

CHAPTER II



TRANSPORTATION IN THE STUDY AREA

Chiang Mai, with many narrow irregular streets connected by sois¹, seems ideally suited to small-vehicle public transportation. Investigations have shown that the area in the vicinity of Warorot market is the central business district (CBD); this is shown in Fig.6. Subsequently in this research, this area will be called the city center. At present, little use is made of one-way streets which might be highly efficient in an area such as the city center. There are but few traffic signs installed and fewer traffic signals in operation. In 1975 there were not many serious transportation problems in the study area. However, in the city center there is considerable traffic congestion at most times of day. This is largely due to the shortage of satisfactory parking places, inadequate areas for boarding unloading of public transport vehicles, the lack of good traffic organization, and due to pedestrians crossing streets without regard for marked cross-walks. Such traffic problems are not limited to the city center, but also occur in other areas especially near intersections. However, these problems have not yet become serious in the study area generally.

¹Soi is a Thai word meaning a narrow or tortuous lane mainly provided for pedestrians or small vehicles.

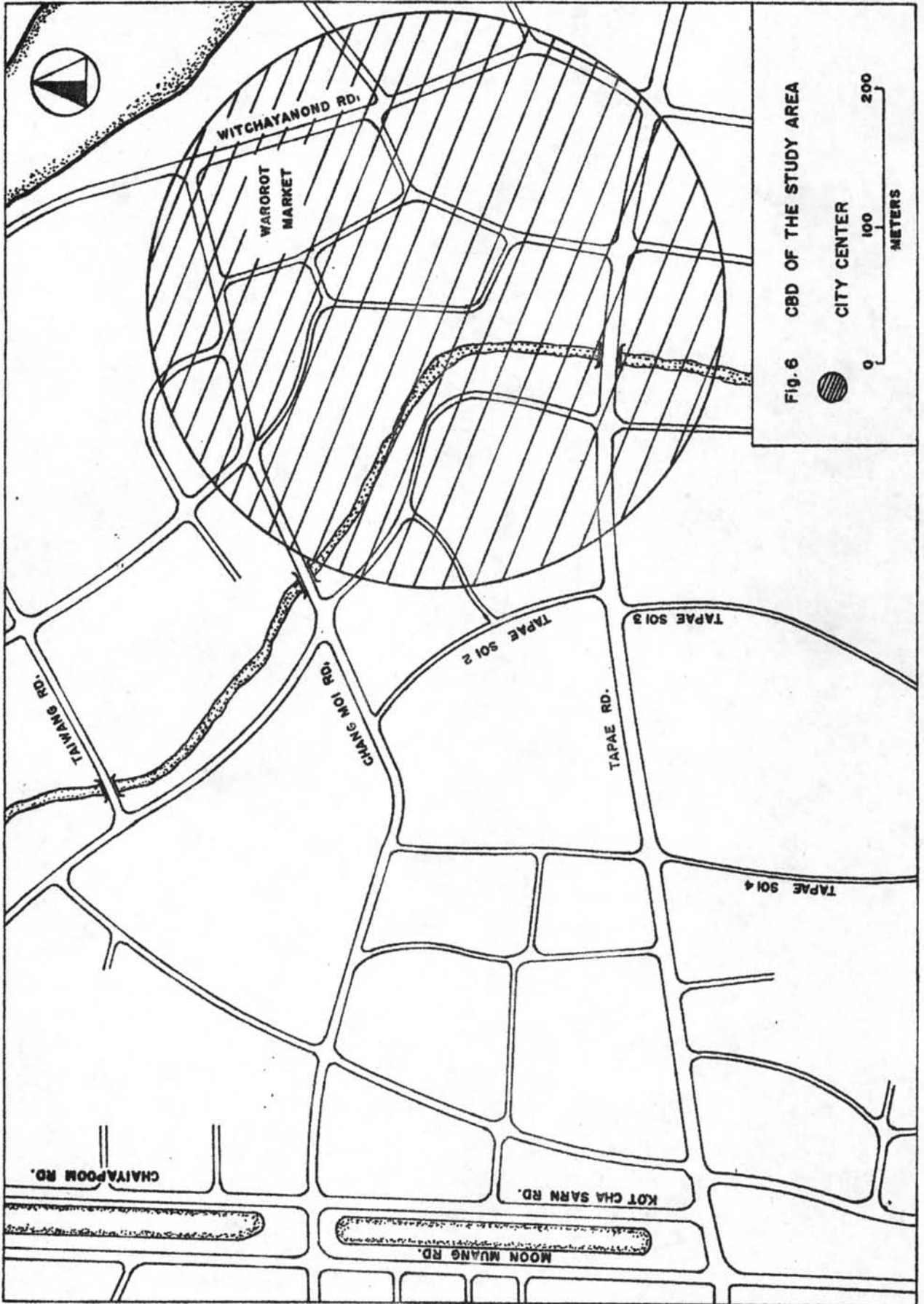


Fig. 6 CBD OF THE STUDY AREA

CITY CENTER

0 100 200
METERS

Public Transportation Services

The existing public transportation in the study area basically consists of two modes of transport. One is the bus service, which is the cheapest mode of public transport; this service carries many passengers at a time, in moderate comfort over relatively long distances. The other is the mini-bus service in which each vehicle carries more passengers than a taxi, but fewer than a bus. The mini-bus service can best be described as "shared-taxi" service. The two modes of public transport available in the study area provide different kinds of services which will be subsequently analyzed in detail.

Bus System Characteristics

Buses are usually the most important mode of mass transportation in the cities of the developing countries. But in Chiang Mai this seems not to be borne out, though buses are the cheapest mode of public transport. There are two categories of bus service in Chiang Mai.

- (1) Bus services within the study area, called "city bus" in this research.
- (2) Bus services going from the bus station in the study area to all important near-by amphoes and provinces, called "intercity-bus" in this research. Whilst there is long-distance intercity bus service from Chiang Mai to many other provinces, these buses were not

included in the study. The criterion used for demarcation was that only those intercity bus routes that were also served by mini-buses (e.g, to Lamphun) were included.

Both of these types of bus service are operated by private companies which are under the control of the Department of Land Transport, Ministry of Communication. The concessions for the different bus lines are issued for a duration of five years. With the concession the following conditions are imposed : number of buses, bus headways (time interval between buses) at various times of day, number of bus trips¹ during operating time, and time of operation.

City Buses

For this research only the city-bus services were deemed to be important. A survey of city-bus services showed that the study area is served by three different bus lines operated by one private company : Chiang Mai Thai Doen Rot Co., Ltd. The basic facts about buses used in public transport, such as age structure, type of vehicle, etc. were not studied in detail in the present research. Investigation showed that no statistics of bus operation are available : not only were there no records of the numbers of passenger carried but neither of the scheduled

¹ A bus trip is defined as the journey from the origin to the destination terminals of a line and corresponds to half a cycle.

frequencies. Details of receipts and expenses for the buses were not available from the private operating company. The routes of city-bus lines 1, 2 and 3 with their check points¹ are shown in Fig. 7, 8 and 9, respectively. Following discussions with the Land Transport Department at Chiang Mai it was found that these three bus routes were chosen to pass the city center and link Government departments, universities, schools, and other public places. No attempt was made to select routes on the basis of population densities, walking distances, or on the origins and destinations of passengers.

Actually, bus lines 1 and 3 operate on the principal east-west streets, and bus line 2 operates on the principal north-south streets. Due to the time restrictions on the one-way street system -- 07.00 - 08.30 hrs and 15.00 - 16.30 hrs southbound on Charoen Prathet Road (from Sri Dornchai Road), and northbound on Chang Klan Road (to Sri Dornchai Road) -- the route of bus line 2 in these periods varies during the day as shown by the dotted arrow in Fig. 8. Bus line 1 has a trip length of approximately 18 kilometers. The trip length is 12 kilometers for bus line 2 and the same distance for bus line 3. From the dispatchers' daily reports on the operation

¹ Check points for this study were selected as key intersections or important attractors of travel, eg. cinemas, schools and hospitals.

