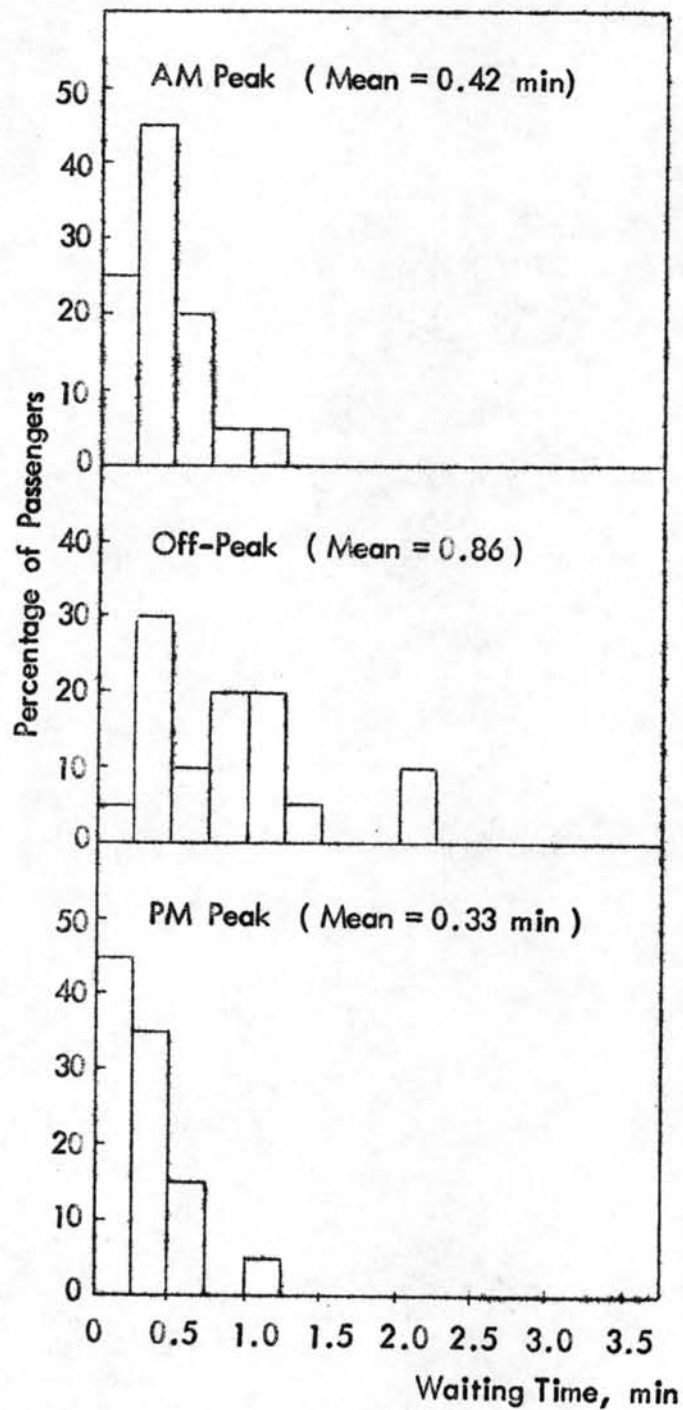


Fig. 43 Histogram of Waiting Time of Passengers Wishing to Board Mini-Bus from Fang Road to City Center

