(b) Inter-City Bus System

As it is mentioned previously inter-city bus routes serve to almost the whole area of Sumatra Island.

(c) Bemo System

The Bemo system including Daihatsu have 23 different routes so far and it will be expanded into 46 routes, effective on and after October 25th 1979, in Medan City. Fig. 3.2.9 shows those Bemo's routes which are located with an average lateral interval between adjacent routes 800 m in maximum and 250 m in minimum. If the expansion of those 46 Bemo routes is realized, passengers will be able to receive the transport services more convenient than before. The destination of those routes are shown in the following table.

Table 3-2-17 Origins and Destinations of Revised Bemo Routes (Effective on and after October 25, 1979)

Origin	Destination
Pasar Sambu	1. Sei Sikambing
	2. Jl. Mongonsidi
	3. Jl. STM Ujung
	4. Simp. Marindal
	5. Jl. S.M. Raja
	6. Jl. MA. Selatan
	7. Jl. Sutrisno
	8. Jl. Prof. Yamin SH
	9. Pasar II Jl. Rakyat
	10. P. Brayan Darat
	11. Belawan
	12. P. Brayan
	13. Jl. Karya Ujung
	14. Sei Agul
Pasar Petisah	1. Perumnas Helvetia
	2. Proy. A. Minum Sunggal
Belawan	1. P. Sicanang
	2. Gabion
Pasar Mercu Buana	1. Sampali
	2. Jl. Negara
	3. Jl. Pelajar Ujung
	4. Polonia Ujung
	5. Jl. Mansur
Total:	46 destinations

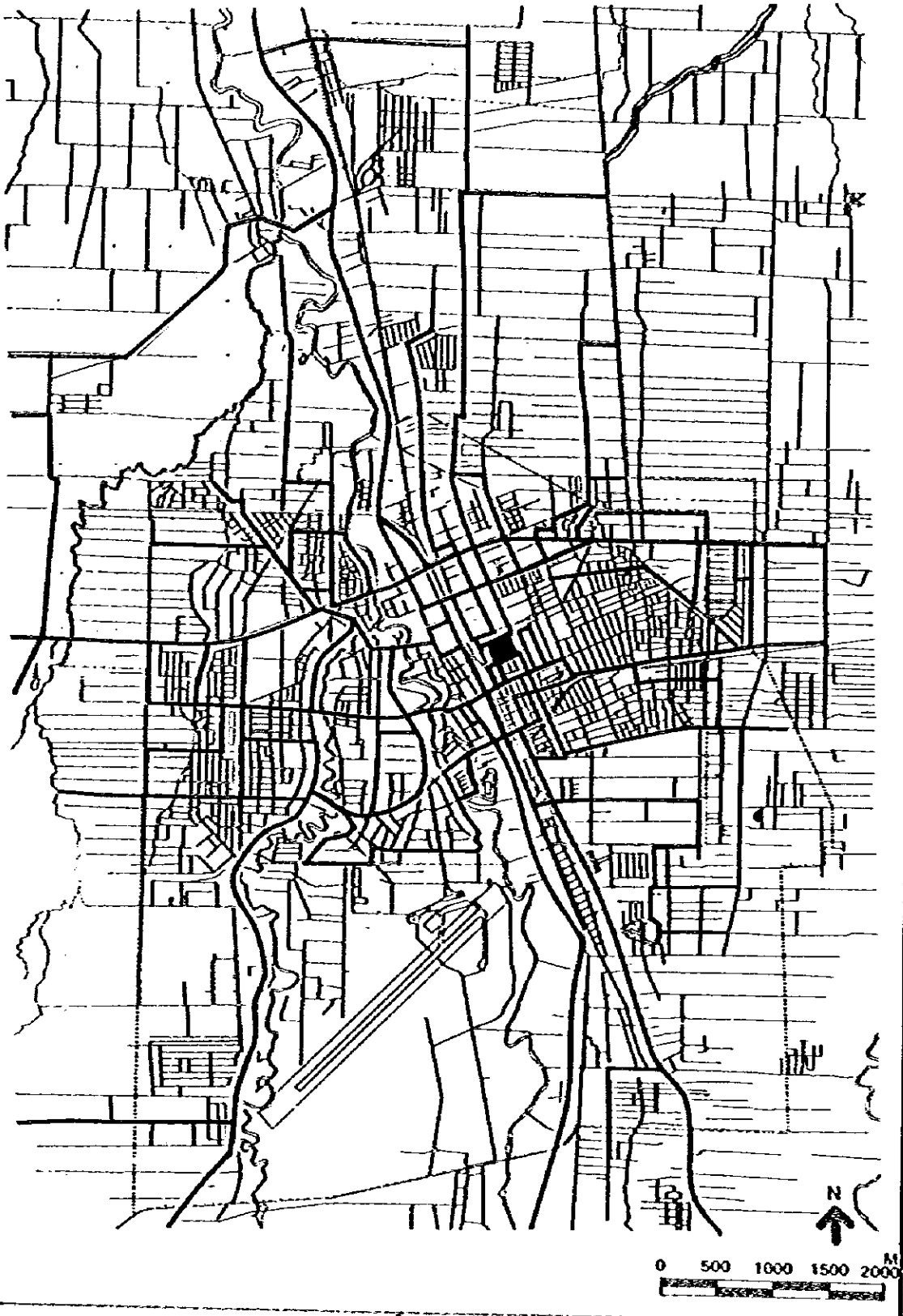


Fig. 3.2.9
Present Bemo Route Map, Medan City
(Effective on and after Oct. 25, 1979)

Medan Area Transportation Study

Legend

Bemo Route

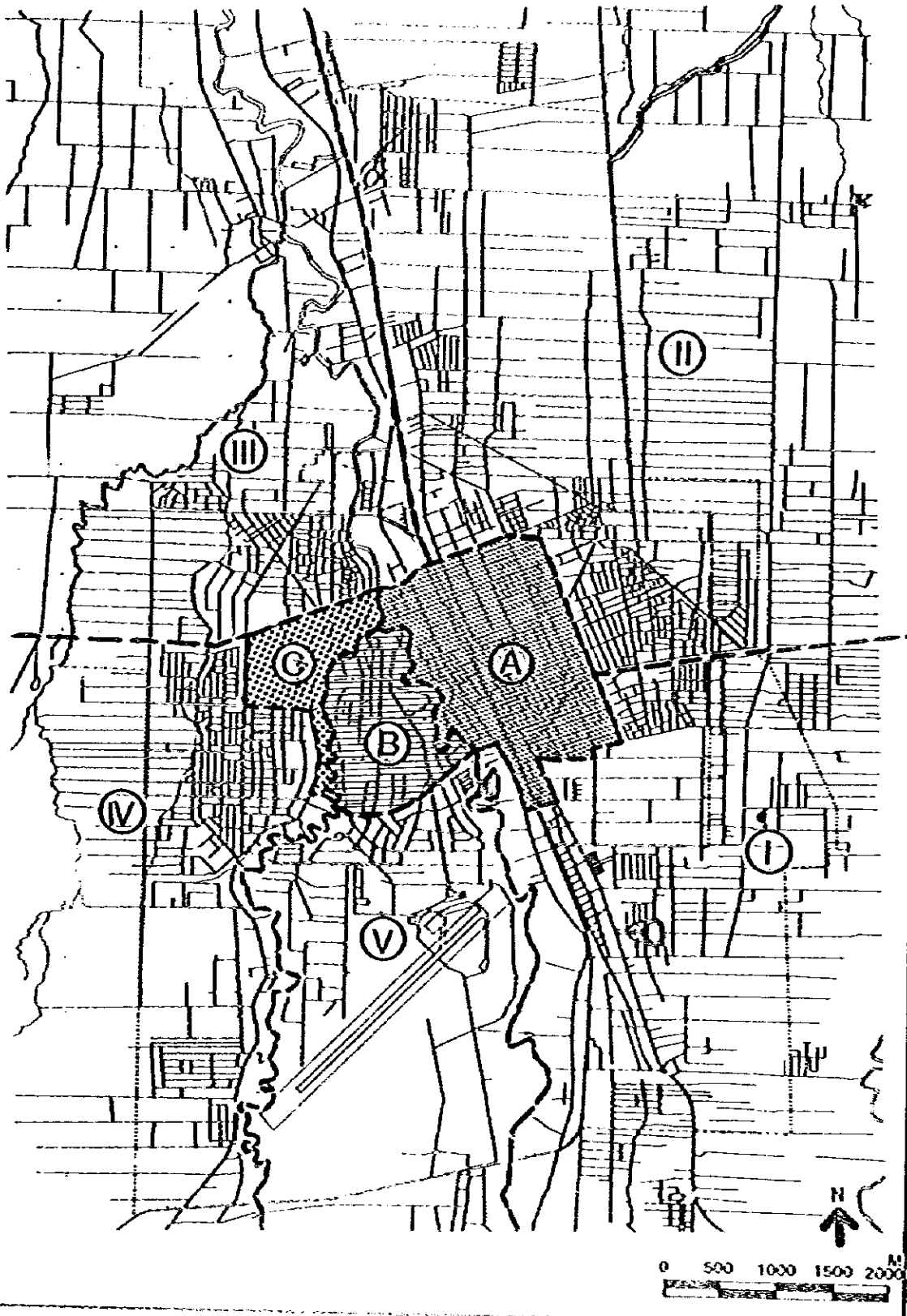


Fig. 3.2.10
Authorized Becak Day Time Operating Zones, Medan City (1979)

Medan Area Transportation Study

Legend

- Becak Operating Zone Boundary
- A B C — Becak Machine Zones
- I - V — Becak Zones

(d) Becak

There are routes of Becak existing in Medan but two zones where it can be put to service has been determined. Becak Mesin has been granted the permission to operate in the central those zones. The Becak is limited to operate in zones around the central districts. However, such a zone regulation ends at 5:00 PM every evening, then Becak is allowed to enter the central three zones. The control on the Becak operation during the daytime is to eliminate traffic congestion in the central zones that can be caused by Becak, and allows Becak Mesin to operate only in the central three zones. (Refer to Fig. 3.2.10)

(5) Bus Stops

Only the bus routes of P.N. DAMRI have their own bus stop facilities, and any bus stop facility cannot be seen on routes of other bus companies. This is due to the fact that passengers have the custom to request drivers to stop buses anywhere they want.

Some statistics show the different number of bus stops, and authorization of bus stops seems to be not so strict so far. Table 3-2-18 shows the present number of existing authorized bus stops of P.N. DAMRI bus routes.

Table 3-2-18 Number of Authorized Bus Stops (P.N. DAMRI)

Route	Open Bus Stop	Sheltered Bus Stop	Total
Kp. Lalang	44	12	56
Belawan	*	*	*
Tg. Morawa	12	6	18

Source: P.N. DAMRI
Note: * marked are unknown

(6) Bus Passenger Traffic

(a) City Bus Passenger Traffic

i) Passenger Movement

According to results of the Bus O-D Survey carried out by the study team in 1979, the total number of city bus passengers in Medan is estimated to be approximately 150,000 per day. Table 3-2-19, Fig. 3-2-11 is a compilation of the results of the survey of the bus passengers.

Looking at the main movement of bus passengers, the following are the approximate figures in each main route:

Direction	Bus Passengers (Approx.)
Medan - Belawan	38,000 persons/day
Medan - Tg. Morawa	28,000 ditto
Medan - Sungal, Kp. Lalan	30,000 ditto

Table 3-2-19 City-Bus Passengers by Route (1979)

Route		No. of Passenger person/day
1.	Medan - Belawan	37,800
2.	Medan - Kp. Lalan	19,000
3.	Medan - Tg. Morawa	19,700
4.	Medan - Sim. Tutungan	10,500
5.	Medan - Tembung	16,000
6.	Medan - Deli tua	8,600
7.	Medan - Cemara	11,000
8.	Medan - N. Navi Hrhp.	7,900
9.	Medan - Tenun	6,500
10.	Medan - Jl. Asrama	9,200
11.	Medan - Tg. Selamat	4,600
	Total	150,800

Source: Results of O-D Survey by the JICA Study Team in October 1979.

ii) Purposes of Trip

Table 3-2-20 Purpose Composition of Trips of City-Bus Passengers (1979)

Purpose	Commuting	Shopping	Return Home	Others	Total
Composition	25.4%	7.3%	49.1%	18.2%	100%

Source: Results of O-D Survey by the JICA Study Team

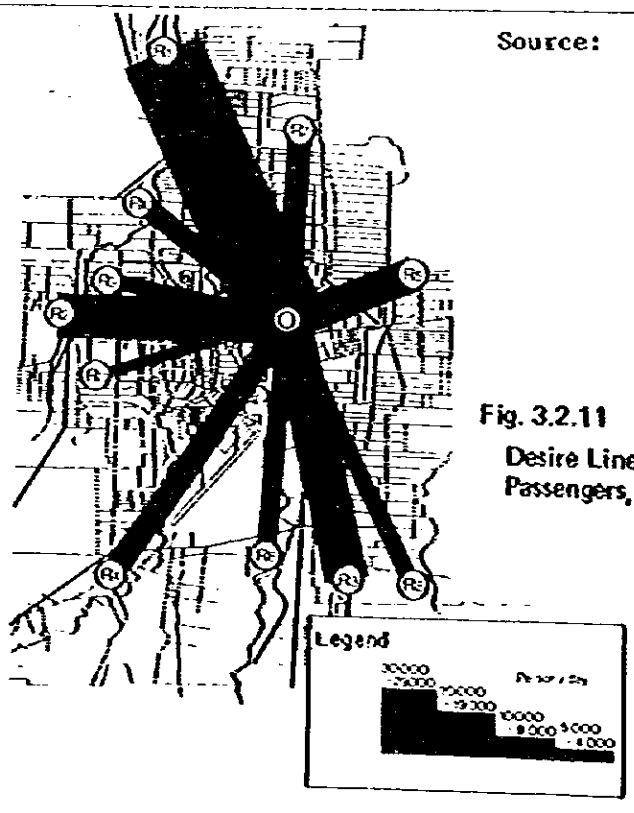


Fig. 3.2.11
Desire Lines of City Bus Passengers, Medan City (1979)

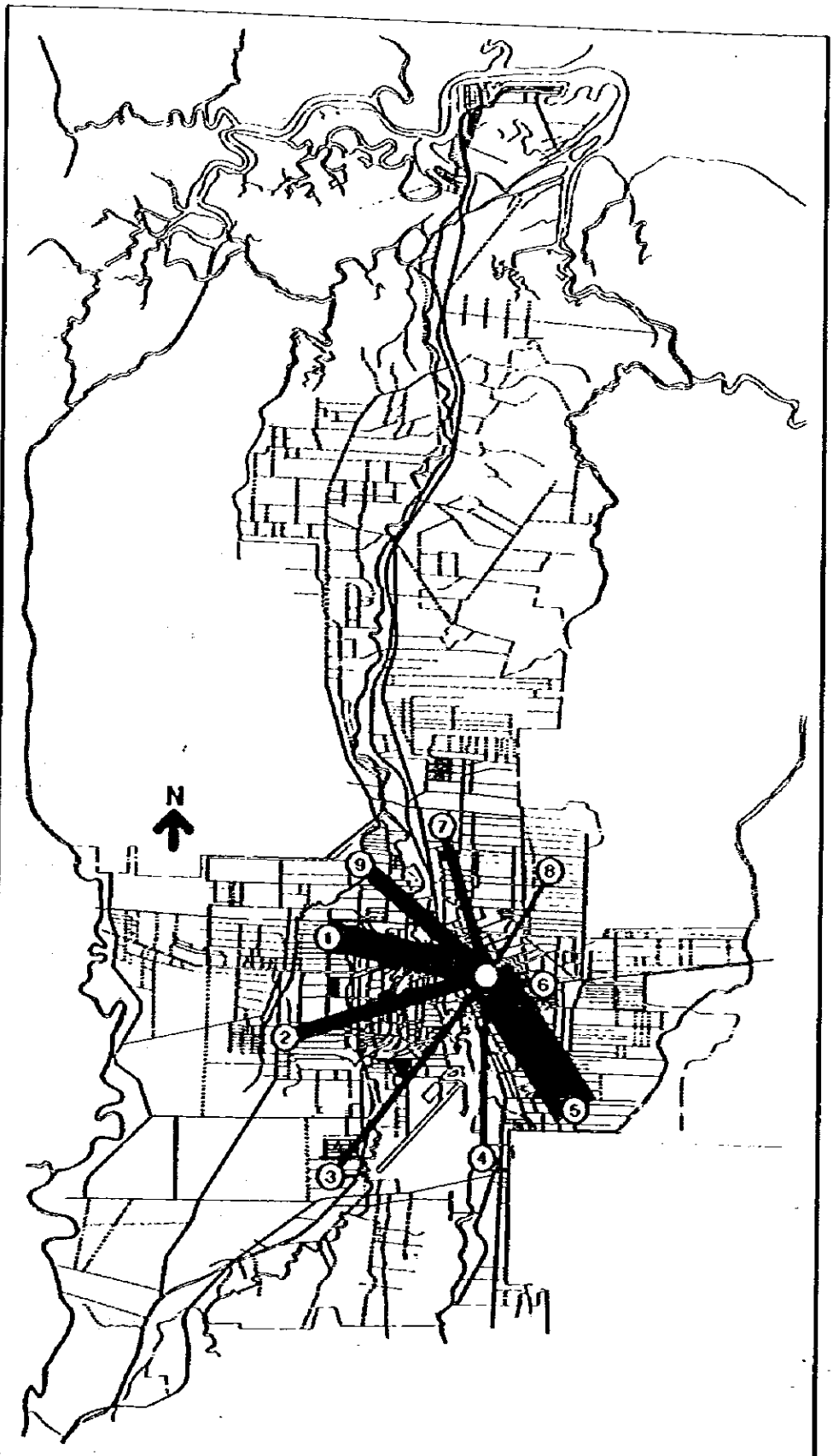


Fig. 3.2.12
Desire Lines of Bemo and Daihatsu Passengers

Legend

Medan Area Transportation Study

(b) Bemo and Daihatsu Passenger Traffic

According to the results of the O-D survey of the Bemo and Daihatsu passengers conducted at the Sambu Bus Terminal, the total number of Bemo and Daihatsu passengers in the city of Medan is estimated to be approximately 173,000 per day in 1979.

The pattern of passenger flows is seen in Fig. 3.2.12. The traffic in the direction of southeast is as high as 32% of the total and the next prominent traffic flow is in the direction of Kp. Lalang.

One of the reasons for the high number of passengers going to the southeastern direction of Kp. Kotamatsum, Kp. Tegal Sari, Kp. Teladan and Kp. Sitirejo is due to the fact that there is no city bus route to these areas and the people have to make use of the public transportation provided by the Bemo and Daihatsu systems. This is because the roads in those areas are too narrow for the bus operation.

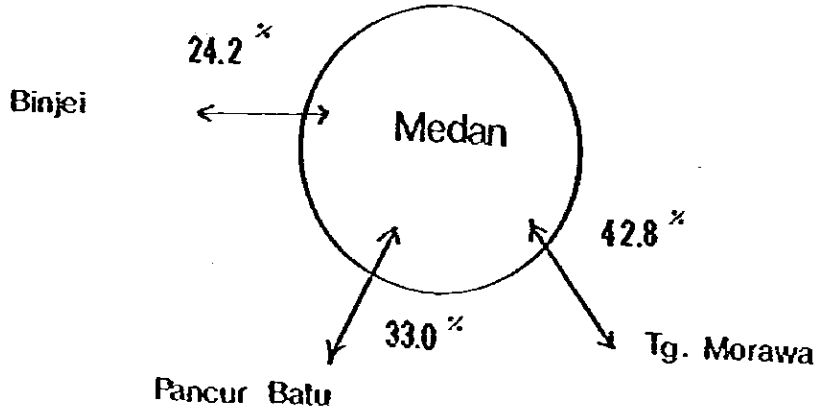
The purposes of trip given by Bemo and Daihatsu passengers are more or less the same as the purposes given by the city bus passengers.

(c) Inter-city Bus Passenger Traffic

The results of the interview survey conducted at four weight bridges within Medan city show that the total inter-city bus passenger traffic per day is estimated to be approximately 23,000.

Fig. 3-2-13 shows the ratio of Bus passenger traffic by direction.

Fig. 3.2.13 The ratio of Inter-City Bus Passenger Traffic by Direction (1979)



Note: Traffic between Medan and Belawan is regarded as intra-city traffic.

The trip purposes of the inter-city bus passengers are classified as follows based on the O-D survey results conducted by the JICA Study Team.

Commuting	12.3%
Shopping	13.1
Return Home	43.4
Others	31.3
Total	100.0

(7) Others

(a) Standard Authorized Bus Fares

Type	Fare
City Bus	Rp. 30 per side
Inter-city Bus	Rp. 3.5/km

Source: P.N. DAMRI

(b) Operating Factor *

While each bus company shows slightly different figures, but average operating factor is considered to be around 80%.

Note: Operating factor means the ratio of actual number of bus in operation/that of buses possessed.

The average annual number of working days are around 300 and the depreciation period of the buses is calculated as 5 years.

(c) Bus Crew Working System

According to the practice of P.N. DAMRI, as an example, the usual bus operating time is from 5 a.m. to 10 p.m. and buses are operated by crew in two shifts.

3.2.3 Marine Port and Airport

(1) Marine Port

(a) Port Facilities

In North Sumatra four commercial ports exist at present at Belawan, Sibolga, Gunung Sitoli and Tg. Balai, and Kuala Tanjung which is under construction in Asahan Project. However, as far as this study is concerned, only Belawan Port is of significance.

Table 3.2.21 shows the present condition of berths at Belawan, 9 berths for Ocean-going vessels, 6 berths for inter-island vessels.

The berths for ocean-going vessels have 10 m water front depth with an average ship length of 150 m and those berths for inter-island vessels have 7 m depth with an average length of 50 m although it is said that the depth of water has been maintained as far as it is practicable or subject to variation and is not guaranteed according to bulletin of Port of Belawan. On the other hand, it is noteworthy that Pertamina Jetty is located in the south part of the port. At the west part of the port mooring bouys and small local facilities can be seen.

Concerning port equipment, detailed number by item is tabulated in Table 3.2.22.