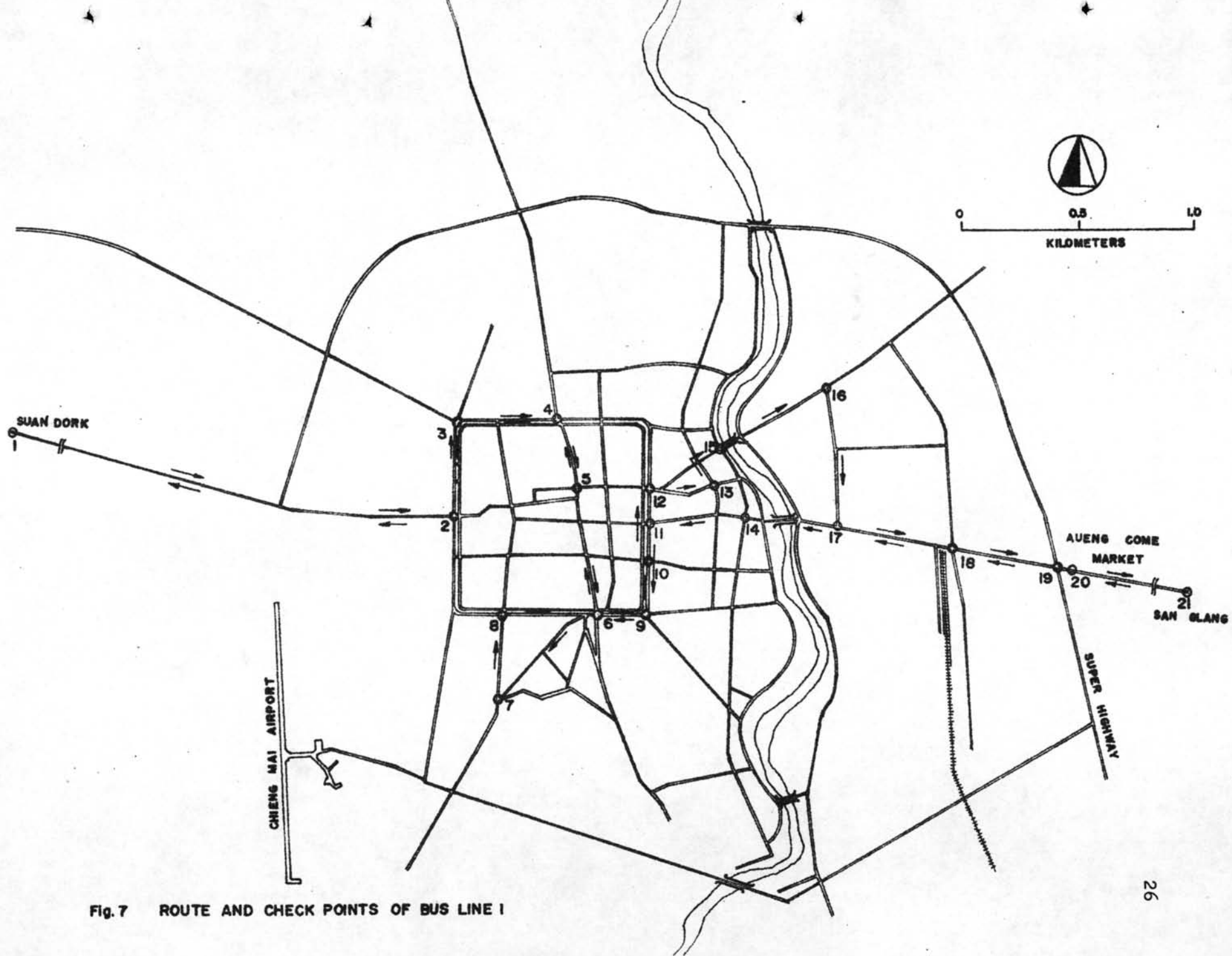


Fig.7 ROUTE AND CHECK POINTS OF BUS LINE 1

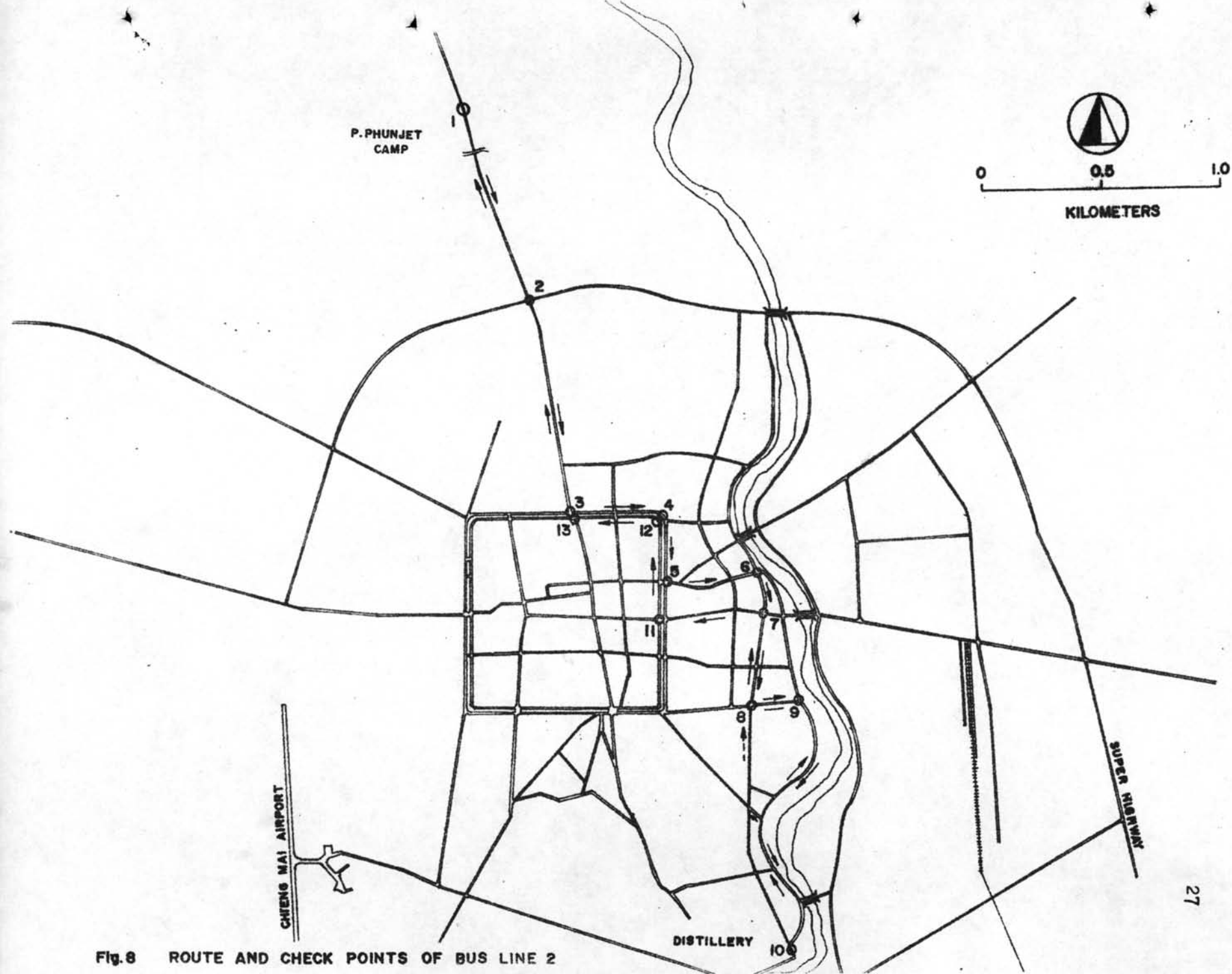


Fig. 8 ROUTE AND CHECK POINTS OF BUS LINE 2

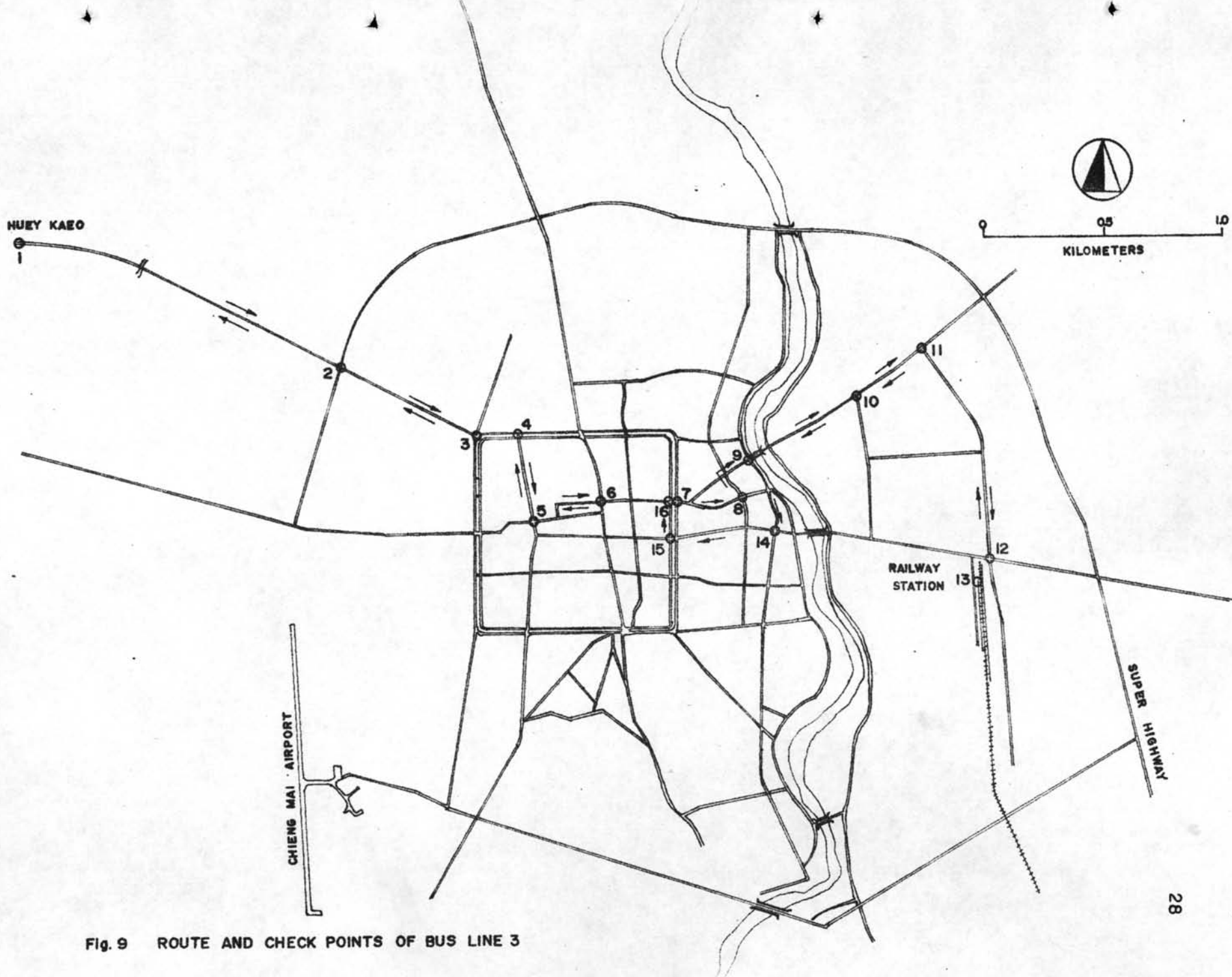


Fig. 9 ROUTE AND CHECK POINTS OF BUS LINE 3

of each city-bus line, obtained for the period 26th May to 2nd June 1975, estimates were made of the actual operating hours, the number of buses running each day, the number of trips per day, and average bus headways. The operating hours of each city-bus line are approximately from 06.00 to 21.00 hrs each day, including Saturdays, Sundays, and holidays. Generally, the average service headway is about 10 minutes, except in the case of broken-down buses or the lack of buses in service. The service frequency is left to the judgement of the dispatchers who are stationed at the two terminals of each bus line. Relevant data for the three city-bus lines are shown in Table 3. These data were obtained at Chiang Mai in May 1975.

The cost to travel any route is 1 baht per trip except for students in uniform for whom the fare is only 0.50 baht per trip. For this price, passengers can travel the entire route (one trip) or any part of it, but cannot travel on a different route as there is no "transfer" arrangement. At present, passengers can only purchase tickets from the bus conductors as in Bangkok, not from vending machines or even shops as in a number of European cities. It was evident that the city-bus drivers will stop to load passengers not only at designated bus stops but anywhere along the route. This may result from the competition from intracity mini-buses. When passengers want to get off, the city-bus drivers only stop at designated bus stops.

Table 3 Relevant Data of the City-Bus System (May 1975)

Bus Line	Route Description	Direction	Distance (km)	(1) Fare (Baht)	Buses per day			Trips per day		Trips per Bus per Day	Passengers per Day	Passengers per Trip	Headway min/veh	
					Proposed	Available	Actual	Proposed	Actual				(2)	Actual
1	Suan Dork to San Glang	EB	19.16	1	31	13	13	518	169	13	11,601	69	-	10
	San Glang to Suan Dork	WB	17.32											
2	P.Phunjet Camp to Distillery	SB	12.55											
	Distillery to P.Phunjet Camp	NB	12.44											
3	Huey Kaeo to Railway Station	EB	11.65											
	Railway Station to Huey Kaeo	WB	12.45											

(1) Except students in uniform pay only 0.5 baht per trip.

(2) See Table 4

Table 4 Operating Plan for City-buses, Proposed by Land Transport Department

Bus Line	No.of Buses veh	No.of Trips per Day	Operating Hours	Headway min/veh
1	31	518	06.00-07.00	5
			07.00-09.00	3
			09.00-14.00	4
			14.00-16.00	5
			16.00-20.00	3
			20.00-21.00	5
			21.00-22.30	6
2	31	504	06.00-07.00	5
			07.00-09.00	3
			09.00-14.00	4
			14.00-16.00	5
			16.00-20.00	3
			20.00-22.00	6
3	31	510	06.00-07.00	5
			07.00-09.00	3
			09.00-14.00	4
			14.00-16.00	3
			16.00-20.00	4
			20.00-21.00	5
			21.00-22.30	6

Date: 27th May 1975

Source: Department of Land Transport, Chiang Mai

In June 1975, the bus company had a total of 37 drivers which resulted in an average of only 1.2 drivers per bus. The consequence of this low number of drivers is excessively long working times,

often up to 14 hours a day. This arrangement, however, is acceptable to the drivers who get a bonus for each trip in addition to their salary. The minimum number of city-buses needed in service was calculated by the Department of Land Transport; this is a function of the trip time, the number of trips per day, and the hours of operation of the buses. Taking an operating time of 500 minutes per day per bus the following formula arises :

$$\text{No. of city-buses in service} = \frac{\text{Trips per day} \times \text{Trip time (min)}}{500}$$