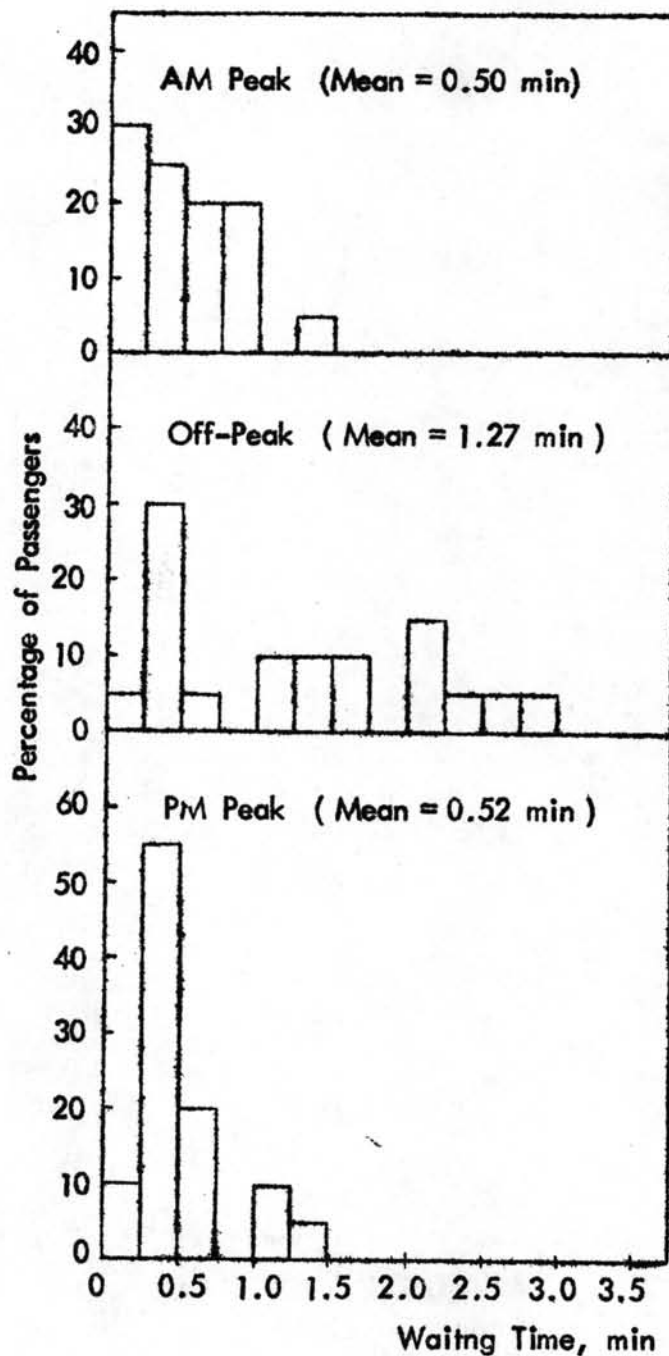


Fig. 44 Histogram of Waiting Time of Passengers Wishing to Board Mini-Bus from Charoen Muang Road to City Center