Table 3.2.21 Accommodations of Port of Belawan (October 1979)

Name of Dock or Quay	Berth No.	Nominal Depth below Chart Datum	Length of Quay
		meter	meter
Ocean-going Ujung Baru	104 105 106 107 108 109 110 112 113	10	2,187
CITRA Ujung Baru	201 202 203	7	
Unit Terminal	101 102 103		
Pelabuhan Lama	022 005 003 006 004 007	6	138
Oil Jetty	Pertamina	10	60
Mooring Buoys	Pelabuhan Lama	8.5	

Source: Belawan Port Authority

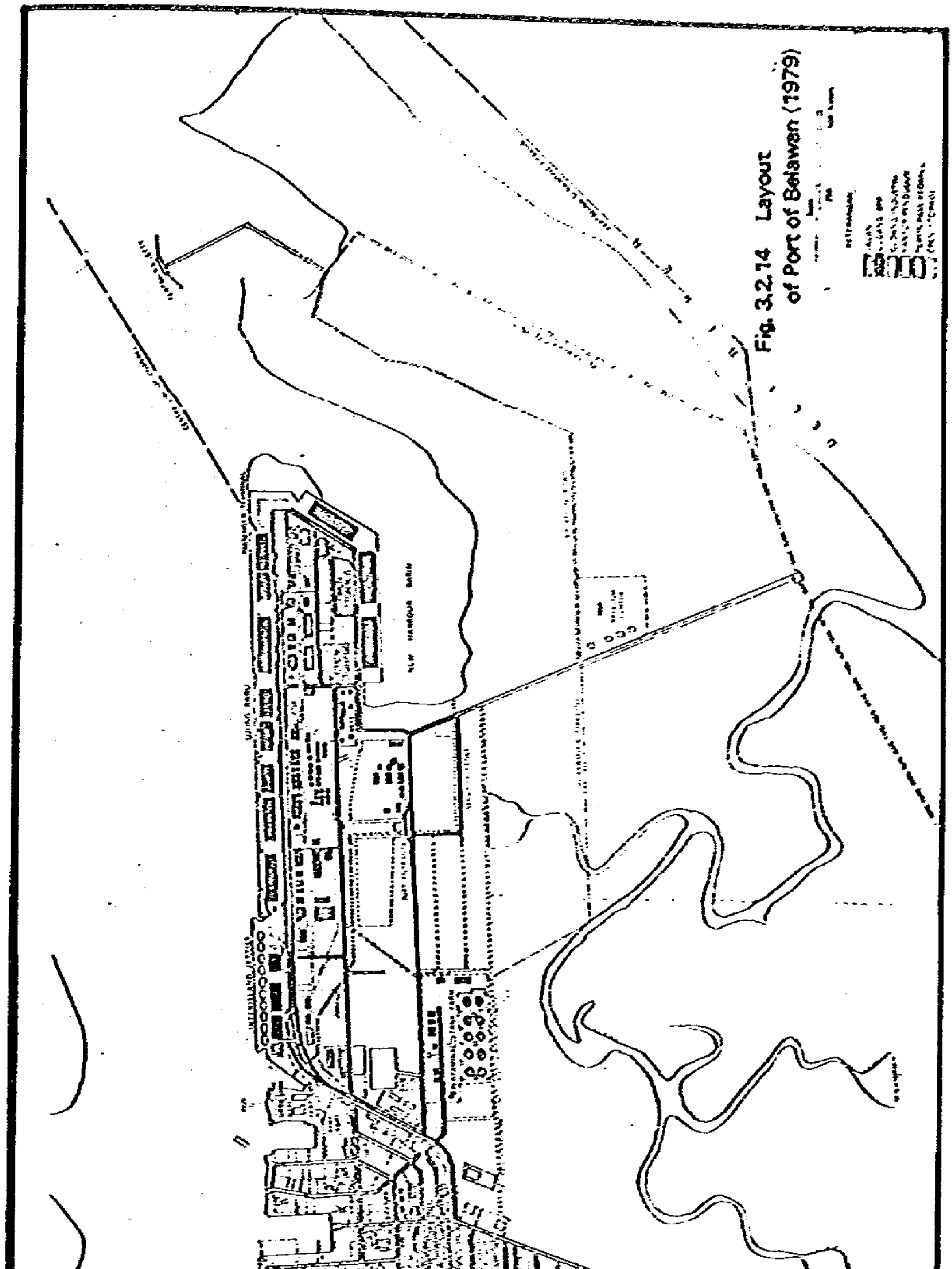


Fig. 3.2.14 Layout of Port of Belawan (1979)

Table 3.2.22 Equipment of Port of Belawan (October 1979)

Item of Equipment	Number & Type	Capacity
Mobile Cranes	2 Tadanos	15 Tons
	3 Drotts	25 Tons
Floating Cranes	1 Dosomuko	40 Tons
Other Cranes	5 (Five)	3-5 Tons
Cargo Trucks	128	2.5-5 Tons
Container Handling Equipment	10 Truckhead	10-20-40
	20 Trailers	Footers
Tug-boats	2 (Two)	800 Hp
	1 (One)	1,200 Hp
Fuel Barge Water Barge	1 (One)	200 Tons
Pilot Boats	2 (Two)	275 Hp
	2 (Two)	230 Hp
	1 (One)	83 Hp
Dredging Vessels	1 Hopper Suction Dredger	34,100 m^3/day
	1 Grab Dredger	1,500 m^3/day
	1 Cutter Dredger	4,000 m^3/day
		Capacity
Mooring Boats	1 MK 10	90 Hp
	1 MK 09	90 Hp
Barges and Lighterage	6 (Six)	200 Tons

Source: Belawan Port Authority

(b) Loading/Unloading Tonnage of Freight

Although a large quantity of crude petroleum is exported from various ports in Sumatra, but only three ports are significant as commercial ports; namely, they are Belawan, Palembang on the east coast and Padang on the south-west coast. However, four ports including small local ones exist in North Sumatra, but they are not so significant except Belawan from the view point of Medan transportation study. Table 3.2.23 shows the loading and unloading tonnage of freight in the period of 1975-1977.

Table 3.2.23 Loading/Unloading, Annual Tonnage of Freight at Ports in North Sumatra (1975~1977)

(Unit: 1,000 tons)

Name of Port	1975	1976	1977
Belawan	2,926	3,101	3,377
Tg. Balai	55	63	94
Gunung Sitoli	25	29	34
Sibolga	164	266	391

Source: Belawan Port Authority

The loading and unloading tonnage of freight for the period of 1967-1978 are tabulated in Table 3.2.24. According to this statistics the total tonnage of loading and unloading freight has expanded around three times during the period 1967 to 1978.

The tonnage of loading and unloading by commodity are shown in Table 3.2.25.

As far as number of ships visiting Belawan is concerned little fluctuation can be observed after 1972 and the total number of ships has been rather decreasing.

Table 3.2.24 Yearly Freight Movements through Port of Belawan (1967 ∿ 1978)

(Unit: ton×10³)

	Int'l Freight		Domestic Freight		
Year	Export	Import	Arriving	Outgoing	Total
1967	459	265	520	23	1,267
1968	537	356	589	36	1,518
1969	521	410	605	25	1,561
1970	524	317	610	28	1,479
1971	609	599	666	65	1,939
1972	698	652	628	100	2,078
1973	749	833	766	136	2,484
1974	760	938	837	172	2,707
1975	901	872	955	198	2,926
1976	954	884	1,029	234	3,101
1977	966	957	1,203	251	3,377
1978	985	910	1,673	343	3,910

Source: Belawan Port Authority

Judging from these tendencies the average size of vessels entering the port has become larger year by year although this is a general trend in other countries too.

Table 3.2.26, Table 3.2.27 show the loading and unloading tonnage of import and export by country, and Singapore and Japan occupy prime positions in import. On the other hand as far as the export is concerned, USA and West Germany occupy significant positions. Palm oil is presently the major exporting commodity, showing the tonnage of around 400,000 ton per average year. Although the freight in containers with the length of 20 feet as well as 40 feet is handled at Belawan although its total tonnage is rather small at present.

The present operational restriction at Port of Belawan are observed as follows:

i) The insufficient dredging of channels and the tidal fluctuation result in restriction of certain classes of ocean going vessel at certain time of a day to berth alongside the quay;

ii) The palm oil handling is hampered by restriction of berthing due to the general cargo handling, bunkering and handling passengers which use commonly Ujung Baru Quay;

iii) The railway facilities in the port area are presently not in adequate condition due to lack of receiving tracks of trains

consisting of different types of freight, lack of adequate number of shunting locomotives and inadequacy of unloading facilities for palm oil.

(c) Passengers

As it is a world-wide tendency, the number of passengers arriving, and departing by boat at Belawan has not been so noticeable.

Table 3.2.28 shows the number of passengers handled at Belawan in the period from 1967 to 1978 and a large fluctuation cannot be seen since 1974. According to Table 3.2.29 in which the number of passengers handled at Port of Belawan is tabulated, almost all of passengers were coming from and out-going to Tg. Priok and the share of 94.7 percent indicates its dominating position.

Table 3.2.25 Monthly Loading/Unloading Tonnage of Freight by Commodity at Port of Belawan (1978)

(Unit: 1,000 tons)

Month	Unloading				Loading						Grand Total
	Import	Inter-island			Export			Inter-island			
		Dry Cargo	Liquid Cargo	Total	Dry Cargo	Liquid Cargo	Total	Dry Cargo	Liquid Cargo	Total	
1	121.3	47.5	77.9	125.4	42.8	34.5	77.3	16.1	3.8	19.9	343.9
2	68.6	35.6	57.0	12.6	39.5	33.6	73.1	17.7	3.9	21.6	255.8
3	77.5	75.2	77.3	152.5	39.6	29.2	68.8	19.0	4.1	23.1	322.1
4	119.8	47.9	68.0	115.9	37.5	28.2	65.7	19.9	4.3	24.2	325.7
5	90.6	61.8	71.4	133.2	28.1	30.8	58.9	18.7	7.2	25.9	308.7
6	64.9	57.1	58.1	115.2	54.1	36.8	90.9	26.6	6.7	33.3	304.3
7	58.1	75.2	97.2	172.4	44.4	34.5	78.9	27.1	6.4	33.5	342.9
8	63.3	107.0	74.0	181.0	37.5	41.0	78.5	31.8	10.0	41.8	364.8
9	62.5	68.5	68.7	137.2	22.5	40.6	63.0	24.9	8.8	33.7	296.5
10	78.1	102.8	76.7	179.5	58.6	37.9	96.5	20.6	7.1	27.7	381.8
11	47.5	67.5	65.8	133.3	80.4	47.2	127.6	19.1	9.5	28.6	337.0
12	57.7	77.5	56.8	134.3	42.6	62.9	105.5	21.3	8.2	29.5	327.1
Total	910.0	823.8	848.9	1,672.8	527.6	457.2	984.8	262.7	80.2	342.9	3,910.4

Source: Belawan Port Authority

Table 3.2.26 Import Tonnage to Port of Belawan from Major Countries (1978)

Country	Tonnage
Singapore	221,741
Japan	155,375
India	75,254
Taiwan	62,423
Philippines	48,846
Others	346,344
Total	909,983

Source: Belawan Port Authority

Table 3.2.27 Export Tonnage from Port of Belawan to Major Countries (1978)

Country	Tonnage
U.S.A.	269,777
German	149,941
Iraq	87,799
Belanda	74,814
Belgium	54,315
Others	348,152
Total	984,798

Source: Belawan Port Authority

Table 3.2.28 Yearly Number of Passengers Handled at Port of Belawan (1967-1978)

(unit: Person)

Year	Incoming	Outgoing	Transfer
1967	34,359	34,902	69,261
1968	19,461	24,373	43,834
1969	25,838	36,271	62,109
1970	28,202	37,764	65,966
1971	28,947	38,689	67,636
1972	40,190	48,214	88,404
1973	55,150	52,589	107,739
1974	44,379	45,614	89,993
1975	50,539	44,513	95,052
1976	45,263	36,875	82,138
1977	49,567	39,947	89,514
1978	47,502	32,391	79,893

Source: Belawan Port Authority

Note : Figures in 1978 are sums of Tg. Priok, Penang, Muntok, Singapore only.

Table 3.2.29 Number of Passengers of Arrival & Departure at Port of Belawan (1978) (Domestic & Foreign)

(unit: Person)

From / To Port	Arrival	Departure	Total
1. Tg. Priok	44,746	30,880	75,626
2. Penang	1,333	877	2,210
3. Muntok	627	634	1,261
4. Singapore	796	-	796
Total	47,502	32,391	79,893

Source: Belawan Port Authority

(2) Airport

(a) General

Polonia Airport in Medan City is conveniently located in a distance of 4 km from the center of Medan City and its general feature in topography and meteorology are shown in the following table.

Table 3.2.30 General Features of Polonia Airport

Classification	Class I Airport
Elevation	27 m
Temperature	26.3°C (Average)
Humidity	81 % (")
Wind	7 Knots(")
Operating hours	06.00 - 21.00

This Airport is one of the existing three international airports in Indonesia.

(b) Facilities

As for existing airport facilities, Table 3.2.31 shows them in detailed items.

(c) Air Passenger Traffic

Twelve flight routes originating from and terminating at Polonia Airport are presently in service and are operated by several airline companies such as MAS, SIA, PAS and GIA, MANDALA and MNA as domestic carriers. Besides those commercial flights some general and military flights are handled.

The average monthly frequencies of international and domestic flights are shown in Table 3.2.32. The number of air-passengers debarking and embarking at Polonia Airport are shown in Table 3.2.34 and Fig. 3.2.17, which show also a noticeable growth rate in the number of domestic passengers. This means that the role of Medan City has become more important as a center of North Sumatra Province year by year.

Fig. 3.2.15 Average Flight Frequencies per Month by Route Polonia Airport, Medan

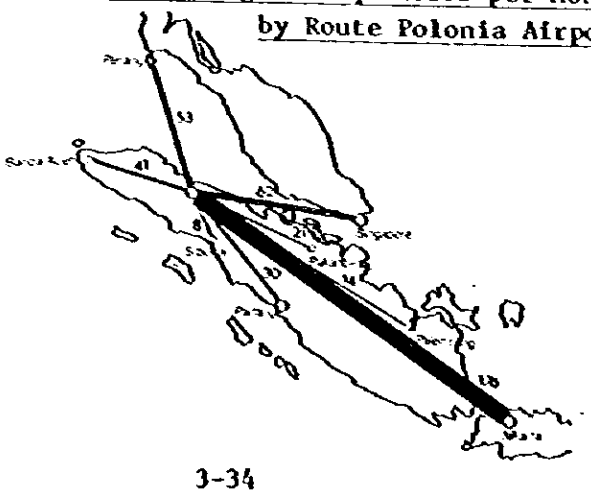


Table 3.2.31 Facilities at Polonia Airport
(October 1979)

Category	Item	Facilities
Location Indicator	-	
Land/Take off	Runway*	2,445m x 45m (LCN 80)
	Taxi way	140m x 23m (LCN 80)
	Apron	51.443 m^2 (LCN 80)
	Shoulder	2,665m x 90m (Grass)
	Over-Runway-05	100m x 45m
	" -23	100m x 45m
	Drainage system	2,375m x 2m (Sand stone)
		1,296m x 0.8m (Concrete)
Controlling Equipment	Control Tower	118,1 MHz
	Aproach Path	119,7 "
	DVOR	113,9 "
	R. DARA	8,820 "
	NDB	375 "
	DME	CH 86 x
Vehicles	Ambulance Car	1 Vehicle
	Crush Car	4 "
	Rescue Car	1 "
	Command Car	1 "
Building and Others	Terminal Building	1,560 m^2 (International)
	"	2,088 m (Domestic)
	Parking Space	14,200 m^2

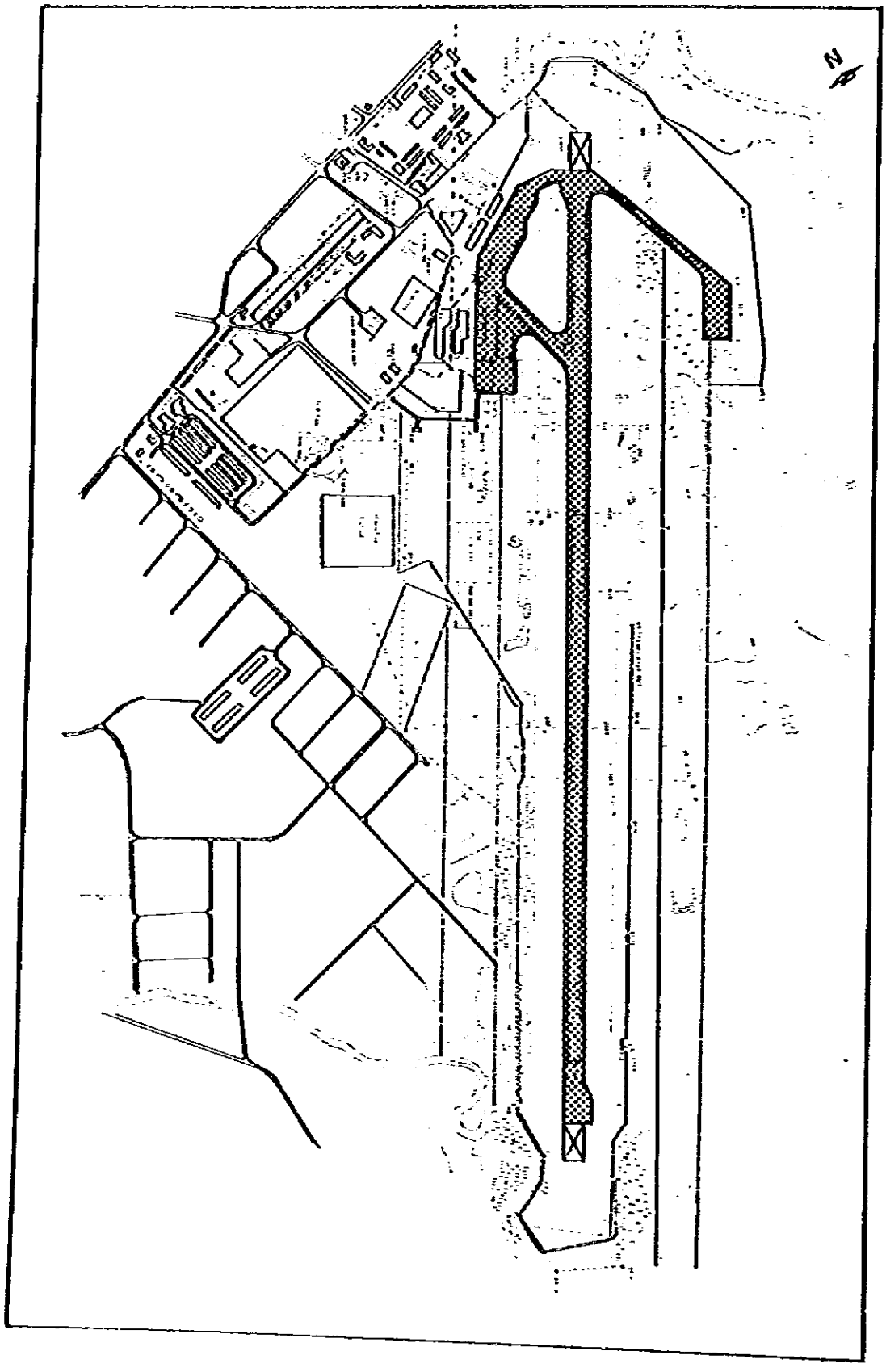
Source: Polonia Airport Authority

Notes : a) Runway improvement to receive DC-10 Class aircrafts has been completed already in 1979.

b) A new Terminal Building of floor area of 20,000 m^2 is now under construction, and is expected to be completed in 1980/1981.

Fig. 3.2.16 shows the present situation of Polonia Airport.

Fig. 3.2.16 Facilities at Polonia Airport (1979)



Besides such usual air passenger traffic it is noteworthy that a seasonal peak usually takes place in September and October due to flights to Holy City of Mecca, Saudi-Arabia.

Table 3.2.32 Average Monthly Frequencies of Flight, Polonia Airport (July, 1979)

International/ Domestic	Original Destination	Flight Frequency/ Month	Carrier
International	Singapore	62	GIA, SIA
"	Penang	53	MAS, MNA
"	Seletara	32	MOL
Domestic	Jakarta	176	GIA, MNA
"	Padang	30	GIA
"	B. Aceh	41	GIA
"	Pekanbaru	21	GIA, MNA
"	Palembang	14	GIA
"	Meulaboth	14	MNA
"	Binaka	44	MNA
"	Rasian	27	MNA
"	Sibolga	8	MNA

Source: Polonia Airport Authority

(d) Air-Cargo

The annual total volume of loaded and unloaded air-cargo at Polonia Airport reached 15,700 tons in 1978 and its tendency is shown in Table 3.2.33.

Table 3.2.33 Annual Tonnage of Loaded/Unloaded Air-Cargo at Polonia Airport (1974-1978)

(unit: ton)

	1974	1975	1976	1977	1978
Unloaded Cargo	-	1,724.6	2,483.0	2,114.3	3,605.9
" Baggages		2,091.7	3,059.6	3,369.6	4,834.8
" Percel/Mails	200.7	245.6	271.1	192.3	287.9
Total Unloaded	-	4,061.9	5,813.2	5,676.2	8,728.6
Loaded Cargo		1,326.9	2,122.8	2,932.5	2,622.0
" Baggages		2,116.7	2,898.9	3,729.0	4,125.3
" Percel/Mails	120.9	119.6	151.2	312.7	188.4
Total Loaded	-	3,563.2	5,172.9	6,974.2	6,935.7

Source: 1974-1977 : Buku Statistik Tahunan SUMATRA UTARA.
1975 : Bagian Pendataan Pelud. Polonia.