Thus the proposed headways and number of buses for each line are shown in Table 4. According to the proposal of the Department of Land Transport, 93 buses would make 1,532 trips per day on the three city bus lines. In fact, under the present operation, buses completed only 28 percent (423 trips) of the proposed number of trips. Considering the current deficiency of 72 percent, the buses presently in service would have an impossible task to carry out the proposed number of trips. Although no statistical data about bus service are available, it is obvious that the city-bus services are not well patronized and many journeys are made by intracity mini-bus services. It is believed that the basic cause of this low city-bus usage is the poor quality of service offered; people seem not want to waste time waiting for city buses which

arrive at infrequent intervals. Details of the travel and service characteristics of city-buses are discussed in Chapters 3 and 4.

Intercity Buses

Besides the three city-bus lines, there are intercity buses operating from the town bus station to near-by amphoes and other provinces. These intercity-bus lines are mainly operated on five streets radiating from the city center in the following directions : northward; north-eastward; eastward, and two streets lie southward. There are many individual and partnership private companies operating these intercity-bus lines. Their organizations and the characteristic of the buses are nearly the same as those of the city-buses. The main difference from city-bus is the cost of travelling. The intercity buses charge stage fares with an average rate of about 0.15 baht per kilometer. Due to the limitations imposed on the present research, details of the intercity-bus services have not been studied. However, from discussions with the Land Transport Department at Chieng Mai, brief details of the intercity-bus lines serving near-by amphoes are summarized in Table 5. The number of intercity buses necessary to serve the present route structure was calculated from the following formula, taking the daily running distance as 200 kilometers per bus.

$$\text{No. of intercity buses in service} = \frac{\text{Trips per day} \times \text{Trip distance(km)}}{200}$$

Table 5 Operating Plan for Intercity Buses, Proposed by Land Transport Department

Company	Route Description	No. of Buses	Operating Hours	No. of Trips per day
Yarnyong Nakorn Chieng Mai Co., Ltd.	Chieng Mai-Fang	39	06.00-17.20	44
Phream Pracha Co., Ltd.	Chieng Mai-Phrao	14	06.00-18.30	24
Mae Rim Doen Rot Co., Ltd.	Chieng Mai-Mae Taeng	23	05.10-20.15	114
Mae Rim Doen Rot Co., Ltd.	Chieng Mai-Samoung	4	07.00-18.10	10
Mae Rim Doen Rot Co., Ltd.	Chieng Mai-Mae Rim	9	05.00-19.30	114
Nakorn Phing Co., Ltd.	Chieng Mai-Hod	27	06.00-18.30	52
Nakorn Phing Co., Ltd.	Chieng Mai-Chom Thong	16	05.10-18.10	54
Nakorn Phing Co., Ltd.	Chieng Mai-Tung Seuw	25	05.00-18.30	164
Thai Pattanakit Co., Ltd.	Chieng Mai-Doi Saket	8	05.00-18.30	80
Chieng Mai Rom Luang Co., Ltd.	Chieng Mai-Mae Jo*	30	05.00-18.00	170

* Actually these are not proper buses, but are modified trucks which have 18 to 20 seats

Date: 27th May 1975

Source: Land Transport Department, Chieng Mai

Mini-Bus System Characteristics

Mini-buses, which are dominant mode of public transport in Chiang Mai, are permitted to travel on any roads they wish. However, they mainly operate to and from the city center as defined in Fig. 6. Vehicles used as mini-buses in Chiang Mai are mostly Mazda and Daihatsu pick-ups¹ which have been modified for urban passenger service. The usual modifications include seating and entry/exit arrangements shown in Figs. 10 and 11. The typical mini-bus has a front seat that holds the driver and two passengers. This is the most comfortable and desirable place in the vehicle. In the back, upholstered benches are fitted along each side, their length providing 5 or 6 seating positions. The total capacity of the vehicle is thus 12 to 14 passengers. However, especially for the intercity mini-buses during rush hours, there is a tendency for more passengers to squeeze in. Entry and exit is from the back through a central opening equipped with a step and elaborate, but mostly decorative, handholds. The roof is curved downward on the sides and is fitted with a roof rack for transporting packages when needed. Some intercity mini-buses carry a description of the line being on front of vehicle. Whilst this message is not difficult to read, it usually consists only of the route terminals.