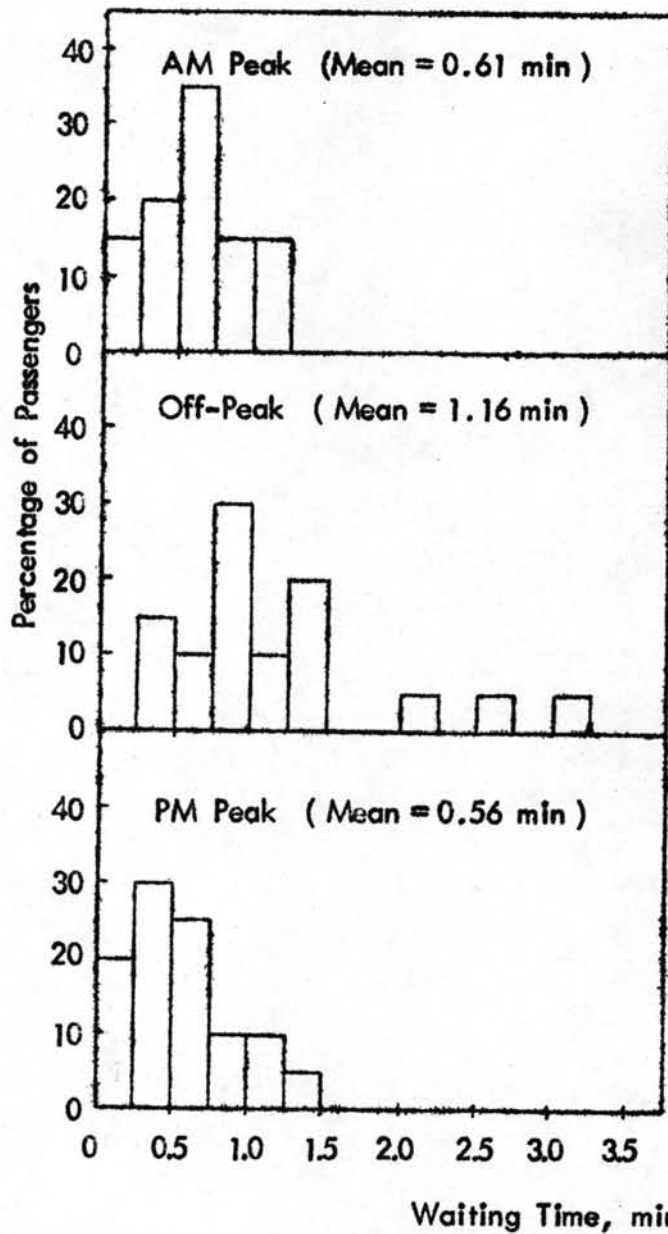


Fig. 45 Histogram of Waiting Time of Passengers Wishing to Board Mini-Bus from Huey Kaeo Road to City Center

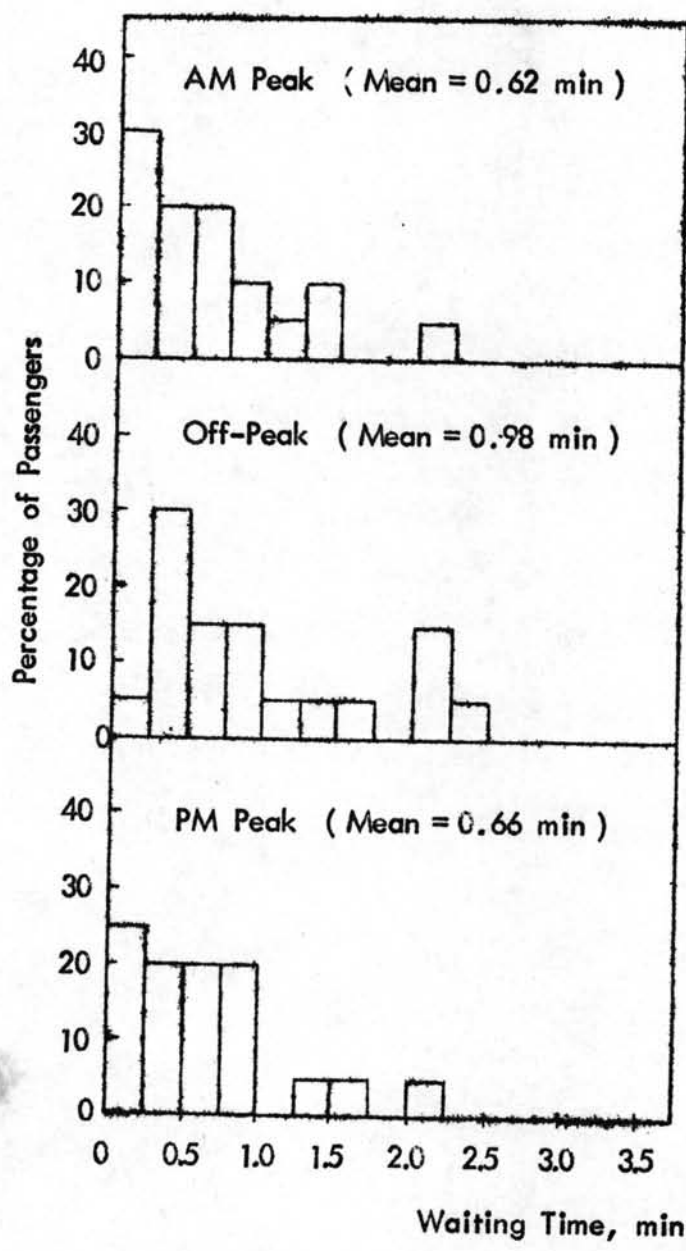


Fig. 46 Histogram of Waiting Time of Passengers Wishing to Board Mini-Bus from Cheryng Doy Road to City Center