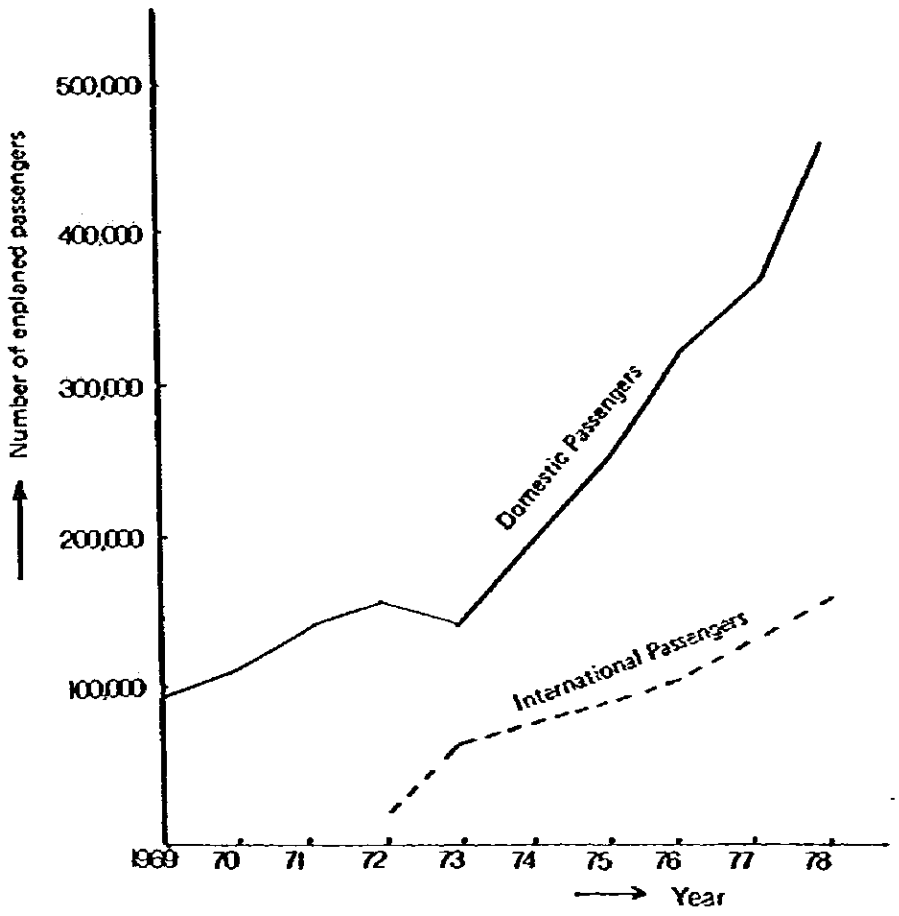
Table 3.2.34 Annual Number of Passengers Handled at Polonia Airport (1969-1978)

(unit: person)

Year		Number of passengers				Annual Growth Rate (%)
		Arrival	Departure	Transit	Total	
1969	Domestic	45,202	45,225	-	90,427	-
	International	-	-	-	-	-
	Total	45,202	45,225	-	90,427	-
1970	Domestic	58,777	61,198	-	119,975	
	International	-	-	-	-	32.7
	Total	58,777	61,198	-	119,975	
1971	Domestic	71,168	73,716	61	114,945	
	International	-	-	-	-	
	Total	71,168	73,716	61	114,945	20.8
1972	Domestic	80,984	74,189	296	155,469	
	International	7,411	9,140	21	16,572	
	Total	88,395	83,329	317	172,041	18.7
1973	Domestic	70,275	72,458	1,355	144,088	
	International	33,699	32,793	978	67,470	
	Total	103,974	105,251	2,333		34.2
1974	Domestic	99,303	97,592	3,412	200,307	
	International	39,504	43,687	354	83,545	
	Total	138,807	141,279	3,766	283,852	34.2
1975	Domestic	123,882	124,455	6,485	254,822	
	International	44,394	51,501	-	95,895	
	Total	168,276	175,956	6,483	350,717	23.6
1976	Domestic	159,966	162,560	7,762	330,288	
	International	56,201	57,015	-	113,216	
	Total	216,167	219,575	7,762	443,504	26.5
1977	Domestic	176,762	177,288	16,982	371,032	
	International	69,439	70,913	-	140,352	
	Total	246,762	246,762	16,982	511,384	15.3
1978	Domestic	241,052	235,547	11,064	487,663	
	International	80,134	85,032	-	165,176	
	Total	321,186	320,579	11,064	652,829	21.7

Source: 1969-1976 North and west sumatra tourism study by JICA, 1978
1977 Buku statistik Sumatra Utara - 1977
1978 Statistik Pelabuhan Udara Polonia

Fig. 3.2.17 Trend of Annual No. of Passengers Handled at Polonia Airport (1969 - 1978)



3.3 Road Traffic Condition

3.3.1 Road Vehicle Traffic

(1) Daily Traffic Volume

The daily traffic volume of the main roads in Medan City are as shown in Table 3-3-1, Fig. 3.3.1, according to the existing data and the results of the survey made by the study team.

In the central area of Medan, the traffic volume is quite heavy and in certain sections of Jl. Pemuda, Jl. Letjen Haryono M.T. and Jl. Sutomo, there are a heavy traffic more than 80,000 vehicles per day.

The reasons for the congestion is due to the fact that the radial road network and the one-way traffic system overlaps in the central area. Therefore, such a traffic movement pattern makes urban road traffic concentrate into the central part of Medan City.

Table 3-3-1 Daily Traffic Volumes on Major Streets Medan City (1979)

Name of Road	Vehicle/day		Location
Jl. Jati	45,162		
Jl. Prof. H.M. Yamin SH	64,395	(61,028)	A-2
Jl. Letjen Haryono M.T.	106,137	(100,527)	A-3
Jl. Pandu	66,115		
Jl. Sutomo (I)	101,692	(71,648)	A-4
Jl. Sutomo (II)	43,367		
Jl. Mesji Raya	(40,562)		A-5
Jl. Prof. H.M. Yamin M.T.	(32,300)*		
Jl. Balai	(60,100)*		
Jl. Pemuda	87,594		
Jl. K.M. Zainul Arifin	(32,292)		A-6
Jl. Jenderab Sudirman	(51,600)		A-7
Jl. Gelugur By Pass	(28,487)		A-1
Jl. Salton Iskandal Muda	(25,000)*		
Jl. Laksma Yos Sudarso	25,169	(29,000)*	
Jl. Jenderal Gatot Subroto	24,422	(45,400)*	
Jl. Kapten Patimva	12,321	(15,400)*	
Jl. Brigjet Katamso	13,154	(22,300)*	
Jl. Singamangaraja	24,882	(24,800)*	
Jl. Singamangaraja	53,000 *		

Notes: (1) Figures in ( ) is the result of survey by the JICA Study Team in October 1979.

(2) Figures with * mark are assumed by expanding traffic volume of 12 hours to that of 24 hours.

(3) *Non-marked figures are the results of survey by Bina Marga in 1978.

(4) Concerning locations of the survey station, Refer to Fig. 3.3.1.

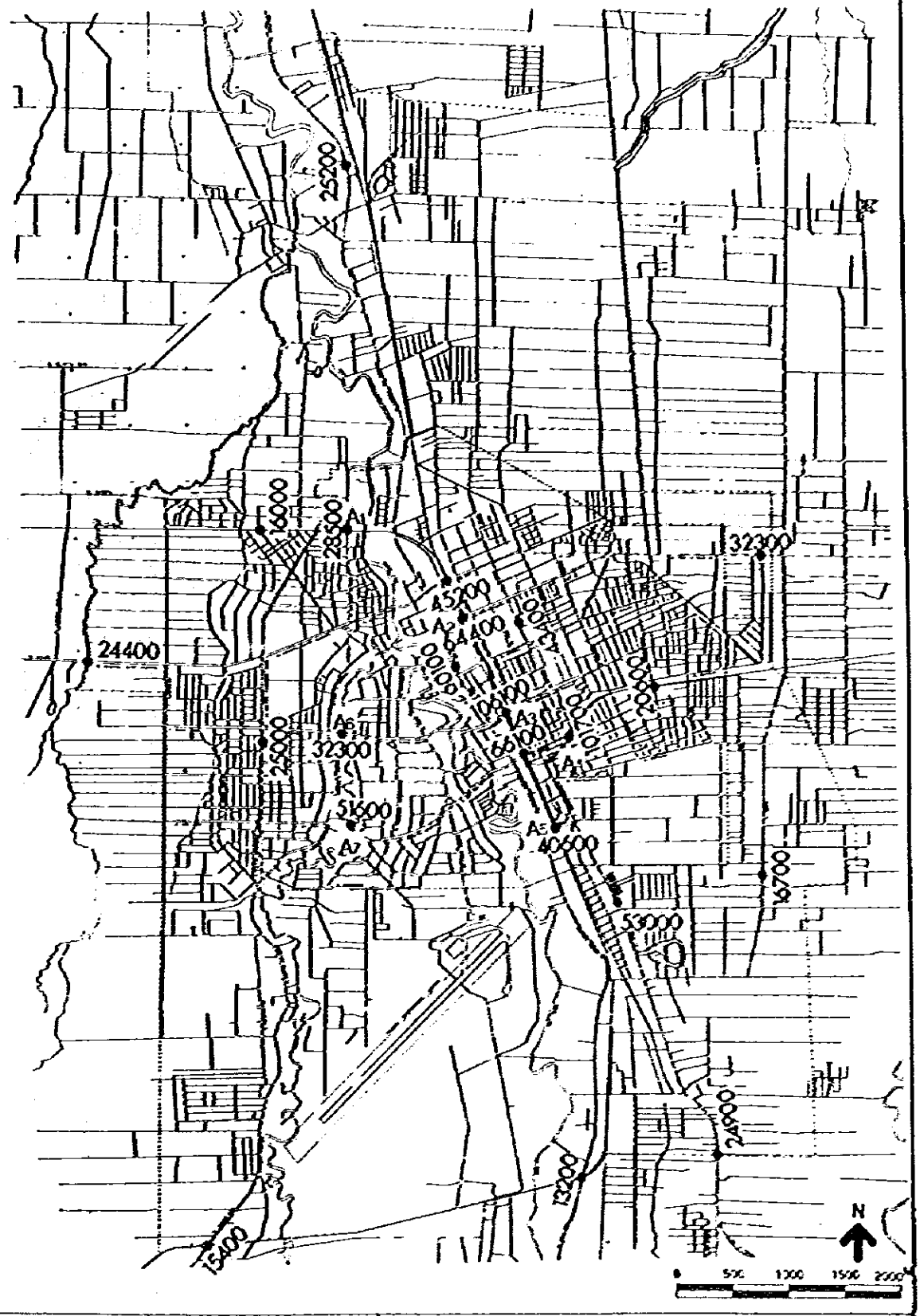


Fig. 3.3.1
Present Cross-section Traffic Volumes on Arterial Roads in Medan City (1978/1979)

Legend

(Unit: Vehicle/day)

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(2) Peak Hour Traffic Volume

The peak hour traffic volume according to the survey are as shown in Table 3-3-2, in which the peak hours are from 7 - 8 in the morning except point A-3. There are some variations in the peak ratio in difference points, but the ratio is usually 9% - 15%.

The peak hours on the arterial roads that connect Medan with Belawan and surrounding cities are shown in Table 3-3-3.

The route to Deli Tua has an extremely high peak ratio and at Jl. Brigjet Katamso, the concentration ratio is 22.8%. Even with the main arterial roads, there is a tendency for the peak hour to be around 7 - 8 o'clock.

Table 3-3-2 Peak Hour Traffic Volumes on Major Roads Medan City (1979)

Location	Traffic Volume * 24 hours	12 hours	Daytime Volume Ratio per day	Peak hour Traffic Volume	Peak Ratio	Peak hours
A-1	28,487	24,420	1.17	3,727	0.13	7 ∿ 8
A-2	61,028	54,464	1.12	6,737	0.11	7 ∿ 8
A-3	100,527	91,914	1.09	9,369	0.09	16 ∿ 17
A-4	71,648	65,026	1.10	7,055	0.10	8 ∿ 9
A-5	40,562	34,433	1.18	4,478	0.11	7 ∿ 8
A-6	32,292	28,607	1.13	3,062	0.09	7 ∿ 8
A-7	51,607	45,725	1.13	7,532	0.15	7 ∿ 8

Source: Results of the traffic counting survey by the JICA Study Team (1979)

Note: *Traffic counting was conducted from 7:00 to 19:00

Table 3-3-3 Peak Ratio of Main Arterial Roads Medan City (1979)

Name of Road	Peak Ratio	Ratio of main Direction	Peak hours
Jl. Laksma Yos Sudarso	10.3%	54.0	7 ∿ 8
Jl. Singamangaraja	13.2	73.1	7 ∿ 8
Jl. Brigjet Katamso	22.8	82.1	7 ∿ 8
Jl. Kapten Patimura	10.8	52.2	6 ∿ 7
Jl. Jenderal Gatotsubroto	14.5	62.1	7 ∿ 8

Source: Bina Marga 1978

The ratio of main traffic direction during the peak hour will be supplemented in Table 3-3-3. The traffic volume of the route from Deli Tua towards the central area of Medan is quite heavy during the peak hour.

(3) Compositions of Road Vehicle Traffic

By the results of traffic survey, which were collected by the Study Team in 1979, the composition of road vehicle traffic are as shown in Table 3-3-4.

According to those results, motorcycles and bicycles have occupied about 40-60% of all Traffic Volumes on the road at present. (Refer to Table 3-3-4)

Table 3-3-5 shows the mode composition ratio of Main Arterial roads' Traffic in Medan.

According to this Table, the mode composition ratio of the large size vehicles such as Bus and Trucks are higher than those in Road Traffic in the central zones.

Table 3-3-4 Mode Composition Ratio by Surveying Location Medan City (1979)

(Unit: %)

Location	Bemo	Sedan & Daihatsu	Truck & Bus	Motor Cycle	Bicycle	Becak Mesin	Becak
A-1	0.1	27.3	5.9	36.6	15.7	2.5	11.9
	0	25.1	8.2	43.5	11.7	2.7	8.8
A-2	4.0	25.4	6.5	46.4	7.4	8.9	1.4
A-3	3.2	23.6	5.1	49.0	6.6	10.3	2.2
A-4	1.1	17.7	3.5	50.2	7.6	14.3	5.6
A-5	0	18.4	6.1	53.7	8.9	8.3	4.6
	0.1	22.8	8.1	43.5	9.6	8.7	7.2
A-6	0	31.9	1.0	39.8	10.2	13.0	4.1
A-7	0	35.3	1.8	45.1	10.1	5.3	2.4
	0	41.4	1.4	41.8	7.8	5.6	2.0

Source: Results of Traffic Counting Survey by the JICA Study Team

Table 3-3-5 Mode Composition Ratio of Traffic on Major Arterial Roads Medan City (1979)

(Unit: %)

Name of Road	Bemo	Sedan Daihatsu	Truck & Bus	Motor Bicycle	Bicycle	Becak Mesin	Becak
Jl. Laksana Yos Sudarso	0.1%	19.1	23.7	33.5	19.5	0.2	3.6
Jl. Singamangaraja	0.2	22.0	22.1	28.3	21.2	1.9	7.9
Jl. Brigjet Katamso	3.9	10.7	8.8	35.4	34.6	2.4	4.2
Jl. Kapten Patimupa	0.2	40.7	11.6	33.4	11.6	1.7	0.8
Jl. Jenderal Gatotsubroto	0.2	25.5	15.9	38.3	18.1	1.1	2.9
Jl. Prof. H.M. Yamin SH	4.2	10.2	3.7	30.7	32.3	2.4	16.5

Source: Bina Marga O-D Survey, February 1978.

(4) Cross-section Traffic Volumes at the Railway Acrossings

According to the results from Study Team and Data of Bina Marga on Traffic Volume count, the total cross-section traffic volume at the Screen line D-G of approximately 280,000 vehicles per day is observed.

Traffic was counted at eleven railway crossings in the central zone. Table 3-3-6 shows the cross-section volumes of each Railway Screen line. (Refer to Fig. 3-3-2).

Table 3-3-6 Cross-section Traffic Volumes at Railway Crossings (1979)

Railway Screen Line	Traffic Volume (Vehicle/day)
A ∿ C	84,800
D ∿ G	281,700
H ∿ L	233,000
Total	599,500

Source: Results of Traffic Counting Survey Conducted by the JICA Study Team in October 1979.

And the mode composition Ratio in the cross section traffic volume at the Screen line (D-G) are as shown in Table 3-3-7.

Fig. 3.3.2 shows the traffic volumes counted at Railway Screen lines in central zones of Medan.

Table 3-3-7 Mode Composition in Traffic Volume at Screen Line (Total of Crossings D ∿ G)

Type of Vehicle	Composition Ratio (%)
Bemo	3.4
Sedan	21.4
Bus	1.2
Truck	3.8
Motor-Cycle	45.4
Bicycle	10.1
Becak	3.3
Becak Mesin	11.4
Total	100.0%

Source: Results of Traffic Counting Survey conducted by the JICA Study Team in October 1979

(5) Variation in Traffic Volume

(a) Trend in Traffic Volume by Year

Table 3-3-8 and Fig. 3.3.3 show the inter-city traffic volumes which data were provided by Bina Marga. According to this data the traffic

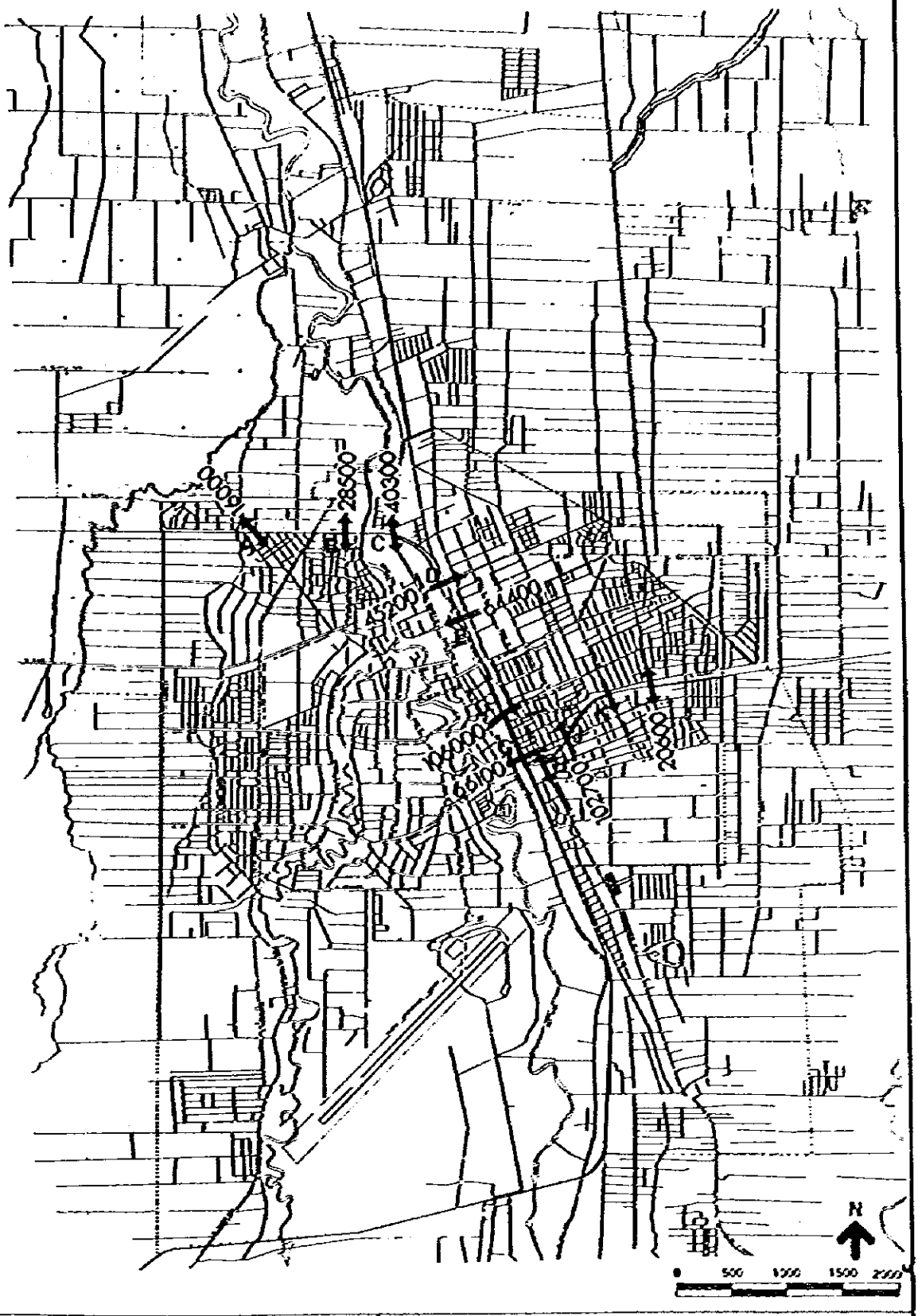

Fig. 3.3.2
Present Cross-section Traffic Volumes at Railway Crossings (1979)

Legend

Unit : Vehicle /day

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volume between Medan and Binjei shows an increasing trend and in 1977 it was doubled comparing to that in 1972. Contrarily, the traffic volume between Medan and Belawan decreased between 1972 and 1974, and then it has increased again to same level as in 1972 during the period between 1975 and 1977. Fig. 3.3.4 is the traffic flow in the study area in 1977.