¹ Pick-ups are small trucks.



Fig. 10 MINI-BUS QUEUE IN CHIENG MAI

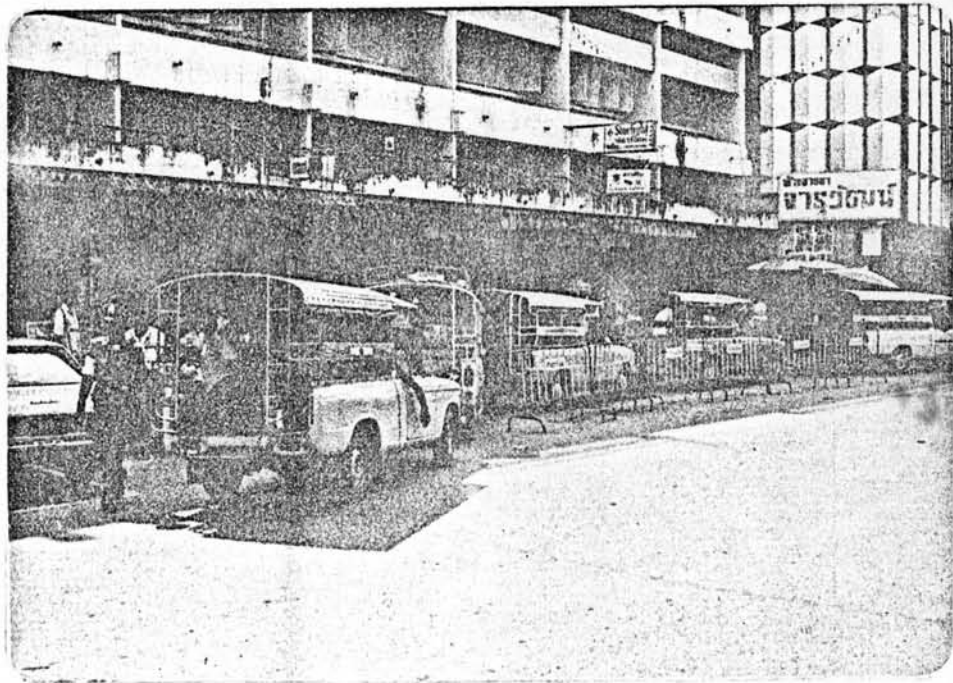


Fig. 11 A LOADING AREA AT WAROROT MARKET IN THE CITY CENTER

In this study, mini-buses were classified into two kinds : one is the intracity mini-bus or free-running mini-bus, and the other is the intercity mini-bus or queue mini-bus. Investigation showed that no statistical data of these mini-buses operations were available. There are no Governmental regulations pertaining to the number of mini-buses in operation, the operating hours, the working days per week, nor the layout of the routes. There is no clear policy of the Government for issuing yellow licence plates (designating a common-carrier vehicle) for these mini-buses. It is the practice to obtain yellow licence plates by registering the vehicle for carrying goods and subsequently modifying them to carry passengers. This practice is, of course, illegal. It appears that the police are not strict with these pirate mini-buses, presumably in the hope that the competition between mini-buses will result in a high level of service for the passengers. Mini-buses in Chiang Mai are important not only for personal transportation, but also for an entire manufacturing and service subsector which employs drivers and a sizable work force to produce and keep the system going.

Intracity Mini-Buses

The intracity mini-bus service is one of the main areas of the present research as this is the dominant mode of public transport in the study area. Subsequently in this report, the

intracity mini-bus is simply called "mini-bus". The number of mini-buses actually operating in the study area is estimated to be 2,200 vehicles in 1975. More than half of these vehicles are pirate mini-buses; that is, they were licenced only for the carriage of goods, or were registered as private vehicles. This opinion was supported by many individuals. It is believed by most mini-bus drivers that mini-buses should use petrol engines of not more than 1000-cc size, as these are more economical of fuel consumption than a larger engine. From enquiry of 32 mini-bus drivers, it was found that most of the drivers own their own vehicles. About 3 percent of drivers rent the vehicle from the owner who receives about 50 baht per day rental charge; any revenue above this cost and the cost of petrol goes to the driver. The hours of service are irregular because they depend on the drivers. However, the service times of mini-bus operation are approximately from 06.00 hrs (some start earlier to load cargo bound for markets) to 20.00 hrs, with reduced and occasional service around the clock. In general, drivers who rent mini-buses drive almost all day long to earn as much money as possible. Vehicle owner-drivers operate independently and may take a long rest during off-peak period of the day. It can be concluded that the operation of this mini-bus service is almost completely unorganized.

In particular, the mini-buses operate with high frequency on a flexible route structure in and around the city center and

in areas which are not served by city buses. These mini-buses operate either as conventional taxis, with the fare negotiated between the passenger and the driver, or as elements of the mini-bus system by cruising in search of passengers. They differ from public city buses by not operating on fixed routes, and usually with shorter headways but without fixed schedules. One of the most important features of mini-buses is their ability to provide a comfortable, frequent, personalized, and essentially door-to-door service.

The mini-bus fare within city is fixed 2 baht per trip. This is the prevailing rate, though a few years ago the fare was only 1 baht. For post high-school students, a loose stage fare arrangement is applied. For example, from Chiang Mai University to destinations in the city to the west of the Ping River, the fare is only 1.50 baht per trip, but 2 baht is charged if students want to cross to the east of the Ping River. For students in uniform, especially those younger than high-school age, the fare is only 1 baht per trip. For trips beyond the environs of the city center, or during night-time hours, the fare (which is higher) must be negotiated with the driver. Mini-bus operating personnel comprise only the driver; there is usually no bus conductor. The general direction of route of any mini-bus is fixed by the first passenger. On any such route, the driver will stop to check on the desired destination of a prospective passenger when

signalled from the sidewalk. If a passenger informs the driver of his desire to be dropped along the route, the driver will pick up that passenger and continue in search of other passengers along the route. The fare is paid when the passengers alight; this is the major cause of unloading delay. The frequent picking up and setting down of passengers also varies significantly throughout the city and tends to disrupt the flow of traffic and thus contributes to delays. The driving habits of Chiang Mai mini-bus drivers are notorious, the way they pick up or drop passengers causes a lot of interference with the traffic stream. A major deficiency of the mini-bus service is the competition amongst them in cruising in search of passengers. This doubtless contributes to noise and air pollution and congestion, and is wasteful of energy. The survey which was conducted in Chiang Mai showed that, on average, mini-bus were about 2.8 passengers per vehicle during peak hours, and 1.3 passengers per vehicle in the off-peak periods. These load factors are low, compared with the capacity of a mini-bus. A possible result is the high cost for travelling by mini-bus, which is twice that of the city buses ; possibly it is the high fare which keeps the load factors so low.

Generally, pick-up points to enable boarding of large numbers of passengers do not exist in Chiang Mai. The principal exception is the pick-up point shown in Fig. 11 which is situated

on Witchayanond Road in the Warorot market area. This point causes much traffic congestion on Witchayanond Road as mini-buses frequently block one lane of this 3-lane, one-way street which has parking permitted on one side. However, better organization of loading operations at an increased number of pick-up points would lead to less effect on other street traffic, but it would also curtail the flexibility of mini-bus operations.

The age of mini-buses in current service ranges from the latest model to vehicles estimated to be 9 years old. The mean age was estimated as four years. This mean age would be somewhat greater if pirate mini-buses were excluded, because these tend to be newer vehicles. The physical condition of mini-buses varies considerably, ranging from excellent to poor. In general, the average condition seems better than worse, in comparison with mini-buses in other provinces in Thailand.

It is difficult to compare mini-bus operating revenues and costs precisely because of the wide variation among them in such key items as working hours, route kilometers of operation, and vehicle age and condition. The available inventory data indicate that mini-bus drivers who are active for the entire day carry an average of 100 to 150 passengers per day, and the probable range of net revenue is from 75 to 100 baht per vehicle per day, after subtracting the cost of fuel. The care and maintenance of the mini-bus is estimated to be between 200 and

600 baht per month depending on the physical condition of the vehicle. In addition, the cost of occasional accidents must be paid from the stated net revenue. It can be tentatively concluded that with the present fare structure, mini-bus revenues are in reasonable excess of operating costs; however, the return for most owner-drivers consists only of a nominal income rather than any substantial profit on their investment in the vehicle and licence.