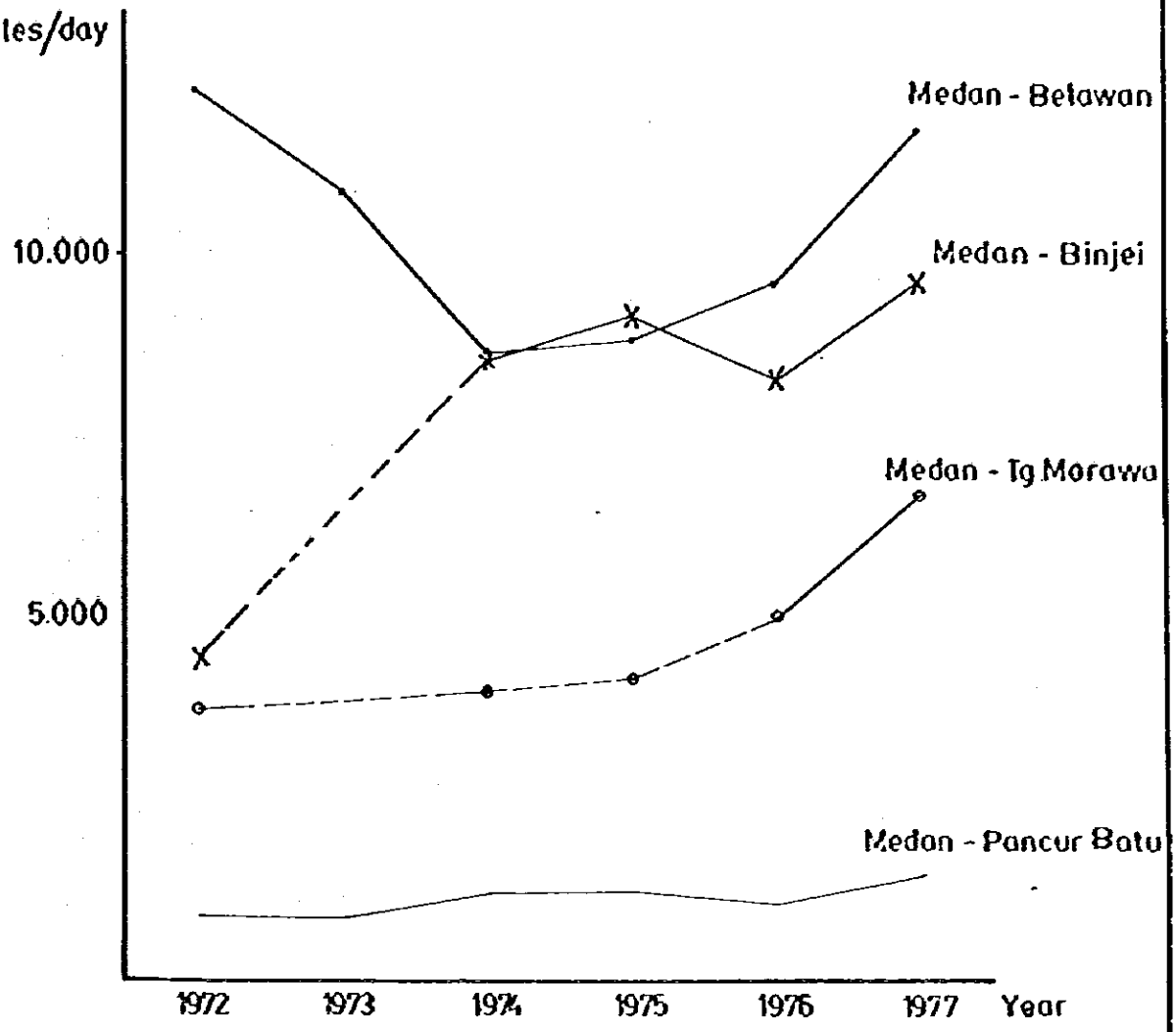
Table 3-3-8 Trend in Yearly Traffic Volume on Major Arterial Roads

(Unit: Vehicle/day)

	Mode	1972	1973	1974	1975	1976	1977	1977/1972
Medan - Belawan	M	6,596	5,627	4,082	4,146	4,717	6,687	1.01
	B	1,108	951	936	749	713	1,229	1.11
	T	4,404	4,329	3,610	3,995	4,764	3,890	0.88
	Total	12,111	10,905	8,628	8,890	9,628	11,806	0.98
Medan - Binjei	M	2,928	–	6,358	6,760	5,822	6,649	2.27
	B	573	–	770	865	1,033	1,223	2.13
	T	969	–	1,412	1,626	1,584	1,879	1.94
	Total	4,470	–	8,540	9,251	8,439	9,749	2.18
Medan - Tg. Morawa	M	2,233	–	2,639	2,795	3,465	4,670	2.09
	B	494	–	458	421	477	639	1.29
	T	1,049	–	942	970	1,138	1,475	1.41
	Total	3,776	–	4,039	4,186	5,080	6,779	1.80
Medan - Pancur Batu	M	560	561	706	734	749	983	1.76
	B	156	156	243	263	89	127	0.81
	T	202	202	271	2,411	255	415	2.05
	Total	918	919	1,220	1,288	1,093	1,525	1.66

Source: BINA MARGA O-D Survey, 1978.

Note: (1) M: Sedan & Pick-Up
(2) B: Bus
(3) T: Truck



Source: Bina Marga

Fig. 3.3.3 Trend in Yearly Traffic Volume on Major Arterial Roads in Medan Area (1972 - 1977)

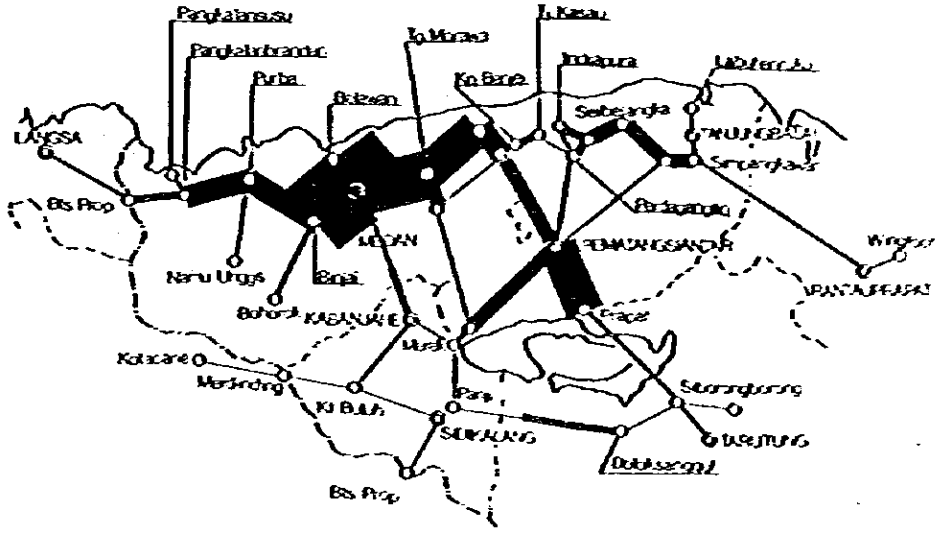


Fig. 3.3.4 Traffic Flows on Arterial Roads in North Sumatra (1977)

3.3.2 Freight Traffic

Actual Freight flows originating or terminating in Medan Area can be classified into three categories such as air freight, marine freight and inland-freight. The majority of aglicultural products from the deep hinterland to be exported are transported by railway directly to Belawan Port without causing any serious traffic problem in Medan Area and most of the imported goods are usually stored in warehouses in Medan Area and are distributed according to local demands.

Contrarily, all arriving air freight is transported by trucks to their destinations. And more than 70% of marine freight loaded and unloaded at Port of Belawan is transported by truck from and into Medan City and other destinations. Therefore, it can be concluded that most of freight traffic through Medan City causing problems is those by truck. This is mainly because the distance of 21.6 km between Belawan and Medan is such a short distance route in which trucks are advantageous in freight transportation.

(1) Air-Transport

The volume of freight flows through Polonia Airport have been increasing at an enormous rate, and the total volume of freight handled in 1976 was 4,605.8 tons which was 50% more than the previous year. Along with the improvement of existing airport facilities underway at present, it is expected to continue to grow steadily. However, it is not anticipated to cause any serious traffic problem due to the limitation of the capacity of this mode.

Table 3-3-9 Freight Flows Through Polonia Airport Medan City (1974-1978)

(Unit: ton)

Category	1974	1975	1976	1977	1978	1978/1975
Unloaded Freight		1,724.6	2,483.0	2,114.3	3,605.9	2.1
Unloaded Baggages		2,091.7	3,059.1	3,369.6	4,834.8	2.3
Unloaded Mails	200.7	245.6	271.1	192.3	287.9	1.2
Total Unloaded		4,061.9	5,813.2	5,676.2	8,728.6	2.1
Loaded Freight		1,326.9	2,122.8	2,932.5	2,622.0	2.0
Loaded Baggages		2,116.7	2,898.9	3,129.0	4,125.3	1.9
Loaded Mails	120.9	119.6	151.2	312.7	138.4	1.2
Total Loaded		3,563.2	5,172.9	6,974.2	6,935.7	1.9

Source: 'Statistical Year Book, North Sumatra Figures, 1976' Kantor Sensus dan Statistik Tk. I Sumatera Utara, Medan, 1977.

(2) Sea Transport

(a) Exports

The exports rose from 488,100 tons in 1966 to 748,500 tons in 1973. Some 40% of the total exports was occupied by rubber and latex, and further 40% by palm oil and palm kernels.

(b) Imports

The total imports through Belawan Port rose from 184,800 tons in 1966 to some 832.600 tons in 1973 (an annual average growth rate of 24%, each Cement and fertilizer accounted for about 20% of the total, and rice for between 10% and 20%.

(c) Inter-Island Freight

The domestic freight loaded at Belawan rose from 23,200 tons in 1967 to more than 136,000 tons in 1973. Over a half of this total is accounted for by general freight movements to Tg. Priok, Palembang and Surabaya. Apart from the rice shipment, there were only small flows of freight from Belawan to other ports in Province of North Sumatra.

Note: Frequent quotations will be made from 'Indonesia Port Study' Vol. 5, Part 3 Belawan. Sir Halcrow and Partners, 1975.

The domestic freight unloaded at Belawan (excluding petroleum) rose from 174,600 tons in 1966 to 366,800 tons in 1973 at an average annual growth rate of 11.2%. Sugar and salt from East Java accounted for between 30% and 40%. Only small quantities of freight were carried to Belawan from other ports in Province of North Sumatra.

Table 3-3-10 Freight Tonnage Loaded & Unloaded at Belawan Port (1966-1978)

(Unit: ton x 10^3)

Year	International			Inter-Islands		
	Imports	Exports	Total	Inwards	Outwards	Total
1966	185	488	673	-	-	-
1967	265	442	707	-	23	23
1968	356	496	857	-	36	36
1969	410	540	950	-	24	24
1970	317	566	883	-	28	28
1971	599	608	1,207	666	65	1,938
1972	652	698	1,350	628	100	2,078
1973	833	749	1,582	766	137	2,485
1976	833	954	1,837	1,030	234	3,101
1977	957	966	1,867	1,203	251	1,454
1978	910	985	1,895	1,673	343	2,016

Source: 'Indonesia Port Study, Vol. 5 Part 3, Belawan'
Sir William Halcraw & Partners, 1975
'Statistical Year Book, North Sumatra Figures 1976'
Kantor Sensus dan Statistik Tk.I Sumatera Utara,
Medan 1977.

(3) Land Transport

(a) Trucks

i) According to "LAPORAN PEMBANGUNAN DAERAH TINGKAT II KOTAMADYA MEDAN SELAMA PELITA II (1974/75 s/d 1978/1979)" the major traffic routes through Medan City are between Belawan and other four surrounding towns such as Binjei, Pancur Batu, Deli Tua and Tanjung Morawa. However, for the radial freight movement to Deli Tua, there is no data available at present. For other radial freight flows, the volume of freight carried by trucks are recorded at existing weight-bridges. The freight flow along the Belawan-Medan corridor is the most massive occupying almost a half of the total of four freight flows. The inbound traffic to Medan by truck has the volume of three times larger than the outbound traffic. According to "Preliminary Study of International Transport Requirements for North Sumatra Plantations", prepared by Canadian Pacific Consulting Services-Soferrail, 1977, the number of inbound trucks is estimated at 850 per day in July 1977, and among them 500 are loaded on the their outbound trips as well. Also about 300 trucks are estimated during a night for both directions. An Average of 8 ton axle load of loaded trucks will give damages to the road with the design standard of 7 ton axle loading (Class II by Bina Marga Standard) (Refer to Table 3.3.11).

ii) The Results of Truck O-D Survey

According to a questionnaire O-D survey on freight flows at 6 weight bridges (conducted in October 1979 by the study team), freight flows at each bridge are as shown in Fig. 3.3.5.

According to Fig. 3.3.5, the freight flows are large through both L. Deli and Titipapan weight bridges, and it is evident that a large volume of freight is flowing towards Belawan.

As for inter-city movement, there is a large flow in the Tg. Morawa-Belawan direction, indicating the characteristics of commodity flows in Medan City area.

The volume of freight passing through weight bridges towards Belawan accounts for about 62.2% of total, showing that there is a large freight movement and a strong relation between Port of Belawan and Medan City and its surrounding cities.

Table 3-3-12 shows commodity flows by truck through weight bridges.

According to survey results of the overall freight flow volume per day recorded at all weight bridges, the volume of building materials account for about 22%, followed by crops/plantation products of about 20% and foods of about 18%.

By records at weight bridges, an average flow is observed for freight at Belawan. At Binjei, building materials occupy 39% share. At Pancur Batu, foods account for some 48%, featuring

Table 3-3-11 Tonnage of Yearly Truck-Freight Measured at Weight-Bridges Medan City (1975-1978)

(unit: Ton)

Location of Weight Bridge	1975 No. of Trucks	1975 Out bound	1975 In bound	1976 No. of Trucks	1976 Out bound	1976 In bound	1977 No. of Trucks	1977 Out bound	1977 In bound	1978 No. of Trucks	1978 Out bound	1978 In bound
1. Labuhan Deli	70,767	448,954	–	88,584	556,996	–	108,452	665,944	–	101,246	705,123	–
2. Titipapan	119,323	–	864,089	168,234	–	916,084	282,805	–	2,075,165	292,303	–	2,128,275
3. T. Morawa I	80,372	113,278.5	318,962.5	82,184	–	412,004	85,222	–	556,065	118,357	–	752,364
4. T. Morawa II	33,122	118,910	–	53,138	311,138	–	71,026	382,620	–	71,803	385,915	–
5. P. Batu	26,141	43,983	61,072	20,426	27,864	50,640	22,894	37,948	46,964	24,914	49,103	45,492
6. L. Pakam	37,785	100,049.5	170,211	18,676	7,949	99,939	11,159	10,680	70,803	20,626	13,037	30,409
7. Binjai	32,957	63,479	103,066.5	19,914	33,728	61,908	20,481	21,427	48,834	26,201	32,875	59,599
8. T. Pura/Gebang	–	56,837	104,860	–	52,180	77,164	37,590	36,415	75,790	88,250	88,250	155,915
Total	400,467	1,015,491	758,112	451,156	989,757	1,617,735	639,629	2,873,621	6,873,621	706,720	1,274,303	3,232,054

Source: DLLAJR-SU

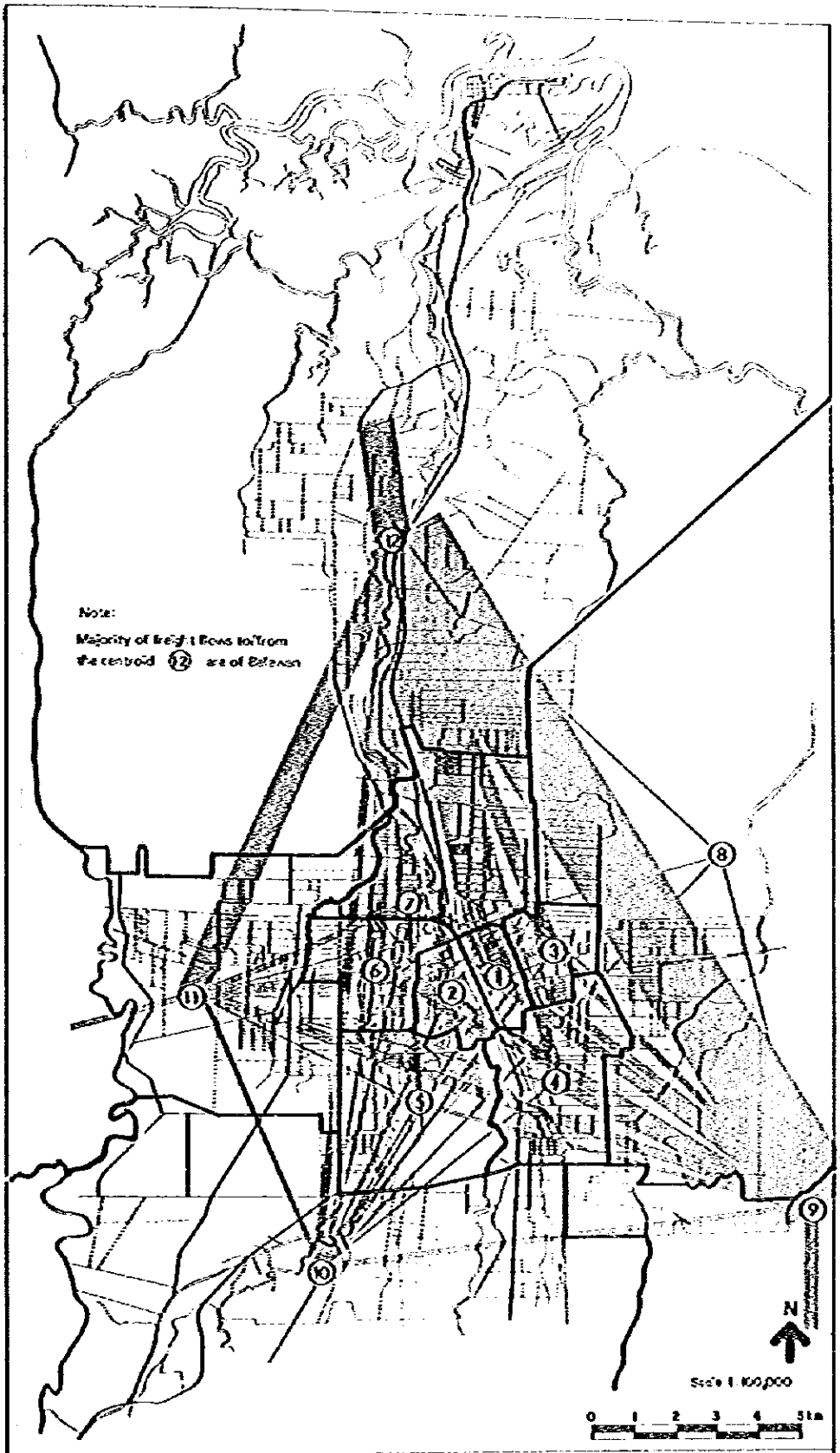


Fig. 3.3.5
Intra-City Freight Flows Measured at Existing Six Weight Bridges, Medan City (1979)

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Table 3-3-12 Tonnage Daily Commodity Flows by Truck Measured at Weight Bridges Medan City (1979)

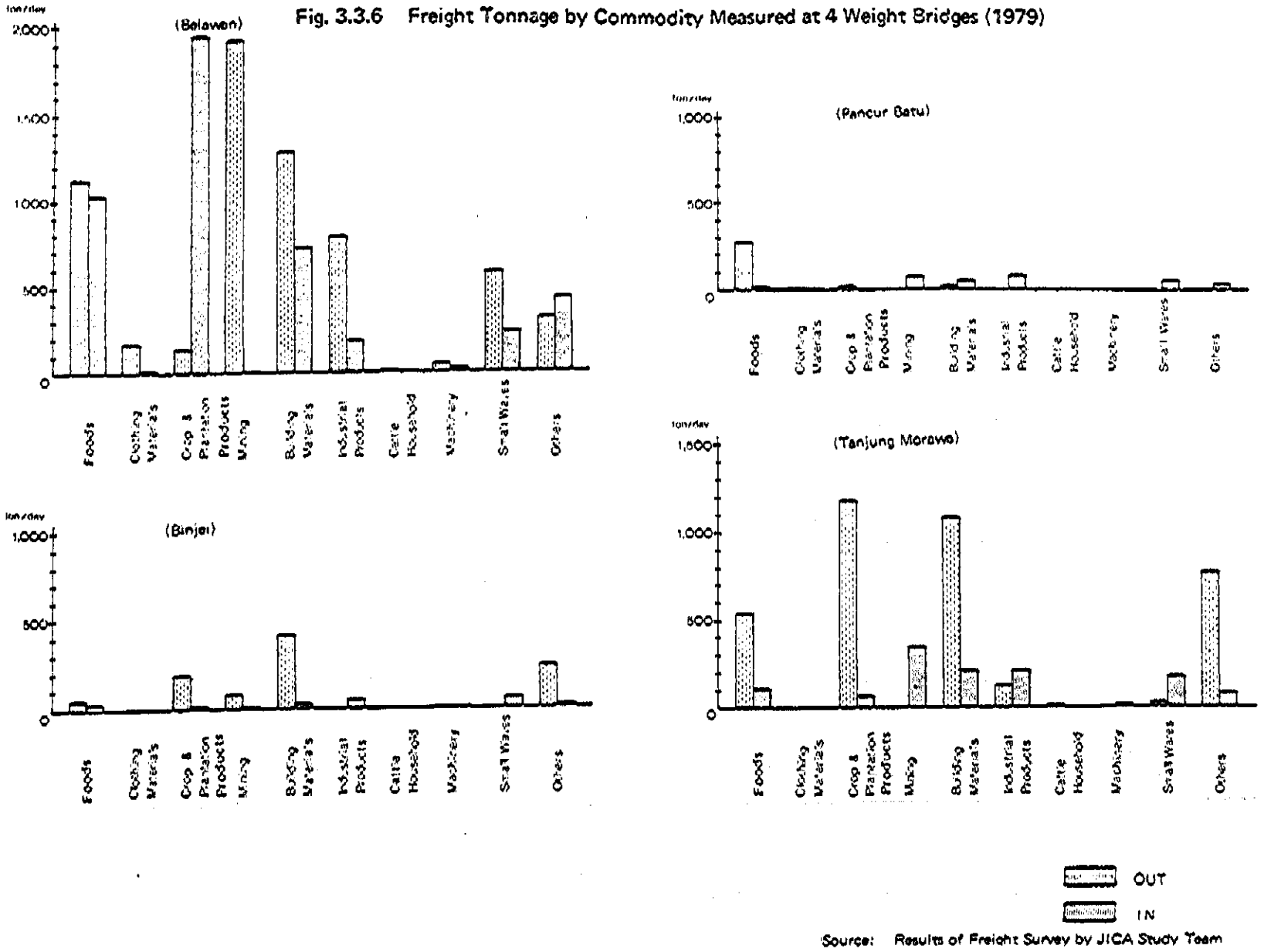
(Unit: Ton/day)

	Type of Commodity	Belawan			Binjai			Puncur Baru			Tanjung Morawa			Ground Total		
		To Medan	From Medan	Total	To Medan	From Medan	Total	To Medan	From Medan	Total	To Medan	From Medan	Total	To Medan	From Medan	Total
1	Foods	1,124.3 (17.6)	1,003.4 (22.0)	2,127.7 (19.4)	46.6 (4.9)	23.0 (13.0)	69.6 (6.1)	269.2 (88.3)	12.2 (4.3)	281.4 (47.9)	536.5 (94.4)	107.4 (9.0)	643.9 (13.1)	1,976.6 (17.4)	1,146.0 (18.4)	3,122.6 (17.7)
2	Clothing Materials	172.2 (2.7)	8.0 (0.2)	180.2 (1.6)	0 (0)	0 (0)	0 (0)	2.4 (0.8)	1.3 (0.5)	3.7 (0.6)	0 (0)	0 (0)	0 (0)	174.6 (1.5)	9.3 (0.2)	183.9 (1.0)
3	Crop & Plantation Products	141.8 (2.2)	1,957.9 (42.9)	2,099.7 (19.2)	188.3 (49.5)	11.9 (6.8)	200.2 (17.6)	15.2 (5.0)	0.4 (0.1)	15.6 (2.7)	1,179.6 (31.7)	67.8 (5.6)	1,247.4 (25.4)	1,524.9 (13.4)	2,038.0 (132.8)	3,562.9 (20.3)
4	Mining Products	1,936.1 (30.3)	2.0 (0)	1,938.1 (17.7)	80.1 (8.3)	5.7 (3.2)	85.8 (7.5)	0 (0)	67.0 (23.7)	67.0 (11.4)	0 (0)	341.3 (28.6)	341.3 (6.9)	2,016.2 (17.7)	416.0 (6.7)	2,432.2 (13.8)
5	Building Materials	1,285.7 (20.1)	726.3 (15.9)	2,012.0 (18.4)	414.0 (43.0)	25.2 (14.3)	439.2 (38.5)	15.3 (5.0)	46.4 (16.4)	61.7 (10.5)	1,081.9 (29.1)	207.8 (97.4)	1,289.7 (26.2)	2,796.9 (24.6)	1,005.7 (16.2)	3,802.6 (21.6)
6	Industrial Products	793.6 (12.4)	190.1 (4.2)	983.7 (9.0)	0 (0)	43.8 (24.8)	43.8 (3.8)	1.3 (0.4)	79.2 (28.1)	80.5 (13.7)	127.5 (3.4)	205.2 (17.2)	332.7 (6.8)	922.4 (8.1)	518.3 (8.3)	1,440.7 (8.2)
7	Cattle & Household	6.0 (0.1)	2.0 (0)	8.0 (0.1)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	9.4 (0.3)	0 (0)	9.4 (0.2)	15.4 (0.1)	2.0 (0)	17.4 (0.1)
8	Machinery	47.3 (0.8)	8.0 (0.2)	55.3 (0.5)	3.0 (0.3)	3.7 (2.1)	6.7 (0.6)	0 (0)	0 (0)	0 (0)	0 (0)	13.9 (1.1)	13.9 (0.3)	50.3 (0.4)	25.6 (0.4)	75.9 (0.4)
9	Small Wares	576.5 (9.0)	233.2 (5.1)	809.7 (7.4)	0 (0)	50.9 (28.8)	50.9 (4.5)	0.7 (0.2)	49.9 (17.7)	50.6 (8.6)	23.5 (0.6)	169.3 (14.2)	192.8 (3.9)	600.7 (5.3)	503.3 (8.1)	1,104.0 (6.3)
10	Others	309.0 (4.8)	431.0 (9.5)	740.0 (6.7)	231.7 (24.0)	12.3 (7.0)	244.0 (21.4)	0.8 (0.3)	26.0 (9.2)	26.8 (4.6)	763.1 (20.5)	82.1 (6.9)	845.2 (17.2)	1,304.6 (11.5)	551.4 (8.9)	1,856.0 (10.6)
	Total	6,392.5 (100.0)	4,561.9 (100.0)	10,954.4 (100.0)	963.7 (100.0)	176.5 (100.0)	1,140.2 (100.0)	304.9 (100.0)	282.4 (100.0)	587.3 (100.0)	3,721.5 (100.0)	1,194.8 (100.0)	4,916.3 (100.0)	11,382.6 (100.0)	6,215.6 (100.0)	17,598.2 (100.0)

Source: Results of Freight O-D Survey executed by the JICA Study Team in October 1979.

Note: Figures in ( ) show %.

Fig. 3.3.6 Freight Tonnage by Commodity Measured at 4 Weight Bridges (1979)



Source: Results of Freight Survey by JICA Study Team

Table 3-3-13 Freight Tonnage O-D Matrix Measured at Weight Bridges Medan City (1979)

(Unit: Ton/Day)

	1	2	3	4	5	6	7	8	9	10	11	12	Total
1	-	-	-	-	-	-	-	-	188	35	75	590	889
2	-	-	-	-	-	-	-	-	61	4	o	371	436
3	-	-	-	-	-	-	-	-	87	48	4	282	421
4	-	-	-	-	-	-	-	-	41	19	4	56	120
5	-	-	-	-	-	-	-	-	7	24	0	34	65
6	-	-	-	-	-	-	-	-	32	0	0	148	180
7	-	-	-	-	-	-	-	-	1**	11	20	499	545
8	-	-	-	-	-	-	-	-	0	4	3	12	19
9	366	135	200	513	97	179	214	62	663	107	286	2587	5400
10	30	20	21	17	9	17	35	6	60	9	33	219	476
11	116	78	105	12	11	63	188	20	131	29	251	442	1446
12	1095	408	425	358	134	588	732	17	1328	140	743	1637	7605
Total	1607	641	751	900	251	847	1169	105	2703	431	1419	6778	17602

Source: Results of Freight O-D Survey conducted by the JICA Study Team.

Note : Zoning is shown in Fig. 3.3.7.

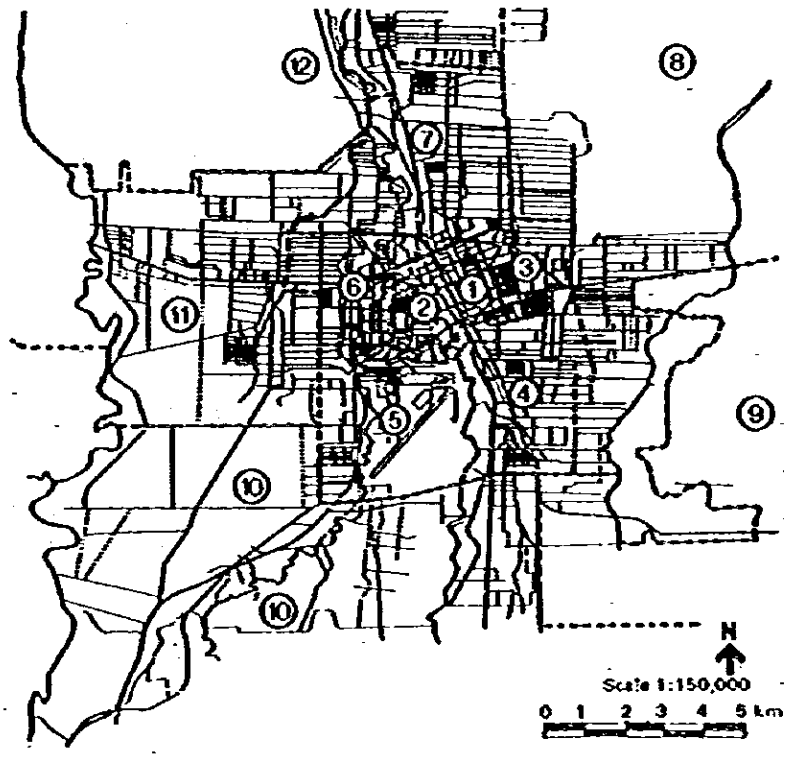


Fig. 3.3.7. Zoning for Freight Tonnage O-D Matrix

a very high rate of flows into Medan City with some 88%. The flow at Tg. Morawa is similar in pattern to the overall flows at all weight bridges.

Fig. 3.3.6 illustrates the freight flows recorded at each weight bridge by type of commodity.

(b) Railway

As shown in Table 3-3-14 the volume of freight carried by railway decreased by 2.2% per year in an average from 689,076 tons in 1971 to 617,466 tons in 1976. 68.6% of the total tonnage was destined to to Belawan for shipment, 8.4% was unloaded at Belawan. The remaining 23% was occupied by local freight transport.

The freight carried by railway to Belawan has increased at an average annual rate of 4.0% mainly due to the increase in export of palm oil. Contrarily, the freight from Belawan to hinterland has decreased by 10.8% per year.

Despite the decrease in tonnage, the railway revenue actually increased due to increased haul length and tariff change. The total ton-km figures increased from 79 million to 92.3 million during the period of 1970-1976.

As observed above, the railway share of freight, transport, particularly in non-liquid freight, has been advantageously transported by trucks in the past 10 years. "Indonesian Port Study" above mentioned summarized this situation as follow:

i) Apart from 40,000 to 50,000 tons of petroleum products, all imports and domestic inward traffic are transported by truck.

ii) A total of 85,000 to 90,000 tons of general and bagged freight is brought in by rail to Belawan, and almost all liquid bulk freight for export are carried by train. The remainder of the traffic is brought in by truck. Although, in 1973/74, small quantities of latex and palm oil were carried by truck to Belawan, this was described by the shippers concerned as a temporary measure in order to avoid rail transport problems then being encountered.

iii) The 85,000 to 90,000 tons of general freight brought to the Port by railway consists mainly of crumb rubber, palm kernels and copra cake originating from Rantau Prapat and Perlanaan over a distance of 290 km and 140 km respectively, from Belawan.

Table 3-3-14 Yearly Freight Tonnage Carried by Railway To/From Port of Belawan (1970-1976)

(Unit: ton)

	1970	1971	1972	1973	1974	1975	1976
To Belawan	320,798	347,545	373,810	334,130	378,955	394,641	423,577
From Belawan	32,752	31,260	91,328	96,096	30,609	61,711	51,974
Others	308,963	250,721	215,889	220,723	190,450	164,875	141,915
Total	713,013	689,076	681,027	700,349	650,014	611,227	617,466

Source: Preliminary Study of Intermodal Transport Requirements for North Sumatra Plantation,
Canadian Pacific Consultants - Sofrenail, 1977

3.3.3 Traffic Control System

(1) One-Way Traffic Control System

As is shown in Fig. 3.3.8 one-way traffic system has been widely adopted presently in the CBD of Medan City. This is evident from the fact that not so many inter-sections are signalized at present in this City in spite of its considerable urban traffic volume. It can be supposed that the reason why the rotary typed inter-section is so widely used in Medan City as well as in other large cities in Indonesia is due to the same motive, namely traffic flow can be controlled by rotary typed inter-section without installing any traffic signal.

The basic conception of one-way control traffic system which is in effect in Medan City consists of two main circulating road networks. (Refer to Fig. 3.3.8) One is the streets surrounding the commerce area located in the west side of the City, which is indicated as A circulating street network.

The second is streets surrounding the CBD in the east side of the City where exists Medan Pasar and so on, and is indicated as B circulating street Network.

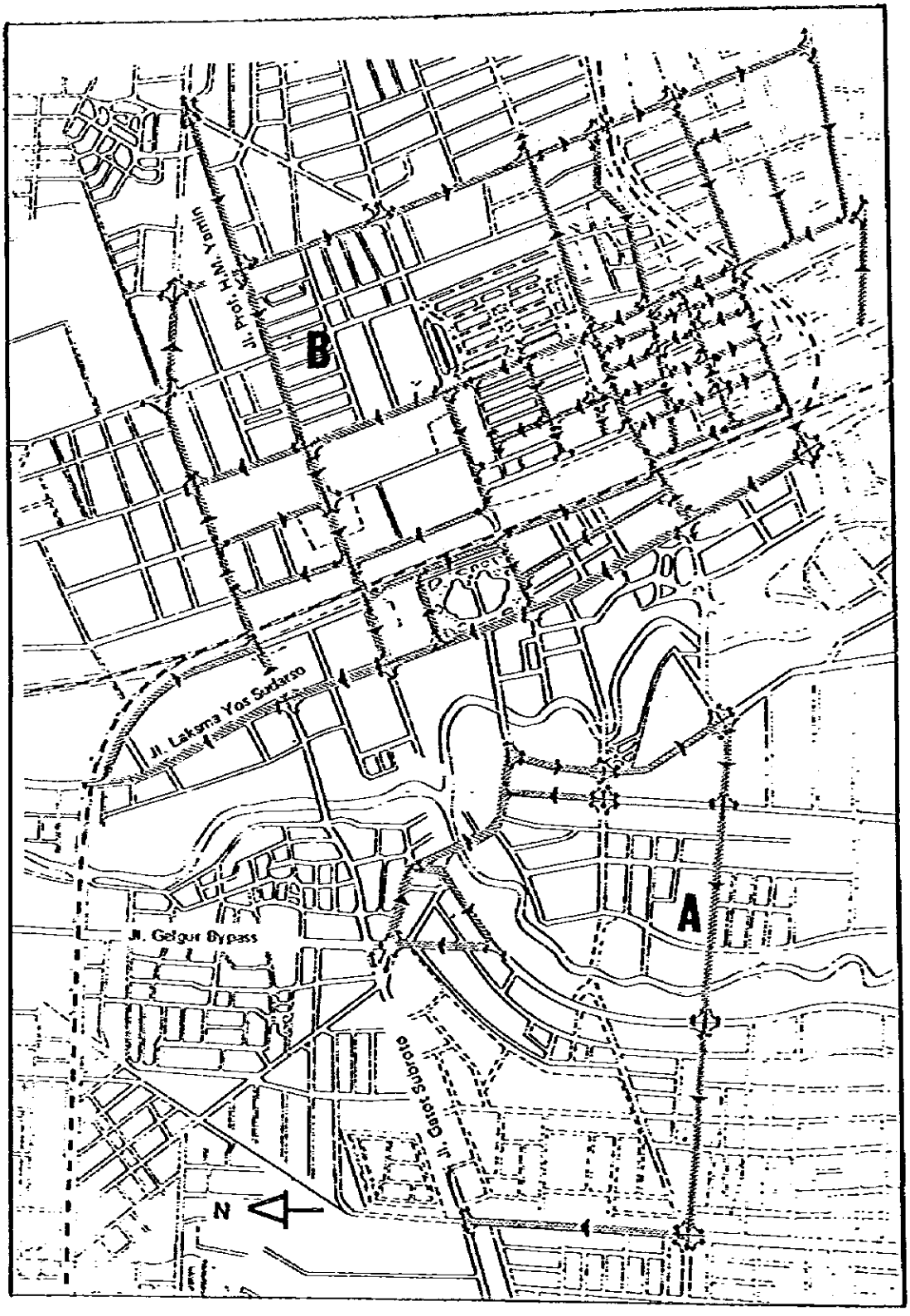


Fig. 3.3.8 Present One-way Traffic Control System and Regulation on Traffic Directions

(2) Traffic Signals

As far as traffic signals in Medan city are concerned, it seems to be necessary to discuss here judging from the traffic management point of view, especially on one-way traffic system in effect. At present major intersections have been signalized or would be signalized so far. Fig. 3.3.9 and Table 3-3-15 shows their existing locations and locations to be signalized in the near future. In Medan City complicated one-way traffic systems have been enforced, this is because such one-way traffic systems make it easy to control traffic flows without installing additional traffic signals.

However, in such a large city as Medan it is rather difficult to fit the one-way traffic system to the traffic situation on almost all of streets due to the fact that a considerable traffic volume has to detour over a considerable distance.

As it is mentioned in the article of one-way system two arterial circulating one-way traffic systems have been in effect in the CBD and the existing traffic signals are mainly installed on major intersections of those two arterial ring roads.

All traffic signals are independently controlled in Medan City and not a any coordinated signal control system can be seen in the present stage. Usually traffic signals are located only at inlets of intersections, and left-turn is allowed at any time, but this seems to be very dangerous to pedestrians crossing the roads.

Thirty or thirty five seconds are arranged for a main phase of traffic signals, it is rather not sufficient time of a cycle is considered at present. However, such a pattern is to be reconsidered with the increase of urban traffic volume.

(3) Vehicle Parking

(a) Parking Situation

The parking situation in Medan City seems to be no serious problem except some special cases at present due to comparatively small number of vehicle privately owned. At night time, vehicles are parked in thier home parking space in residential area, and in day time mainly on road side everywhere on business and commuting trips.

Only a few problems can be observed on Becak parking around bus terminals and car parking inside the CBD. Furthermore, Becak parking alongside on some streets, where commerce shops stand abreast, seems to be a cause of traffic congestions.

As far as the Becak parking around bus terminals is concerned it would be a problem of bus terminal itself rather than that of Becak parking. Concerning vehicle parking in the CBD alternate place cannot be found except on roadside although this area has a great demand of vehicle parking. According to this fact, road side parking has been allowed in two zones in the CBD in Medan city as shown in Fig. 3.3.10.

Table 3-3-15 Locations of Traffic Signal Installation Medan City (1979)

I. Existing:

1.	Sudirman	-	Walikota
2.	Pemuda	-	Pandu
3.	Imam Bonjol	-	P. Merah
4.	Diponegoro	-	Z. Ariffin
5.	S. Parman	-	Z. Ariffin
6.	Gajah Mada	-	Iskandar Muda
7.	Gatot Subroto	-	Iskandar Muda
8.	Iskandar Mudan	-	Abdullah Lubis
9.	Gatot Subroto	-	Darus Salam
10.	Gatot Subroto	-	Kapten Muslim
11.	Gatot Subroto	-	Glugur By Pass
12.	Guru Patimpus	-	Putri Hajau
13.	Sutomo	-	Jati
14.	Sutomo	-	M. Yamin S.H.
15.	Sutomo	-	Haryono
16.	Sutomo	-	Herbabu
17.	M. Raya	-	Katamso
18.	M. Raya	-	S.M. Raja
19.	Thamrin	-	Sumatra
20.	Patimura	-	Sumarsono
21.	Thamrin	-	Jati

II. Under Construction

1.	J. Suprapto	-	Suryani
2.	J. Suprapto	-	Badur
3.	Pemuda		
4.	Raden Saleh		
5.	Jati		
6.	Jati	-	Durian
7.	M. Yamin Sh.	-	Durian
8.	M. Yamin Sh.	-	Thamrin
9.	Haryono	-	L. Tobing

III. Under Planning

1.	H. Juanda	-	Imam Bonjol
2.	Mongonsidi	-	Patimura
3.	Abdullah Lubis	-	W. Hasyim
4.	Abdullah Lubis	-	S. Parman
5.	R.A. Kartini	-	Diponegoro
6.	Palang Merah	-	Wazir
7.	Palang Merah	-	A. Yani
8.	Kejaksaan	-	Imam Bonjol
9.	Haryono	-	Irian Barat
10.	Pandu	-	Cirebon
11.	Pandu	-	Sutomo
12.	Pelangi	-	S.M. Raja
13.	Sakti Lubis	-	S.M. Raja

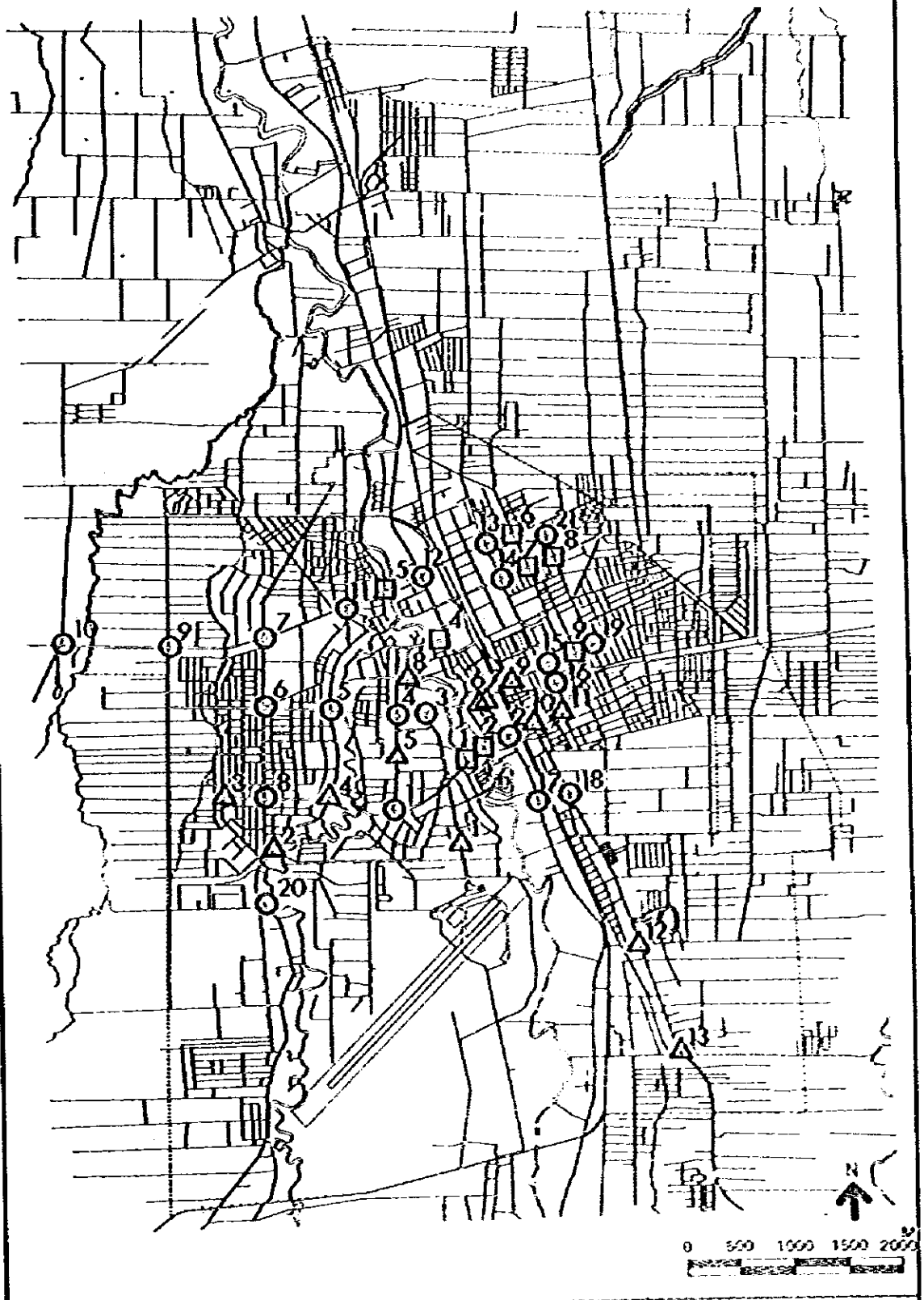


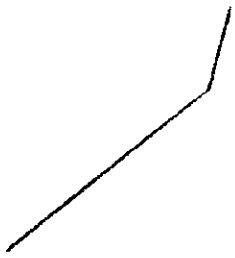
Fig. 3.3.9
Locations of Signalized or to be Signalized Intersection, Medan City (1979)

Medan Area Transportation Study

Legend

- ○ Existing (21 locations)
- □ Under Construction (9 locations)
- △ Under Planning (13 locations)