Intercity Mini-Buses

In addition to the intracity mini-buses which provide transportation in the study area, there are also intercity mini-buses (called queue mini-buses) carrying passengers from city center to the university, and near-by amphoes and provinces in almost complete duplication of intercity-bus routes. At present, some queue mini-buses serve passengers in outlying areas to which intercity-buses do not operate, such as Pa Kluey and Pa Dau (located southward from the city). Apart from the competition with intercity-buses, queue mini-buses compete among themselves as there are queue mini-buses operating along the same routes from many terminals in the city.

The service of these mini-buses is systematized in queues along the curbs of particular streets, near important traffic generators such as markets and theaters, and in alleys. At such

terminals, the queue mini-buses are usually controlled by a person working as a dispatcher. These dispatchers charge the drivers a fee which is customarily the equivalent of one round-trip fare for each mini-bus departure from the terminal. No payment is made to the municipality for the use of the space at the terminal. Most of these mini-buses have a route description sign on the front of the vehicle.

According to the frequency of service, there are two kinds of queue mini-buses. One has a fixed departure headway, usually 10 minutes between departures ; however, if all seats are occupied, the mini-bus will likely leave before the scheduled time. So, the maximum waiting time of passengers on such queue mini-buses is the scheduled headway time. This type of queue mini-bus is usually operated on the main routes, with boarding passengers concentrated at the departure terminal. The other type of service is the queue mini-bus which does not work according to a schedule. The frequency depends on the rate of arrival of passengers ; the mini-bus will leave the terminal only when all the seats are occupied. The average effective headway of these non-scheduled service was not observed.

There are eight queue mini-bus routes which radiate outward from the city center, chiefly serving its close suburbs. In the city center there are five terminals for these routes. On most queue mini-bus routes, the operating hours are from 07.00

to 18.00 hrs. The fare structure is a stage fare which is approximately 2 baht for the first ten kilometers and 1 baht for each additional ten kilometers. Arrangements for the picking up and dropping of passengers, and the collection of fares, is the same as for mini-buses operating in the CBD. Observations showed that the vehicles used as queue mini-buses are of the same types as intracity mini-bus, except for some long distance queue mini-buses which have petrol engines of 1,300 to 1,600-cc size. It was noticed that the queue mini-buses used on short-distance routes, generally have 1,000-cc petrol engines. In the morning, drivers will start from, say, Lamphun taking passengers to Chiang Mai city. After arrival they will place their names in the queue table and wait for the time of departure from the terminal. During this waiting period, which may be for several hours, drivers will cruise in the city carrying passengers wherever they may be found.

The operating costs of the queue mini-bus drivers are nearly the same as those of intracity mini-bus operators. However, from interviews with drivers, it was found that the revenues of queue-mini-buses are somewhat higher than those of intracity mini-buses.

Other Vehicles

Besides the public transport vehicles described in the

previous part, the streets of the study area and the suburbs are extensively used by motorcycles which are a convenient and rapid mode of transport. Motorcycles are especially suited to the road network in Chiang Mai which mostly comprises narrow and tortuous lanes. It can be seen from the vehicle registration data shown in Table 6 that in 1974 about 73 % of the vehicles registered were motorcycles. It is believed that many of these are used for work trips and school trips. Investigation showed that the portion of passenger cars in Chiang Mai was very low compared with Bangkok. However, the trend of passenger car registration has closely paralleled the total vehicle registrations as shown in Fig. 12. Bicycles, which are seen on many of the streets radiating from the city center, are another effective mode of low-cost transport, next in order from motorcycles.

Table 6 shows the numbers of vehicles registered in Changwat Chiang Mai for the past ten years ; the indices are plotted in Fig. 12. The rapid increase in vehicle registration in recent years identifies the important role of transportation in Chiang Mai. From Fig. 12 the rate of growth of vans and trucks (which includes mini-buses) increased sharply from 1968 to 1974. Fig. 12 also shows the fluctuation of bus registration in Changwat Chiang Mai. It is interesting to compare the registration of buses with that of vans and trucks. It is likely that the inadequacy of the city-bus service is directly related

Table 6 Vehicle Registration in Changwat Chiang Mai

Year	Passenger Cars		Motorcycles		Buses		(1) Vans & Trucks		(2) Others		Total	
	Number	Index	Number	Index	Number	Index	Number	Index	Number	Index	Number	Index
1965	1,035	100	5,547	100	659	100	1,035	100	464	100	8,740	100
1966	1,431	138	9,320	168	550	83	1,491	144	521	112	13,313	152
1967	1,485	143	10,505	189	360	55	1,271	123	550	118	14,171	162
1968	2,125	205	14,485	261	231	35	1,671	161	449	97	18,961	217
1969	2,584	250	16,179	292	205	31	2,209	213	399	86	21,576	247
1970	2,651	256	21,849	394	477	72	2,579	249	295	64	27,851	319
1971	3,228	312	23,864	430	394	60	4,139	400	469	101	32,094	367
1972	3,598	348	26,178	472	215	33	4,460	431	682	147	35,133	402
1973	3,950	382	28,157	508	363	55	5,032	486	405	87	37,907	434
1974	4,313	417	30,599	552	502	76	6,059	585	424	91	41,897	479

(1) Including mini-buses.

(2) Others: Motor-tricycle, trailer, tractor, motor grader, motor crane, etc.

Source: Police Department and Department of Highways, Bangkok.