* Refer to Table 3-3-15



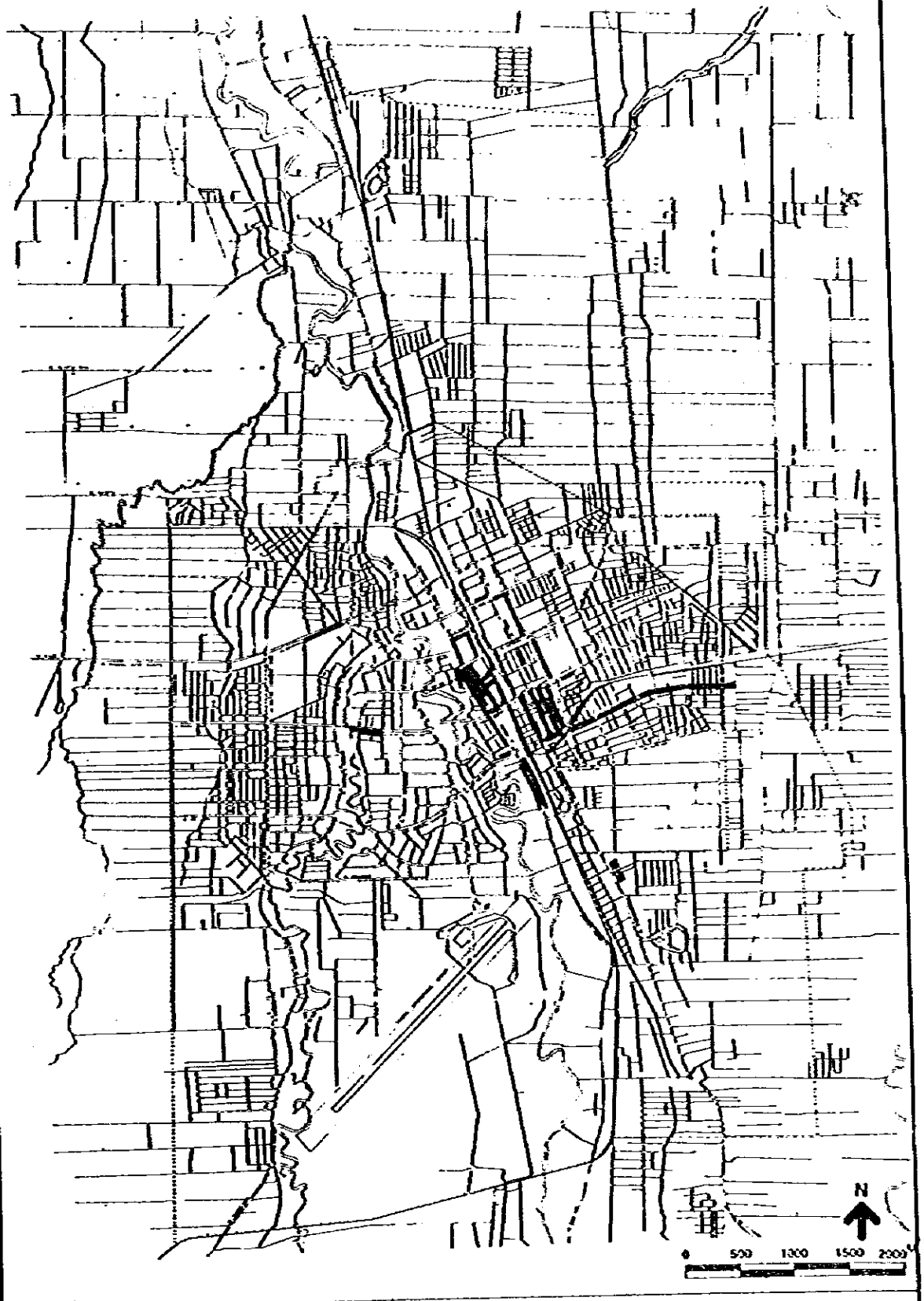


Fig. 3.3.10
Authorized Road-side Vehicle Parking Spaces in Medan City (1979)

Legend :

Authorized Road side Parking Spaces

Medan Area Transportation Study

On streets where commerce shops stand abreast Becak parking makes the effective width of streets narrower and the road traffic flows seems to be disturbed by such way of parking.

In addition to this, pedestrians on side walks and customers of shops are also troubled by such road side parking.

However, such a phenomenon does not take place on whole area along all streets in city but on a part of those in the CBD, therefore it can be a big problem only on arterrial streets.

(b) Parking Spaces

It is estimated that the total parking spaces and their capacities, which are shown in Fig. 3.3.10, are approximately 51,420 m^2 and 2,850 vehicles respectively.

Table 3-3-16 Existing Vehicle Parking Spaces in the CBD, Medan City (1979)

Location	Length of Road side Parking	Parking Capacity	Parking Area
	m	vehicle	m^2
1	400	130	2,400
2	300	100	1,800
3	2,400	800	14,400
4	1,470	490	8,820
5	1,320	440	7,920
6	1,570	520	9,420
7	460	150	2,760
8	650	220	3,900
Total	8,570	2,850	51,420

Notes: Considering under the following conditions, the parking space can be estimated:

1) Parking System on road side in the central area of Medan seems to be Back-Up pattern at present.

2) It is assumed that Parking Style is as in Fig. 3.3.11.

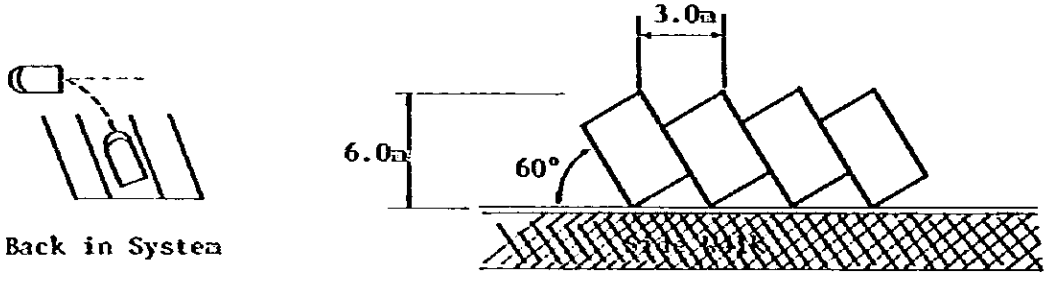


Fig. 3.3.11 Roadside Parking Pattern

(c) Total Parking Vehicle Frequencies

There has been no data on Parking Frequencies per vehicle in Medan City at present. Therefore, in this study, the number of total parking vehicles per day on road side can be assumed as shown in the following conditions in Table 3-3-17.

Table 3-3-17 Vehicle Parking Frequencies And Estimated of Daily Capacity

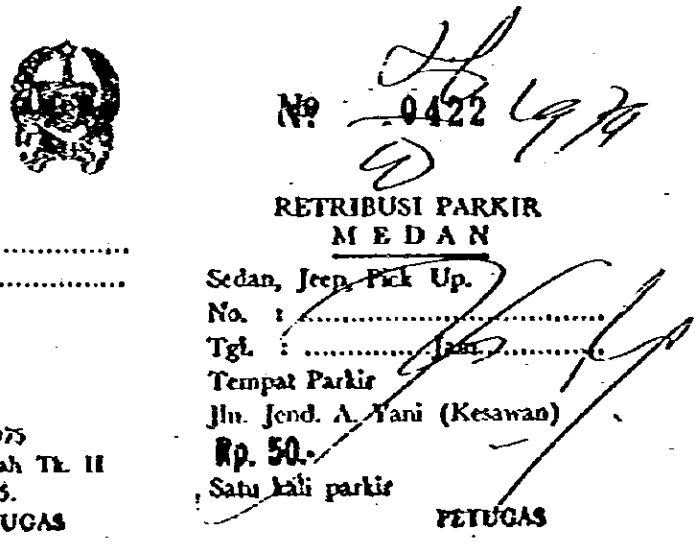
(1) Average Parking Time (min.)	(2) = 1020 ÷ (1) Parking Frequencies per day	(3) Capacity of Parking	(4) = (2) x (3) No. of Total Parking Vehicles per day
30	34	2,850	96,900
60	17	2,850	48,450
90	11.3	2,850	32,205
120	8.5	2,850	24,225
150	6.8	2,850	19,380
180	5.7	2,850	16,245

According to the assumption, total parking vehicles per day in which is the case of 30 minutes in average parking time are about 96,900 vehicles per day.

(d) Parking Charge System

Toll parking system is enforced on road side parking. A flat parking charge of 50 Rp. per parking vehicle is counted as an important revenue source of Municipal Government of Medan at present.

Drivers are requested to pay 50 Rp. when they want to drive off the parking space in exchange of a receipt. One of the samles of Receipt Parking Charge in Medan is shown below.



3.4 Present Situation of Railway

3.4.1 General

The railway network in North Sumatra is shown in Figure 3.4.1. Railway lines radiate out from Medan station to North, East, South and West directions, which system is under the management of PJKA-ESU (North Sumatra Regional Office, Indonesian State Railways). The route length of those lines are as follows:

		(km)
North Line :	Medan - Belawan	21.607
East Line :	Medan - Tg. Balai	174.422
	Kisaran - R. Prapat	113.872
	T. Tinggi - Siantar	48.467
	Lubuk Pakam - Petumbukan	18.883 *)
West Line :	Medan - Kuala	41.406
	Binjei - Besitang	80.905
	Besitang - Pangkalan Susu	10.400 *)
South Line :	Medan - Batu	14.283 *)
	Medan - Pancur Batu	19.339 *)

Notes: *) Marked lines are not in use at present.

Thr route network of the railway in Medan area is shown in Fig. 3.4.2. The railway in North Sumatra including Medan area is utilized originally to transport agricultural products and imported commodities between Belawan Port and plantation estates in hinterland, secondly to transport passengers between Medan area and other cities. Presently in 1979 the railway does not share substantially the urban traffic in Medan Area. The railway infrastructure and rolling stock presently require a considerable upgrading to be able to maintain its existing market share and to take advantage of the growth over the next 20years. Present allowable axle load of rolling stock is 9tons.

3.4.2 Passenger and Freight Traffic

(1) Passenger Traffic

Past records of numbers of railway passengers and passenger - kms in North Sumatra by year are shown in Table 3.4.1. The number of passengers has dropped year by year for the past more than ten years. However, it has changed to increase slightly since 1978. On the other hand the average haul of passenger traffic became longer year by year and it is found that the number of short distance travelling passengers has decreased due to the competition with bus. The location of stations in Medan area are shown in Figure 3.4.2, and the number of departing and arriving passengers at those stations are shown in Table 3.4.2, which shows that those numbers are very small at present except that at Medan station. This is partly due to the fact that such stations are mostly out of use for urban transportation. Such situation was confirmed from the results of O - D survey by interviewing railway passengers carried out on October 18th by PJKA - SU personnels and the Study Team. Table 3.4.3 shows the total number of passengers originated from and terminated at Medan and Medan Pasar stations. According to this table, the Eastern line for Tanzing Balai has more significant volume of passengers than that of the

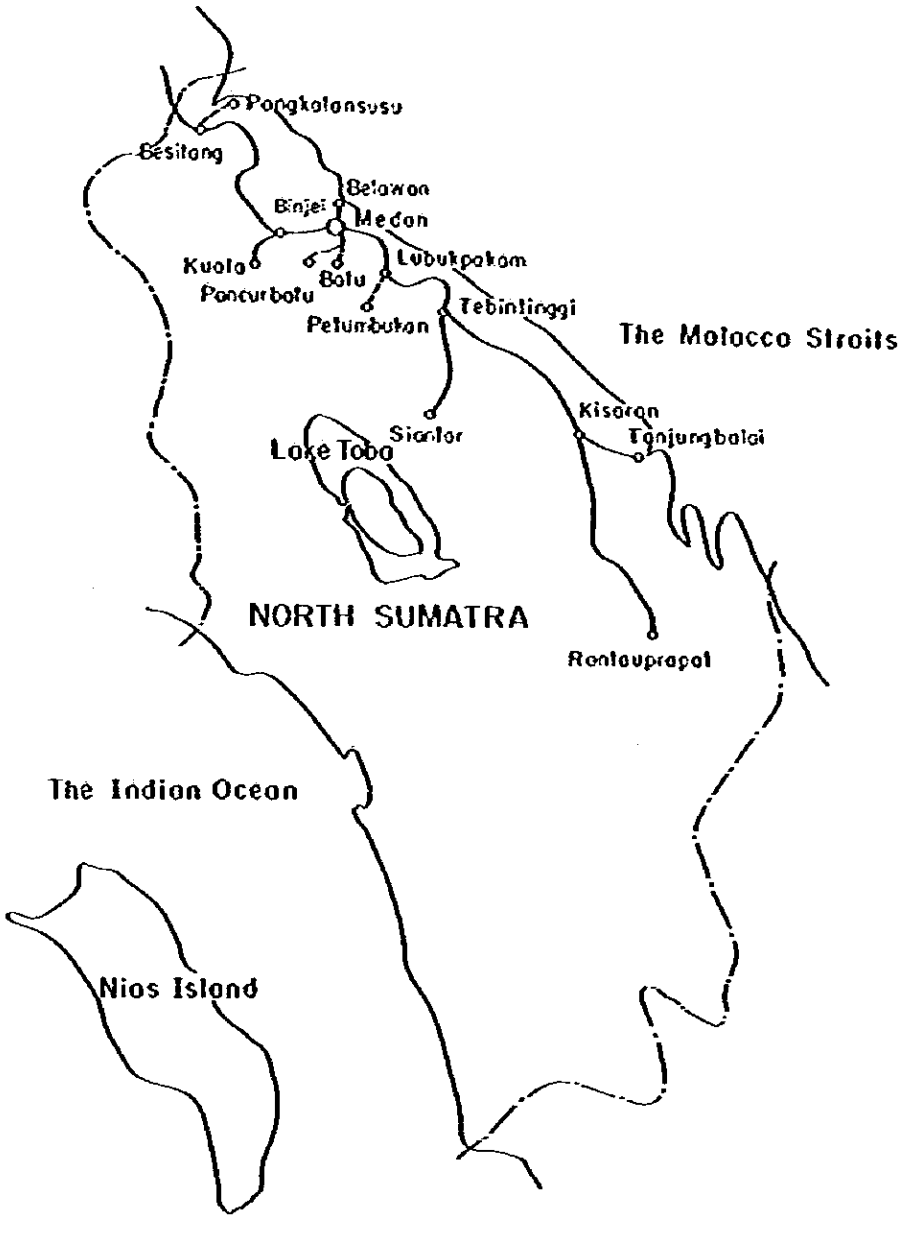


Fig. 3.4.1 Railway Route Map in North Sumatra	Legend —— Operated Line ----- Non-Operated Line
Medan Area Transportation Study	

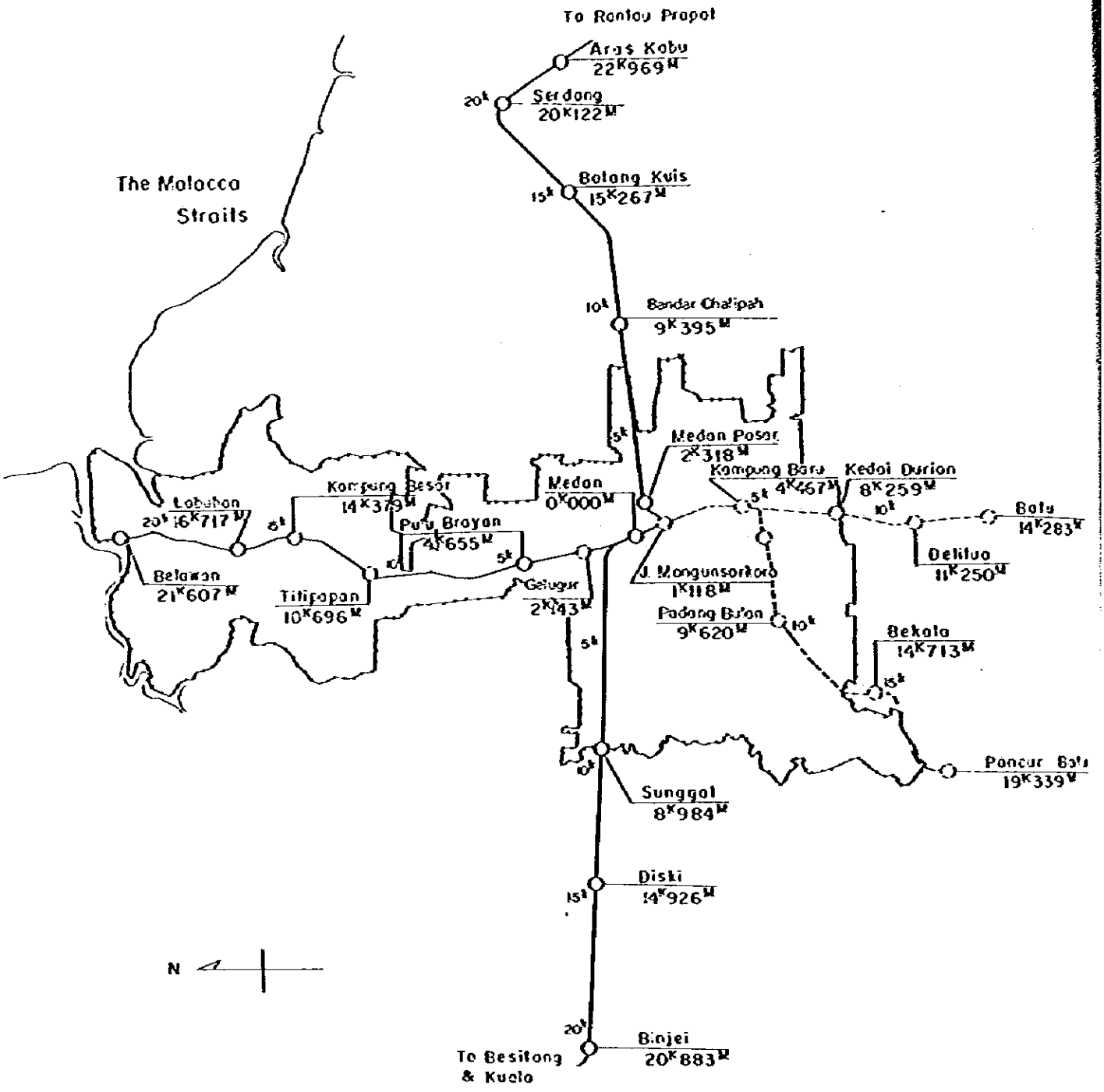


Fig. 3.4.2 Railway Route Map in Medan Area	Legend —— Operated Line ------ Non-Operated Line O Operated Station ○ Non-Operated Station ·-·-·-· Boundary Line Of Medan City
Medan Area Transportation Study	

Western line of Besitang. The total daily number of passengers departing from and arriving at Medan station counts around 1,100 persons, and that of Medan Pasar is around 200 persons according to the source of PJKA in 1978.

(2) Freight Traffic

Tonnage of railway freight traffic and figures in ton-km in North Sumatra by year are shown in Table 3.4.4. Tonnage of freight traffic had decreased slightly year by year for the past more than ten years. However, the average haul of freight traffic became somewhat longer in recent years partly due to the competition with truck. Major commodities transported by railway are palm-oil, palm-kernel and petroleum products. Palm-oil and palm-kernel are transported from plantation estates in hinterland to Port of Belawan and petroleum products to oil terminals in Noth Sumatra. Tonnage of major commodities loaded and unloaded at Belawan station are shown in Table 3.4.5.

Table 3-4-1 Yearly Number of Passengers and Passenger-Kms by Railway Transport in North Sumatra (1969∿1976)

Year	Number of Passengers (x 10^3)	Passenger-Kms (x 10^6)	Average Number of Km Travelled per Passenger
1969	2,100.0	126.0	60.0
1970	1,946.0	121.0	62.2
1971	1,886.0	116.0	61.5
1972	1,397.0	90.0	64.4
1973	1,043.0	76.0	72.8
1974	1,105.0	97.0	87.8
1975	750.4	83.6	111.4
1976	643.2	75.6	117.5
1977	480.8	64.4	133.9
1978	773.4	102.8	132.9

Source: (1969∿1974) Railway statistics
(1975∿1978) PJKA-ESU

Table 3-4-2 Yearly Number of Departing and Arriving Railway Passengers by Station (1978)

Station	Departing (per year)	Arriving (per year)
Medan	226.225	180,089
Sunggal	122	22
Diski	371	517
Binjei	9,897	6,081
Medan Pasar	55,543	16,729
Lubukpakam	4,228	4,108
Perbaungan	6,623	5,697
Total	304,309	213,730

Source: PJKA-ESU

Table 3-4-3 Daily Number of Railway Passengers by Train (October, 1979)

(Unit: persons)

Train Number	From:	To:	Number of Passengers	
			Medan	Medan Pasar
#91	Tg. Balai	Medan	202	108
#95	Tg. Balai	Medan	187	85
#93	R. Prapat	Medan	110	71
#93F	R. Prapat	Medan	137	90
#90	Medan	Tg. Balai	192	68
#94	Medan	Tg. Balai	217	101
#92	Medan	R. Prapat	215	44
#92F	Medan	R. Prapat	153	15
Sub-total			1,413	582
#1927	Medan	Besitang	20	-
#1925	Medan	P. Brandan	29	-
#1924	P. Brandan	Medan	27	-
#1928	Besitang	Medan	8	-
Sub-total			84	-
Grand Total			1,497	582

Source: The O-D survey for railway passengers was conducted by The JICA Study Team on October 18, 1979.

Table 3-4-4 Yearly Tonnage of Freight Traffic and Ton-Kilometers by Railway in North Sumatra (1969∿1978)

Year	Tonnage of Freight ($\times 10^3$)	Ton - Kms ($\times 10^6$)	Average Number of Km hauled per ton
1969	711	82	115
1970	713	79	111
1971	688	82	119
1972	678	91	134
1973	701	109	156
1974	605	96	159
1975	556	89	160
1976	532	90	169
1977	549	95	173
1978	632	103	163

Source: (1969∿1974) Railway statistics
(1975∿1978) PJKA-ESU

Table 3-4-5 Yearly Tonnage of Railway Freight Loaded and Unloaded at Belawan Station (1978~1979)

Commodity	1978	1979
LOADED:		
Benzine	21,487	22,216
Kerosene	11,410	3,231
Diesel Oil	39,619	30,619
Fertilizer	10,994	13,793
Asphalt	-	2,570
Others	3,212	3,690
Total	86,722	76,119
UNLOADED:		
Palm Oil	348,519	260,584
Palm Kernels	46,866	36,533
Crum Rubber	21,176	9,199
Sleeper	-	4,078
Others	64,402	37,352
Total	480,963	347,746

Source: PJKA-ESU
Notes : 1978 : January - December
1979 : January - August (8 months)

3.4.3 Train Operation

The current train operating diagram in Medan area is shown in Fig. 3.4.3. On the Medan-Belawan line only freight trains are operated in each direction, and no passenger train is operated at present except extra trains on some season. On the East line for the direction of Tanjung Balai, Rantau Prapat etc., four express passenger trains, one mixed train and seven freight trains are presently operated daily in each direction. But the mixed train is used only for freight traffic presently for the time being. On the West line for the direction of Kuala, Besitang etc. only three mixed trains and one extra freight train are presently operated in each direction. All trains are hauled by diesel locomotive in North Sumatra. It is found out from this train operating diagram that the railway in Medan area contributes presently to neither commuter service nor urban transport.