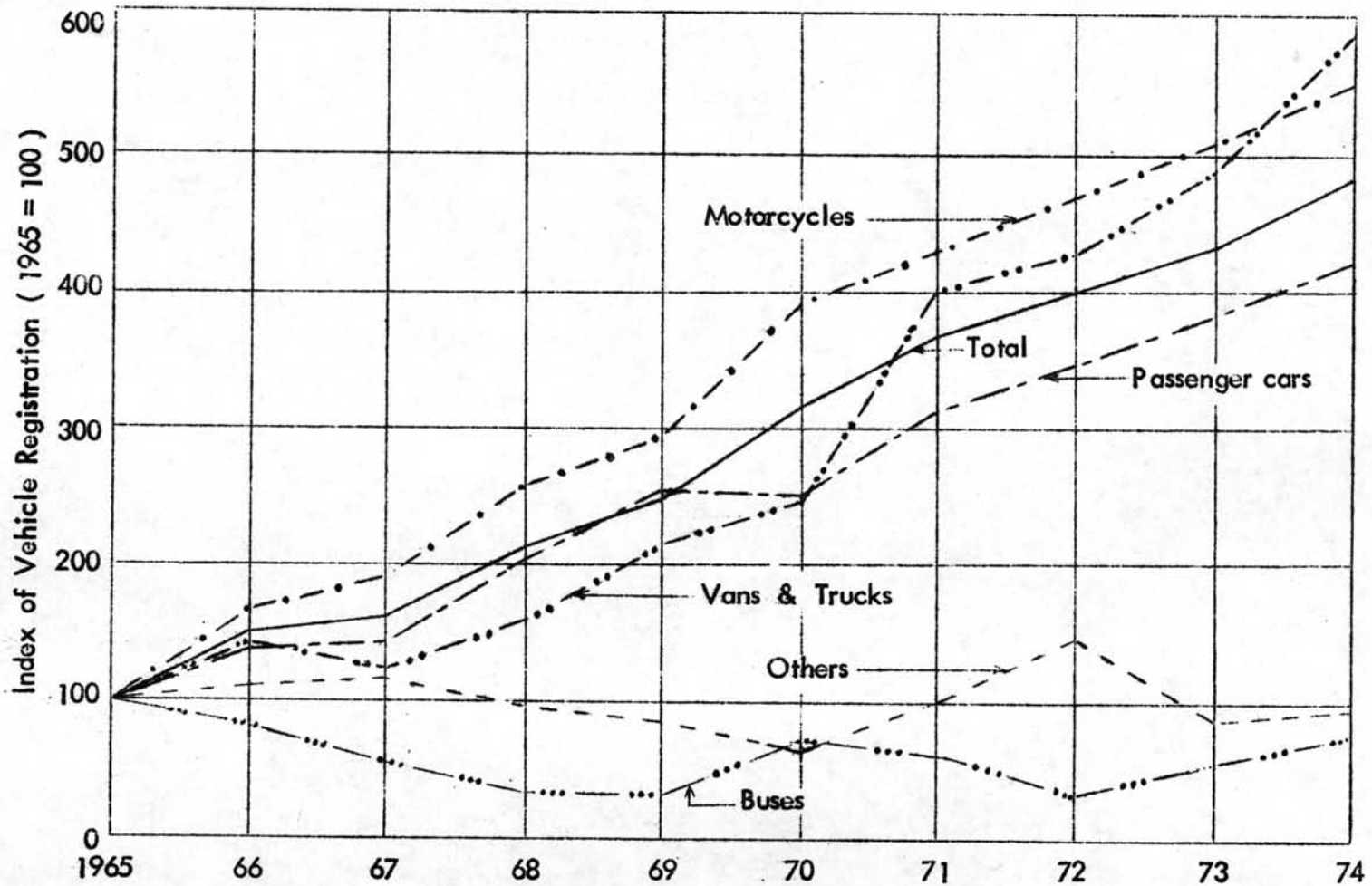


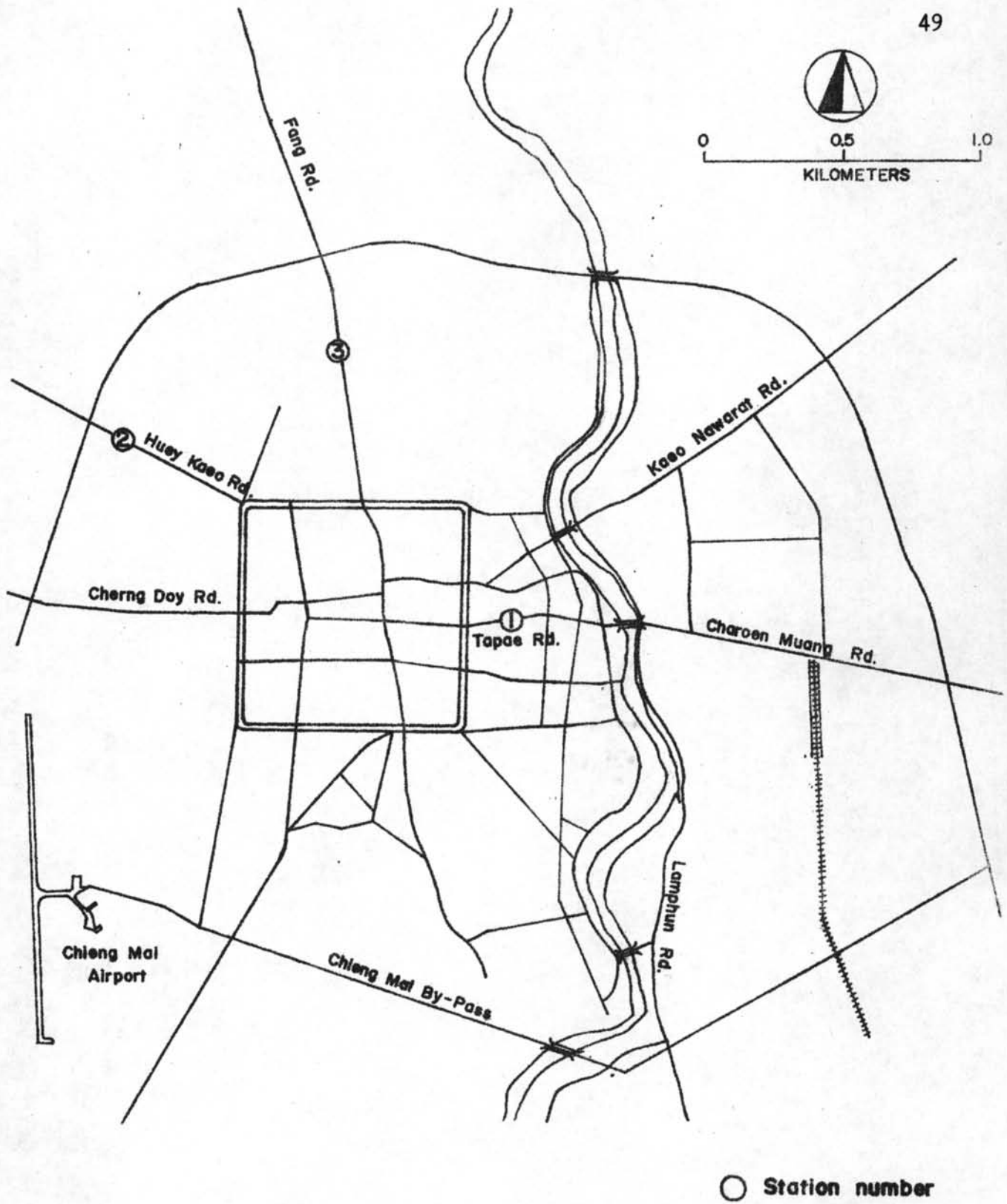
Fig. 12 Vehicle Registration in Changwat Chiang Mai

to the small number of buses registered in the Changwat. This is likely the reason why mini-bus service came to be the dominant mode of public transport in Chiang Mai.

Traffic Composition

This section deals with the composition of traffic in the city center and some important surrounding streets. The results roughly show the present basic traffic movements. Investigation showed that no statistics of traffic volume were available. In order to determine the percentage of motorized vehicles on streets in the study area, a directional manual count was conducted on two weekdays, the 8th and 9th December 1975, at sites along three main roads. One station was in the city center, and the other two were on the periphery of the city center as shown in Fig. 13. The form used for these mid-block counts is shown in Appendix A, Table Ap/A1. The classified counts were made for the following classes of vehicles :

- Motorcycles - including scooters
- Mini-buses - small passenger or goods-carrying vehicles (black or yellow licence plate) whether intracity or intercity mini-buses.
- Light Vehicles - all passenger cars having four wheels, excluding mini-buses.
- Buses - municipal, city, and intercity-buses.



○ Station number

Fig. 13 Traffic Count Stations

Trucks - light and heavy trucks.

Motor tricycles¹ - three-wheeled motor vehicle

The appropriate times for making the volume counts were obtained from review of the running speeds of city buses along each section. The traffic volume records from Station Nos. 1, 2 (EB and WB), and 3 (SB and NB) are shown in Tables 7, 8, 9, 10, and 11, respectively. From these traffic volume records and Figs. 14, 15 and 16 it may be seen that the traffic composition varied from the A.M. peak to the off-peak, and thence to the P.M. peak. In analysing the data, the motor tricycles were omitted as their number is very low, and the vehicle registration data also showed that the number of these vehicles has been generally decreasing. Motor tricycles represented only about 1 % of the vehicles registered in the Changwat in 1974.

The data from Station No.1 showed that the percentage composition of traffic in the city center was nearly the same all day. The portion of motorcycles in the city (43 percent) was dominant and somewhat higher than mini-buses which comprised about 39 percent of the city-center traffic on Tapae Road. It

¹ Similar to Samlors used in Bangkok, but with the passenger benches in the back running along each side ; smaller but similar to mini-buses.

can be seen that the portion of light vehicles (mostly passenger cars) was only 17 percent. Thus, passenger cars comprise fewer than half the number of mini-buses passing this station. The total hourly volume gradually decreased from morning to evening on Tapae Road, a west-bound one-way street.

The data from Station No.2 showed that the portion of motorcycles on Huey Kaeo Road, a two-way arterial street, was high. It is notable that the percentages of mini-buses and light vehicles were nearly equal and remained the same all day. The total hourly volumes also showed that in the morning, west-bound trips were dominant, whilst in the evening the dominant number of trips was east-bound.

Station No.3 data showed that during the peak periods the percentage of mini-buses was slightly higher than that of motorcycles in the two directions. In the off-peak period the reverse was true. The number of light vehicles on Fang Road was lower than that on Huey Kaeo Road. The total hourly volume showed that generally trips on the Fang Road were made into the city (south-bound) in the morning and out from the city in the evening. However, a substantial number of trips were made outbound in the morning as there is some industry and government offices near or beyond the super highway.

The traffic volume data have shown that the traffic volume

was very high in the city center. The volume on Fang Road was higher than on Huey Kaeo Road, which can be attributed to the high density of the residential and commercial areas along Fang Road.

Table 7 Traffic Volume Record

Manual Count Station No. 1

Location: Tapae Road

Direction; WB

8th December 1975

Time, hrs		Type	Motorcycles	Mini-buses	Light Vehicles	Buses	Trucks	Motor tricycles	Total *
AM Peak	07.45-08.00		253	196	72	2	1	3	524
	08.00-08.15		229	173	87	8	3	4	500
	08.15-08.30		202	205	81	6	3	4	497
	08.30-08.45		196	196	103	5	3	4	503
	Total		880	770	343	21	10	15	2,024
	%		43.5	38.1	16.9	1.0	0.5	-	100.0
Off-Peak	11.45-12.00		210	184	82	6	3	4	485
	12.00-12.15		192	192	91	5	4	7	484
	12.15-12.30		206	196	74	5	0	9	481
	12.30-12.45		199	176	75	6	3	7	459
	Total		807	748	322	22	10	27	1,909
	%		42.3	39.2	16.9	1.1	0.5	-	100.0
PM Peak	15.15-15.30		157	160	74	8	3	4	402
	15.30-15.45		186	176	71	3	3	4	434
	15.45-16.00		193	164	71	5	2	6	435
	16.00-16.15		210	182	82	6	3	7	483
	Total		746	677	298	22	11	21	1,754
	%		42.5	38.6	17.0	1.3	0.6	-	100.0

* Excluding motor tricycles

Source: Field survey

Table 8 Traffic Volume Record
 Manual Count Station No. 2
 Location: Huey Kaeo Road
 8th December 1975

Direction: EB

Time, hrs		Type						Total *
		Motorcycles	Mini-Buses	Light Vehicles	Buses	Trucks	Motor tricycles	
A.M.-Peak	09.00-09.15	47	39	29	2	4	0	121
	09.15-09.30	35	31	28	1	7	1	102
	09.30-09.45	60	50	47	5	4	0	166
	09.45-10.00	39	20	20	0	4	0	84
	Total	181	141	124	8	19	1	473
	%	38.3	29.8	26.2	1.7	4.0	-	100.0
Off-Peak	13.00-13.15	54	47	25	2	2	0	130
	13.15-13.30	57	32	28	1	5	1	123
	13.30-13.45	62	29	33	3	3	0	130
	13.45-14.00	53	28	26	1	2	0	110
	Total	226	136	112	7	12	1	493
	%	45.9	27.6	22.7	1.4	2.4	-	100.0
P.M.-Peak	16.30-16.45	108	36	49	2	2	0	197
	16.45-17.00	92	42	40	2	1	0	177
	17.00-17.15	96	33	31	2	7	0	169
	17.15-17.30	62	47	41	3	3	0	156
	Total	358	158	161	9	13	0	699
	%	51.2	22.6	23.0	1.3	1.9	-	100.0

* Excluding motor tricycles

Source: Field survey

Table 9 Traffic volume Record
 Manual Count Station No. 2
 Location: Huey Kaeo Road Direction: WB
 8th December 1975

Time, hrs \ Type		Motorcycles	Mini-Buses	Light Vehicles	Buses	Trucks	Motor tricycles	Total *
AM Peak	09.00-09.15	51	56	42	3	7	0	159
	09.15-09.30	56	25	33	1	3	1	118
	09.30-09.45	59	50	48	2	9	1	168
	09.45-10.00	43	35	16	1	3	0	98
	Total	209	166	139	7	22	2	543
	%	38.5	30.6	25.6	1.3	4.0	-	100.0
Off-Peak	13.00-13.15	78	34	23	1	3	0	139
	13.15-13.30	74	20	29	1	4	0	128
	13.30-13.45	54	28	36	3	1	0	122
	13.45-14.00	51	35	41	2	0	0	129
	Total	257	117	129	7	8	0	518
	%	49.6	22.6	24.9	1.4	1.5	-	100.0
PM Peak	16.30-16.45	45	35	32	2	5	0	119
	16.45-17.00	66	30	37	1	2	0	136
	17.00-17.15	64	24	36	1	1	0	126
	17.15-17.30	68	31	34	3	5	0	141
	Total	243	120	139	7	13	0	522
	%	46.6	23.0	26.6	1.3	2.5	-	100.0

* Excluding motor tricycles

Source: Field survey

Table 10 Traffic Volume Record

Manual Count Station No. 3

Location: Fang Road Direction: SB

9th December 1975

Time, hrs \ Type		Motorcycles	Mini-Buses	Light Vehicles	Buses	Trucks	Motor tricycles	Total *
AM Peak	07.45-08.00	100	93	26	3	6	2	228
	08.00-08.15	87	75	19	3	4	0	188
	08.15-08.30	76	67	24	3	10	2	180
	08.30-08.45	58	87	19	3	3	1	170
	Total	321	322	88	12	23	5	766
	%	41.9	42.0	11.5	1.6	3.0	-	100.0
Off-Peak	12.00-12.15	71	66	24	2	3	2	166
	12.15-12.30	75	60	17	2	2	0	156
	12.30-12.45	49	54	28	3	3	2	137
	12.45-13.00	57	42	17	2	6	3	124
	Total	252	222	86	9	14	7	583
	%	43.2	38.1	14.8	1.5	2.4	-	100.0
PM Peak	15.30-15.45	78	84	25	3	2	1	192
	15.45-16.00	59	65	16	4	1	0	145
	16.00-16.15	62	79	32	4	5	2	145
	16.15-16.30	45	71	29	2	4	2	151
	Total	244	299	102	13	12	5	670
	%	36.4	44.6	15.2	2.0	1.8	-	100.0

* Excluding motor tricycles

Source: Field survey

Table 11 Traffic Volume Record

Manual Count Station No. 3

Location: Fang Road

Direction: NB

9th December 1975

Time, hrs \ Type		Motorcycles	Mini-Buses	Light Vehicles	Buses	Trucks	Motor tricycles	Total *
AM Peak	07.45-08.00	61	62	21	1	8	2	153
	08.00-08.15	43	61	15	7	5	2	131
	08.15-08.30	55	66	30	3	2	2	156
	08.30-08.45	53	72	28	4	10	2	167
	Total	212	261	94	15	25	8	607
	%	34.9	43.0	15.5	2.5	4.1	-	100.0
Off-Peak	12.00-12.15	67	60	38	3	1	1	169
	12.15-12.30	68	70	29	4	3	2	174
	12.30-12.45	52	49	18	3	6	3	128
	12.45-13.00	52	54	29	2	6	1	143
	Total	239	233	114	12	16	7	614
	%	38.9	37.9	18.6	2.0	2.6	-	100.0
PM Peak	15.30-15.45	81	82	28	2	4	1	197
	15.45-16.00	74	67	13	2	3	0	159
	16.00-16.15	77	91	25	3	3	2	199
	16.15-16.30	72	86	21	2	4	0	185
	Total	304	326	87	9	14	3	740
	%	41.1	44.1	11.7	1.2	1.9	-	100.0

* Excluding motor tricycles

Source: Field survey

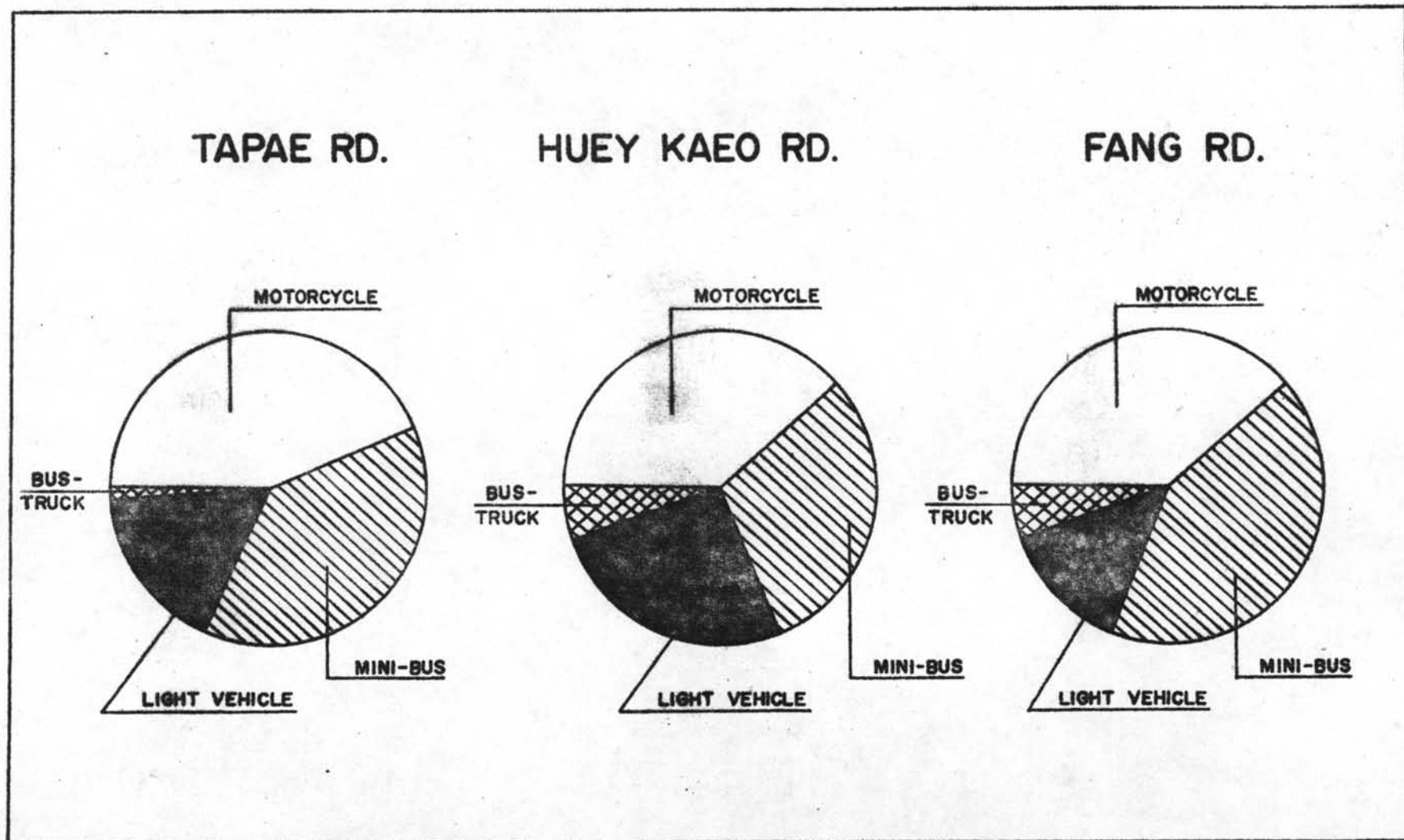


Fig. 14 Comparison of Traffic Composition in and around the City Center during A.M. Peak