3.4.4 Stations

There are not many railway stations in Medan City area. Major station in the city is Medan station, which is located in the central part of Medan city, and can be utilized effectively for the urban traffic in Medan city. Medan Pasar station located adjacent to Medan station on its eastern line is also situated in the city's central area; however, the number of passengers departing and arriving at those two stations are not many presently as shown in Table

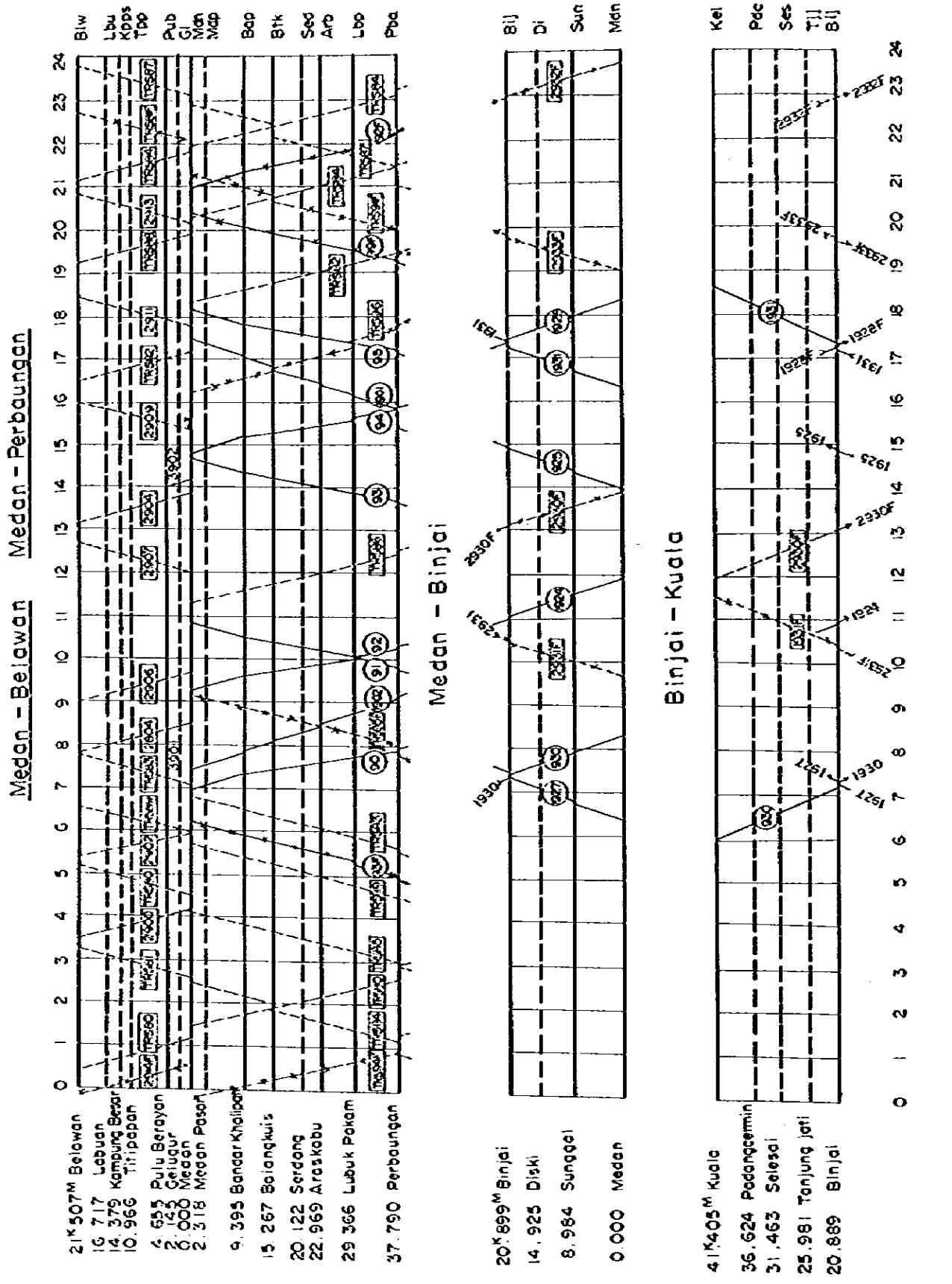


Fig. 3.4.3
Train Diagram of Medan Area
(as of June 1979)

Legend

- Express Train
- Local Train
- Freight Train
- Irregular Train

Medan Area Transportation Study

3.4.2. Medan station which is the key point of railway network in North Sumatra, has four platform tracks, a coach yard, a switch yard and a locomotive shed and warehouses. Those layouts are shown in Figure 3-4-4. Belawan station has a freight yard and a freight terminal for export and import, while other stations in Medan area are comparatively small, having only a passing siding except Medan Pasar station.

3.4.5 Tracks and Bridges

The classes and grades of railway tracks in Medan area are presently as follows: (refer to Table 3.4.6 and Figure 3.4.10)

Section		
Medan - Belawan	2	1
Medan - Lubuk Pakam	2	1
Medan - Binjei	2	2
(Medan - Batu)	(2)	(2)
(Medan - Pancur Batu)	(2)	(2)

(Note: Sections in parenthesis are not in use presently.)

The allowable maximum operating speeds on those sections are 59 km/h on Medan-Belawan Line and Medan-Lubuk Pakam Line, and 45 km/h on Medan-Binjei Line respectively. The conditions of those tracks are not so good because of their old sleepers, slackness of fastenings, shortage of ballast and so on. Railway bridges existing in Medan area are shown in Table 3.4.7, and their design loads are shown in Figure 3.4.11. Most of those bridges are considerably old, and their bracing members and rivets are partially deteriorated. However, their main girders are well maintained so that there is no bridges to be reconstructed for the purpose to carry on the current train loads under the current operating condition.

3.4.6 Railway Crossings

All crossings with public roads in Medan area are at grade. The main crossings located in Medan are shown in Table 3.4.8 and most of them are equipped with barrier-bars operated by gate-men at site or signal men in the station. However, no device informing approaching train to gate-men as well as road users are installed presently. Gate-men are noticed on approaching train only by train despatchers in adjacent stations through telephone, or have to confirm by sight by themselves.

Such a procedure tends to increase the closing time of barrier-bars and is one of the problem to be improved. Another problem is the surface condition of crossings which pavement lacks repair and tracks at crossing are not well maintained. Such a situation at crossings brings about some obstruction against smooth flow of road traffic through crossings.

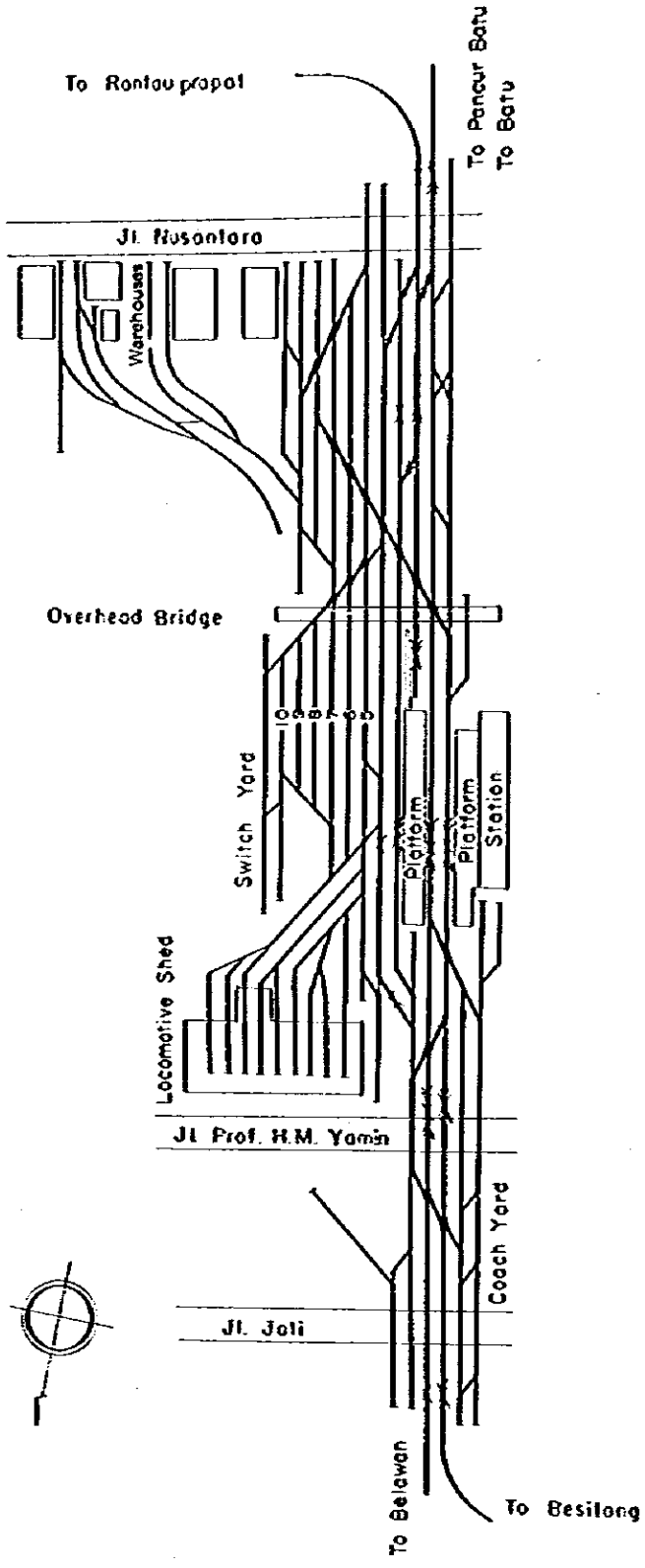


Fig. 3.4.4 Track Layout of Medan Station (1979)	Legend
Medan Area Transportation Study	

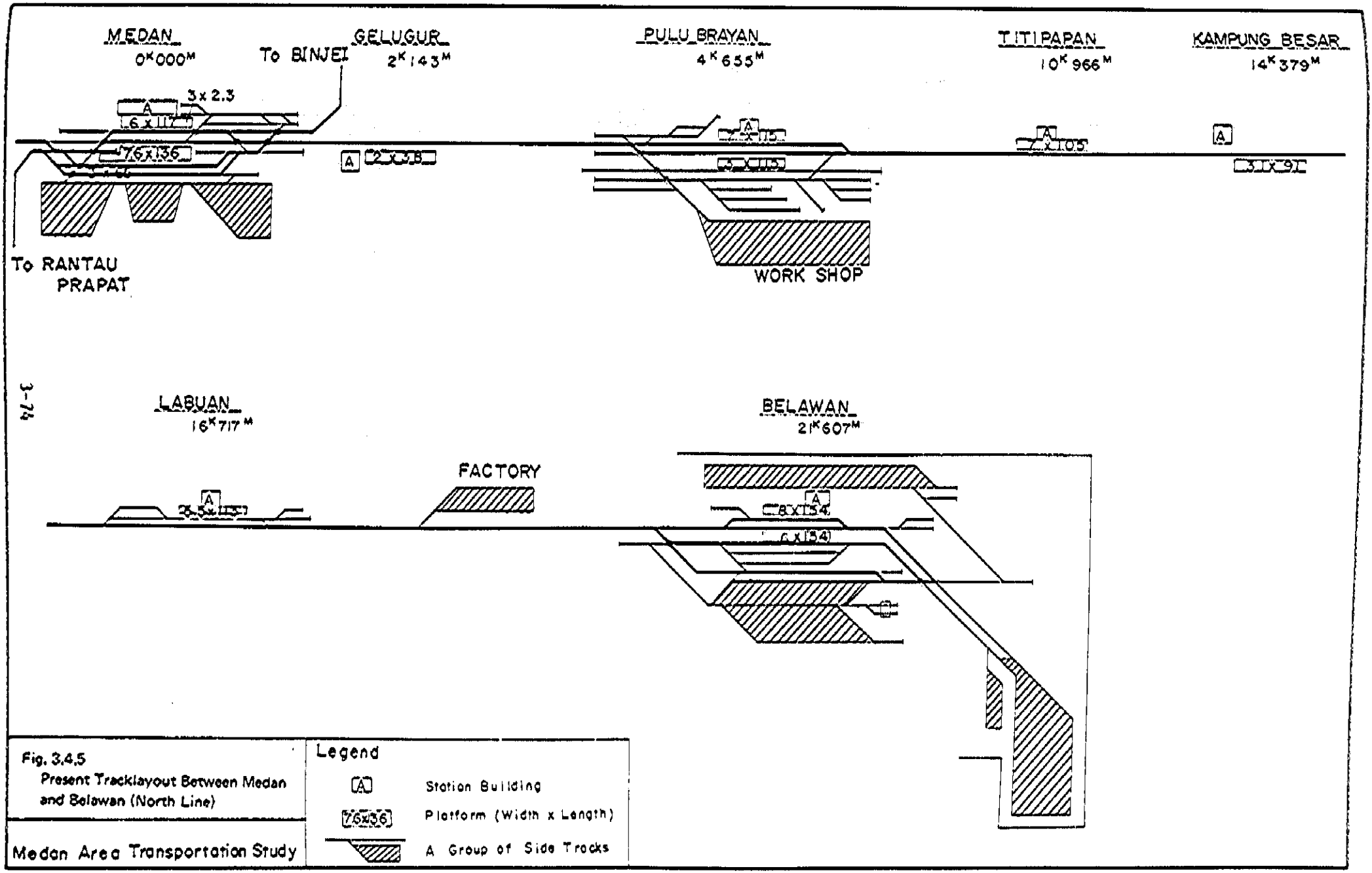


Fig. 3.4.5
Present Tracklayout Between Medan and Belawan (North Line)

Medan Area Transportation Study

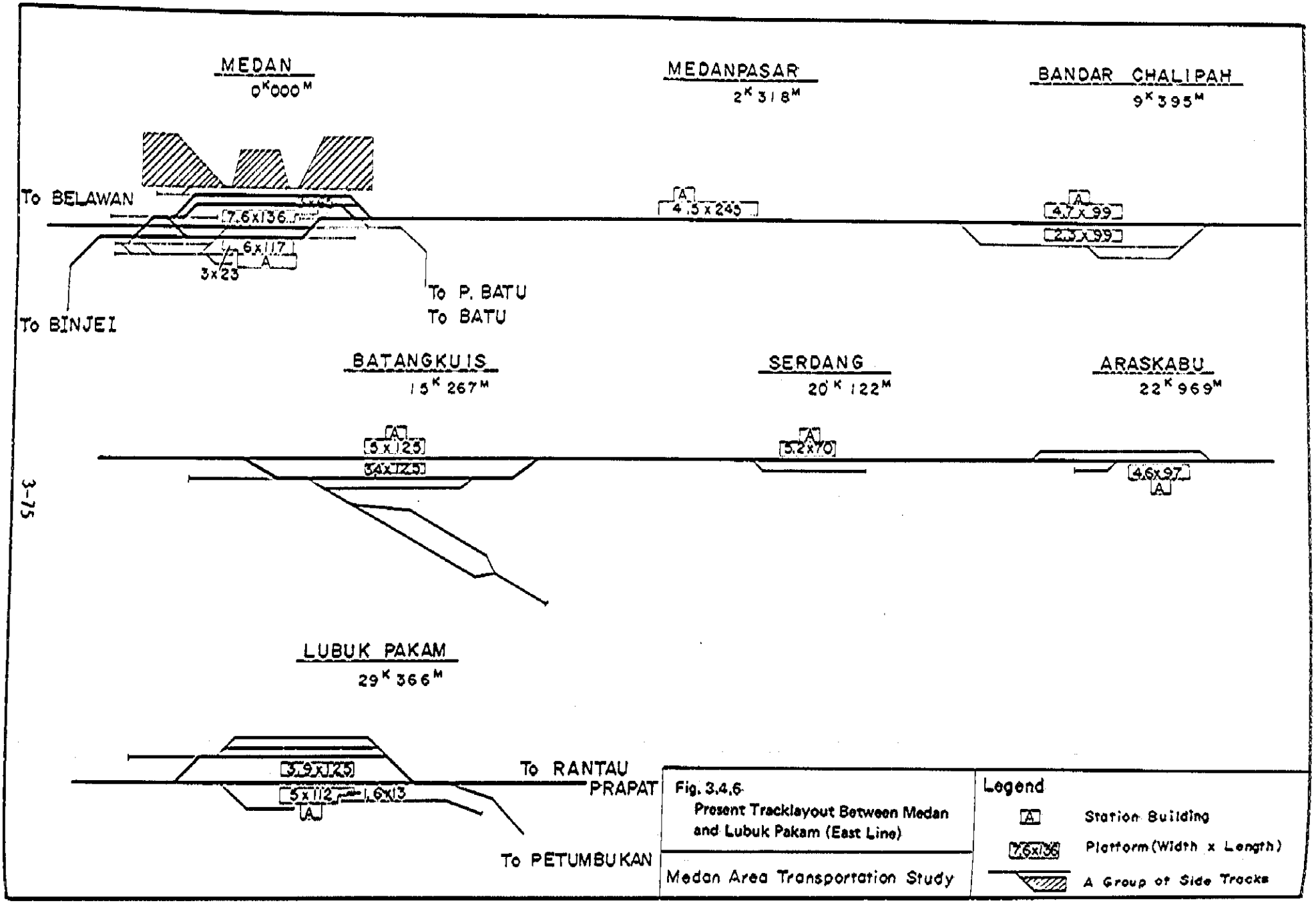


Fig. 3.4.6
Present Tracklayout Between Medan and Lubuk Pakam (East Line)

Medan Area Transportation Study

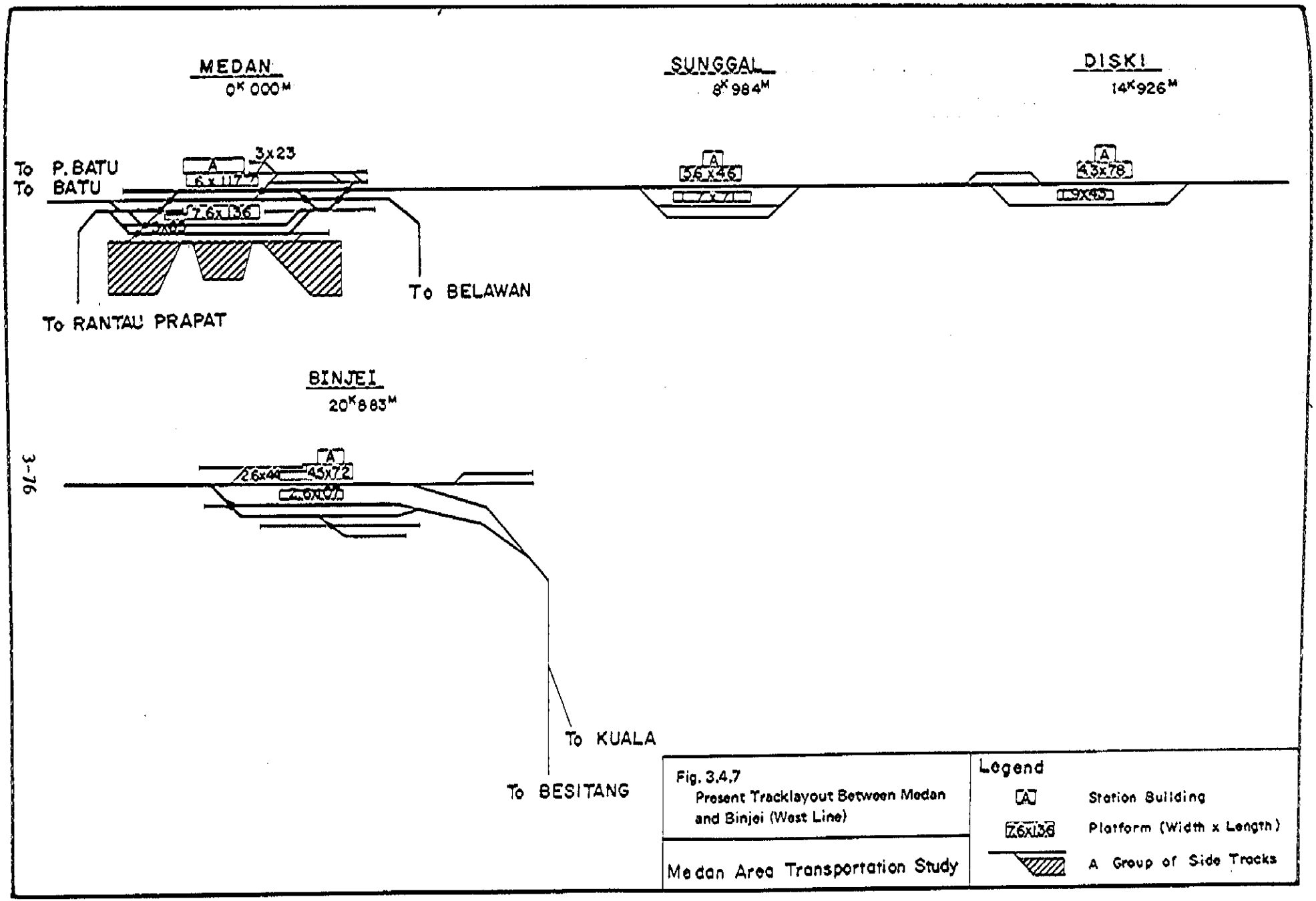


Fig. 3.4.7
Present Tracklayout Between Medan and Binjei (West Line)