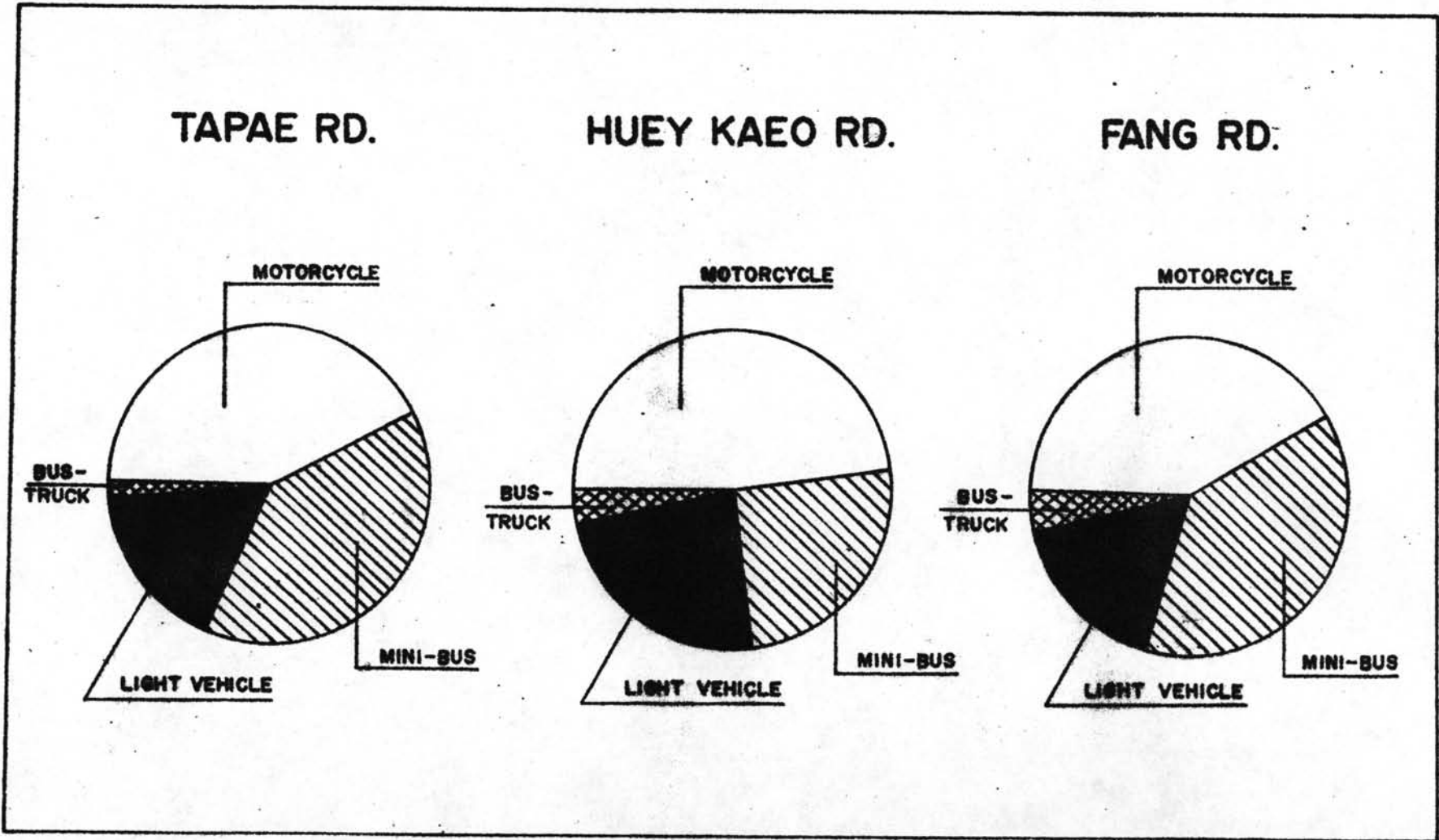


Fig. 15 Comparison of Traffic Composition In and around the City Center during Off-Peak

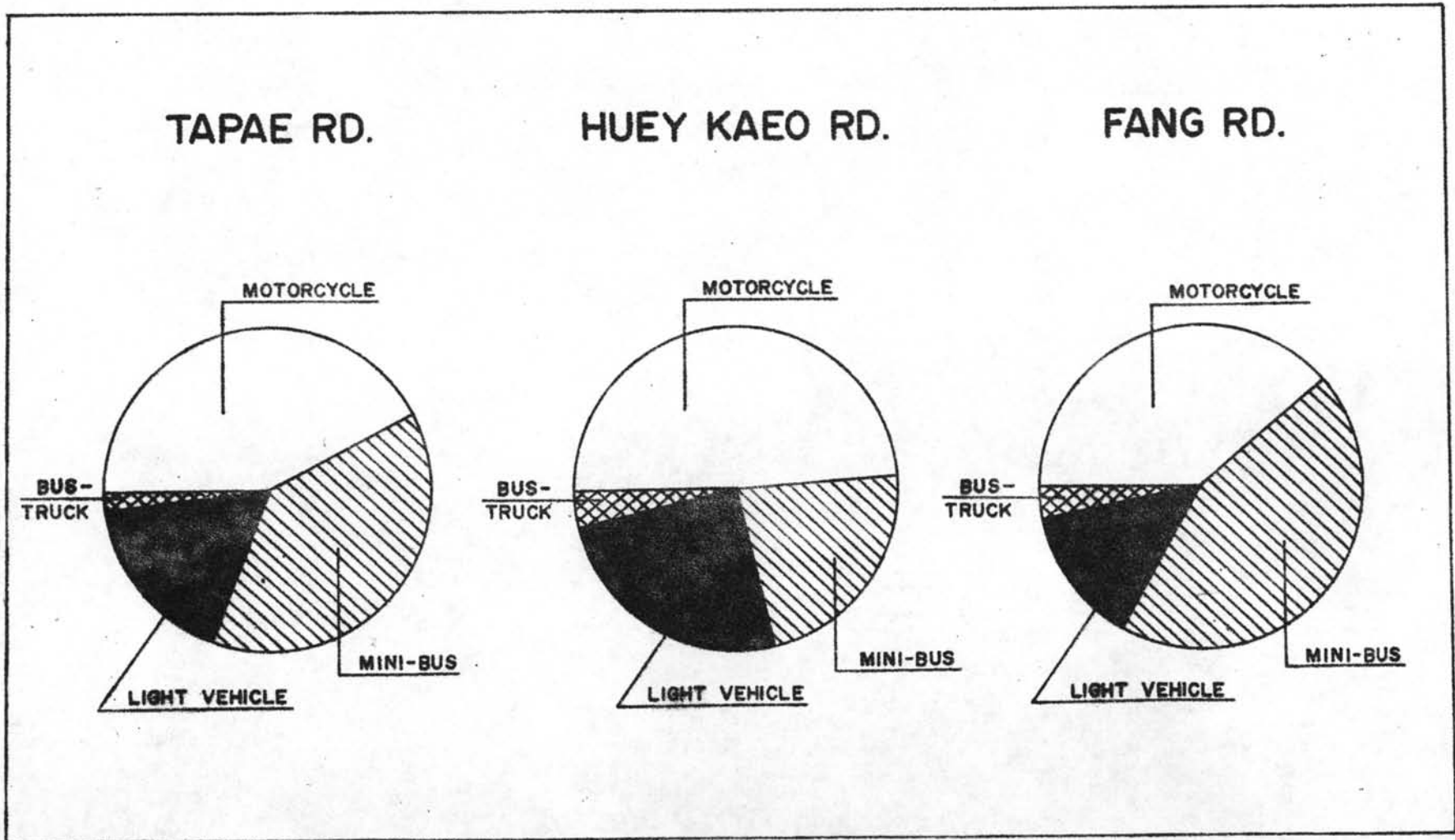


Fig.16 Comparison of Traffic Composition in and around the City Center during P.M. Peak