Medan Area Transportation Study

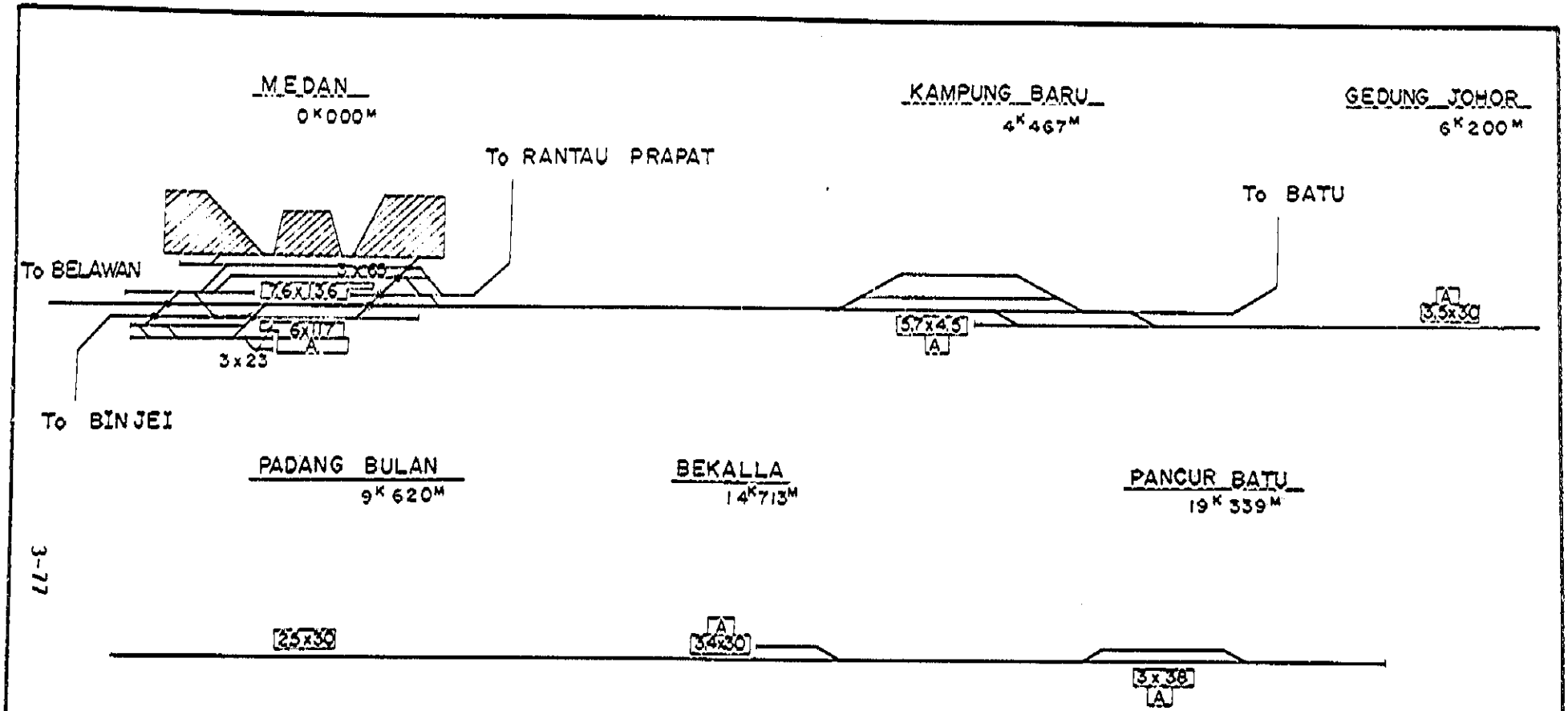


Fig. 3.4.8
Present Tracklayout Between Medan and Pancur Batu (South Line)

Medan Area Transportation Study

Legend

A — Station Building

7.6x136 — Platform (Width x Length)

A Group of Side Tracks

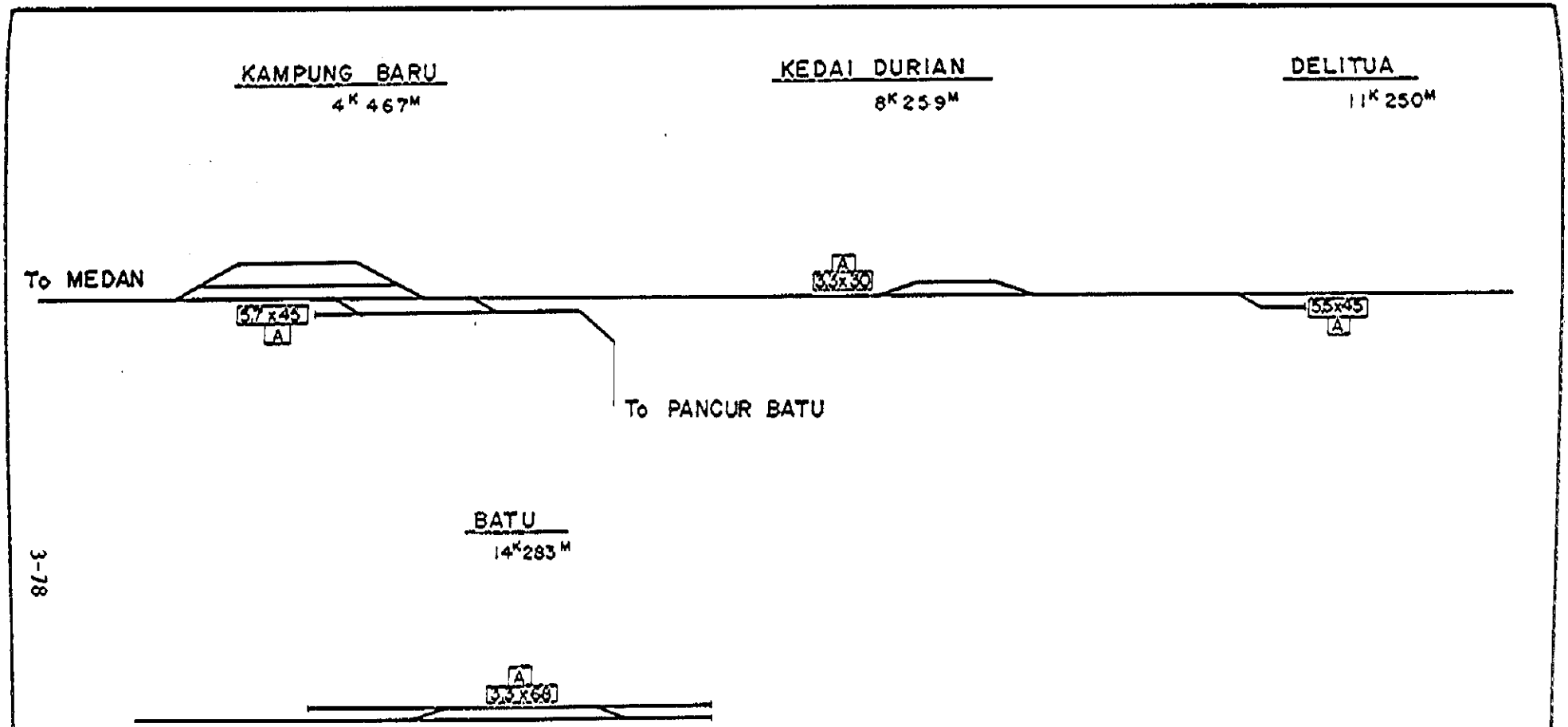


Fig. 3.4.9
Present Tracklayout Between Kampung Baru and Batu (South Line)

Medan Area Transportation Study

Legend

A — Station Building

5.7x45 — Platform (Width x Length)

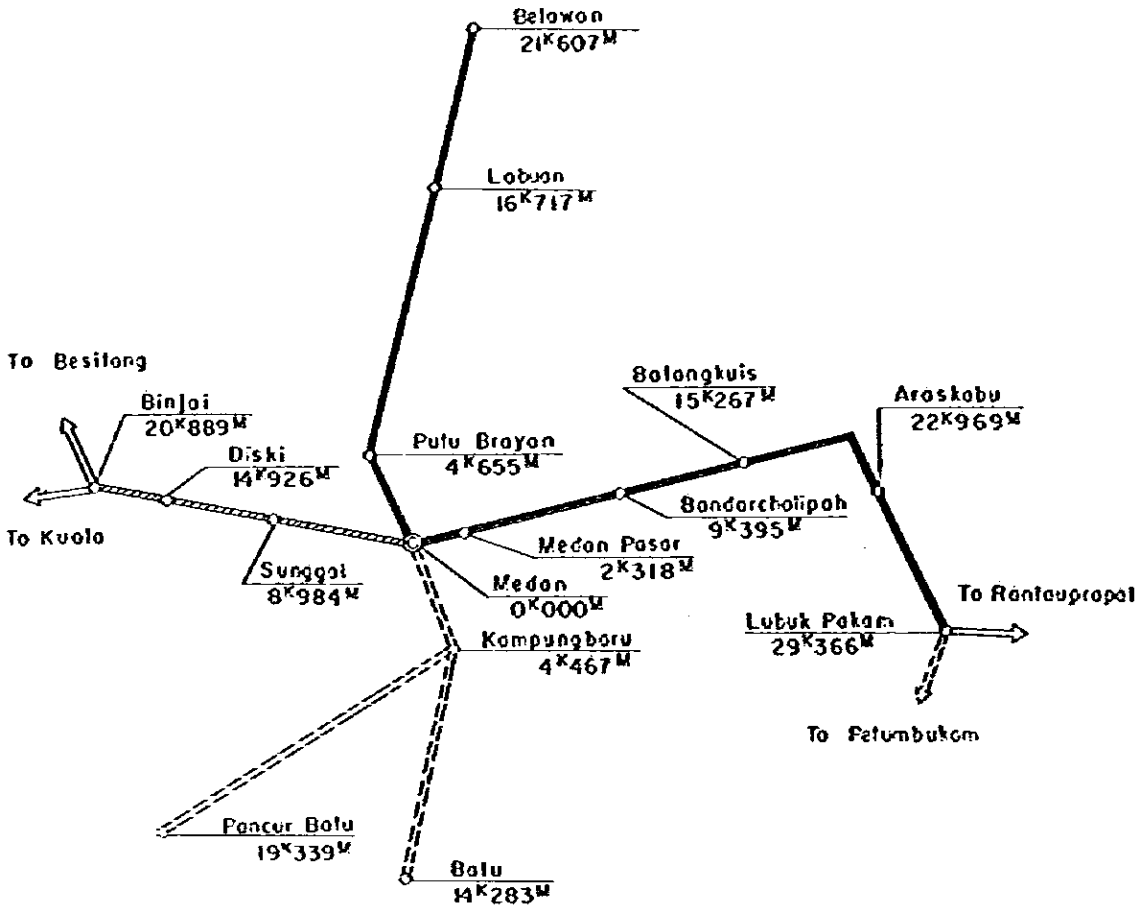
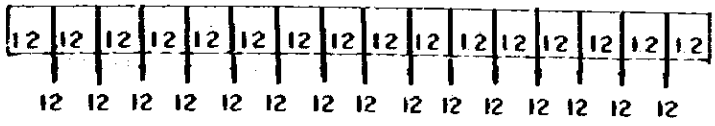


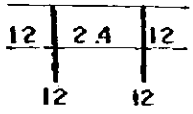
Fig. 3.4.10 Railway Track Classification in Medan Area (1979)	Legend Operated Line Non-Operated Line Track : Class 2 Grade 1 Track : Class 2 Grade 2
Medan Area Transportation Study	

RM 1921 (in meter, ton)



Equivalent Uniform Load

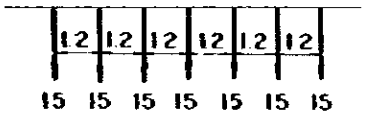
8.75 t/m



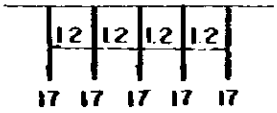
Equivalent Uniform Load

5.00 t/m

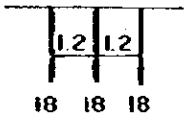
If the number of cars consisting train is undetermined the calculation should be as follows



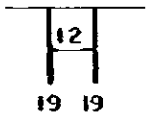
7 axles



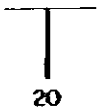
5 axles



3 axles



2 axles



1 axle

Fig. 3.4.11 Standard Design Loads of Railway Bridges	Legend
Medon Area Transportation Study	

Table 3-4-6 Classification & Requirements of Railway Tracks
Indonesian State Railway

Class of Track	Allowable max. Axle Weight (Ton)	Rail Type Number	Weight of Rail (Kg/m)	Maximum Interval between Ties (m)	Depth of Ballast (m)
(CLASS 1 Grade 1)					
Speed 100-120 Km/hour	13.4	14	41.52	0.70	0.25-0.30
(CLASS 1 Grade 2)		3 (11P)	33.40	0.68	
Speed 60-100 Km/hour	13.4	12	33.50	0.68	0.20
		14P	37.17	0.80	
(CLASS 2 Grade 1)		15P	38.00	0.81	
Speed 45-59 Km/hour	12.0	14	41.52	0.81	0.15-0.20
		2	25.75	0.70	
(CLASS 2 Grade 2)					
Speed 20-30 Km/hour	12.0	2	25.75	0.72	0.15
(CLASS 2 Grade 3)					
Speed 20-30 Km/hour	12.0	2	25.75	0.75	0.15

3.4.7 Signalling and Telecommunication

(a) Signalling

The method of train blocking on railway lines in North Sumatra including Medan area depends on only telephone system. The despatcher who wants to allow a train to depart has to obtain an approval by telephone from the next station which receives the train. No more device for blocking system is equipped to maintain safety of trains en route.

There are home signals and starting signals at main stations such as Medan, Belawan and so on, while only home signals are existing at small stations. Those signals are of semaphore type, except that in Medan station which is equipped with color-signals of two aspects. The signals are mechanically interlocked only within each station.

(b) Telecommunication

The telecommunication network in Medan area is shown in figure 3.4.12. It consists of an ordinary telephone system, a telegram system and a telephone system for train despatching. The telephone system for train despatching and the ordinary telephone system has two networks. One is such connecting all stations, and another is the one connecting only main stations.

Table 3-4-7 Railway Bridges Existing in Medan Area (1979)

LOCATION		Type of Bridge	Length of Bridge (m)
Kilometrage	Section		
I. Medan – Belawan			
k m 1,822.6	Medan – Gelugur	I. beam	4.00
3,595.7	Gelugur – Pulu Brayan	– " –	3.00
II. Medan – Lubuk Pakam			
3,010.9	Medan Pasar – B. Khalipah	Deck plate-girder	6.00
3,720.5	– " –	– " –	6.00
III. Medan – Binjei			
1,665.5	Medan – Sunggal	Through truss	17.00 + 30.00 + 17.00
2,868.9	– " –	Deck plate-girder	5.00
4,220.4	– " –	Through plate-girder	10.00
IV. Medan – Pancurbatu			
5,739.4	Kamp. Baru – Gedong Johor	Through truss	29.00
7,277.0	G. Johor – P. Bulan	I. beam	2.00
8,171.0	– " –	Through truss	24.00
8,831.0	– " –	I. beam	2.00

Table 3-4-8 Railway Crossings Existing in Medan Area (1979)

No.	K.M.	Name of Crossing Road	Operator	Barrier	Gate-men's Cabin	Sight Length	Number of accidents occured from Sep. 1978 to Aug. 1979
	I. MEDAN – BELAWAN						
	k m						
1	0.324	Jl. Prof. H.M. Yamin	DL	Yes	Yes	6M	1
2	0.696	Jl. Jati	DL	Yes	Yes	10M	2
3	2.138	Jl. Karantina	DB	Yes	Yes	Not fulfill condition	
4	3.492		No	No	No	24M	
5	3.688	Jl. Budi Pempangunan	No	No			1
6	3.987		DL	Yes	Remote control from signal cabin	24M	
7	4.368	Jl. Cemara	DB	Yes	Remote control from Pulu Brayan station	24M	
	II. MEDAN – LUBUK PAKAM						
1	0.600	Jl. Nusantara	DL	Yes	Yes	20M	3
2	1.083	Jl. Pandu	DB	Yes	Yes	6M	1
3	1.164	Jl. Mahkamah	DB	Yes	No	6M	1
4	1.324	Jl. Singamangaraja	DB	Yes	Yes	10M	
5	1.675	Jl. Sutomo	DB	Yes	Yes	15M	
6	2.277	Jl. Thamrin	DB	Yes	No	20M	1
7	2.681	Jl. Bakaran Batu	DB	Yes	No	10M	1
8	3.925	Jl. Aksara	DB	Yes	Yes	6M	
9	4.525	Jl. Mandala	DB	Yes	No	5M	1
	III. MEDAN – BINJAI						
1	1.380	Jl. Yos Sudarso Mdn	Yes	Yes	Yes	Not fulfill condition	
2	1.800	Jl. Glugur – Bypass	Yes	No	No	Fulfill condition	1
3	2.695	Jl. Skip	No	No	No	Fulfill condition	
4	4.456	Jl. Kaptea Muslim	No	No	No	Fulfill condition	

Notes: DL = belongs to Traffic Department
DB = belongs to Track Department

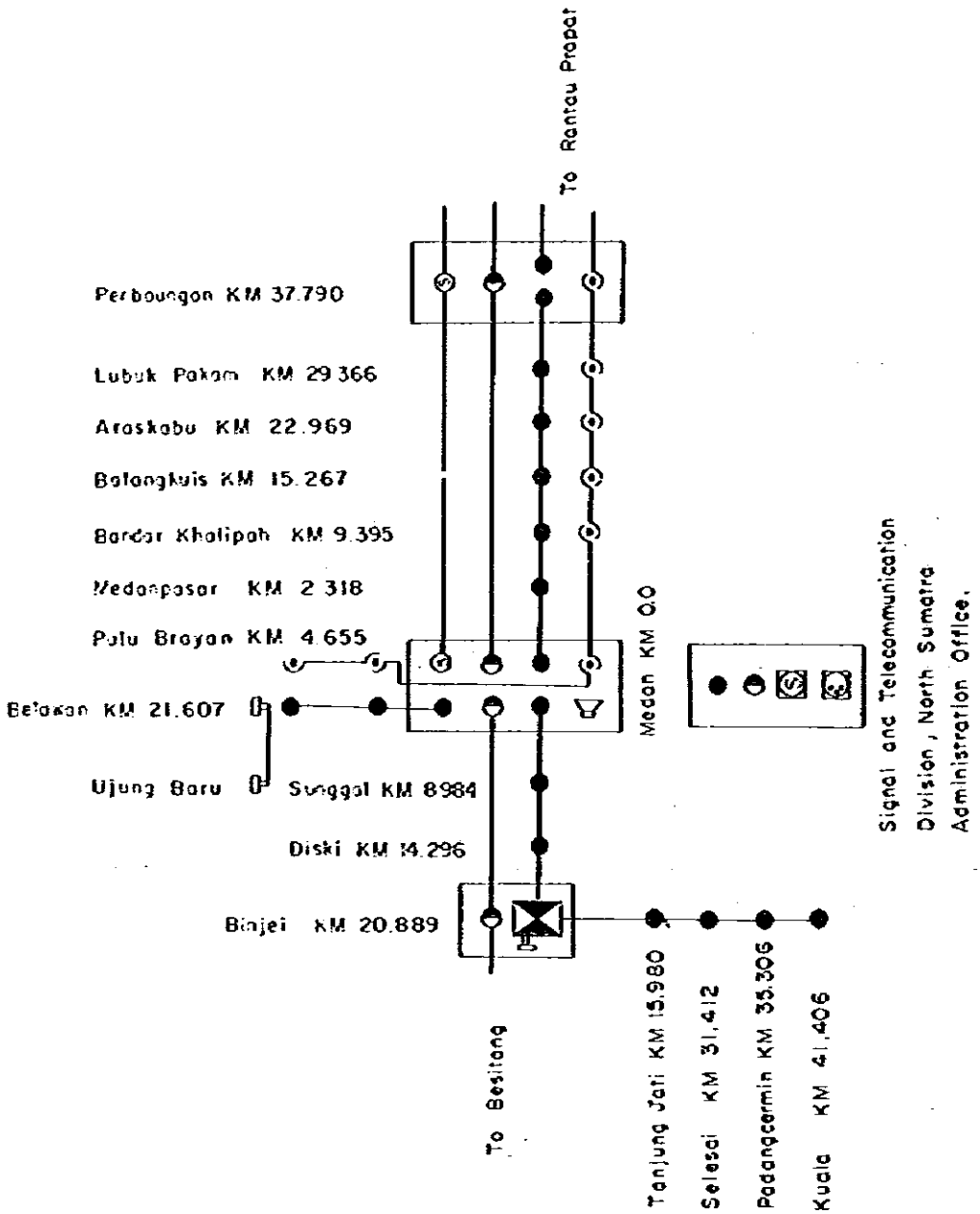


Fig. 3.4.12
Present Telecommunication Network in Medan Area

Medan Area Transportation Study

Legend

- Telephone A
- Telephone B
- Telegram
- Telephone for Train Despatching
- Telephone Local
- Sound System
- Central B 10
- Central UH 200
- Switching Board

3.4.8 Rolling Stock

(a) Locomotives

Four types of locomotives are in service in North Sumatra, all of them being assigned to Medan Locomotive Depot. Their horse-power and total numbers by type are shown in Table 3.4.9. Locomotives of the type BB-302 and BB-303 are for the use on main line traction and those of D-301 are for the use in shunting service. Those of BB-300 are used for both services on main line traction as well as in shunting service.

(b) Passenger Coaches

Number of coaches by type in North Sumatra are shown in Table 3.4.10. Twenty seven coaches recently imported from Yugoslav are equipped with air brake system, while existing old coaches are equipped with vacuum brake device. Presently new coaches are used only for express train. A few old coaches are used for mixed train, and the rest of them are under waiting repairs.

(c) Freight Cars

Number of freight cars by type are shown in Table 3.4.11. More than half of them are tank cars for palm-oil and petroleum products. The rest are box cars, flat cars, low side cars and animal cars. Average number of availability of all freight cars is 75.48% in the term from January 1979 to July 1979.

Table 3-4-9 Characteristics and Number of Locomotives by type Owned by State Railway in North Sumatra (1979)

Item	(BB-300)	(BB-302)	(BB-303)	(D-301)
Diesel engine	MB.820	MB.820	MB.820	MB.836
Transmission	Lisolmemith	Voith	Voith	
Axle arrange-ment	BB	BB	BB	D
Weight	36 ton	44 ton	42.7 ton	27 ton
Horse Power	680	910	1,010	340
Brake Equip-ment	Vacuum brake/ hand brake	Vacuum and air-pressure hand brake	Air brake/ hand brake	Hand brake with independent air brake
Maximum speed	75 km/h	90 km/h	90 km/h	50 km/h
Number of locos. owned	9	6	13	3

Source: PJKA-ESU

Table 3-4-10 Number of Coaches by Type Owned by State Railway in North Sumatra (1979)

Old Type		New Type	
Type	Total Number	Type	Total Number
CL. 9000	15	CW. 9000	13
CFL. 9000	3	BCW. 9000	2
CDL. 9000	2	BW. 9000	3
CDPW. 9000	1	DPW. 9000	5
CFRU. 9000	2	CFW. 9000	4
ARU. 9000	2		
Total	25	Total	27

Source: PJKA-ESU

Note: A = First Class
B = Second Class
C = Third Class
D = Baggage
R = Restaurant
L = Vacuum Brake
W = Air Brake

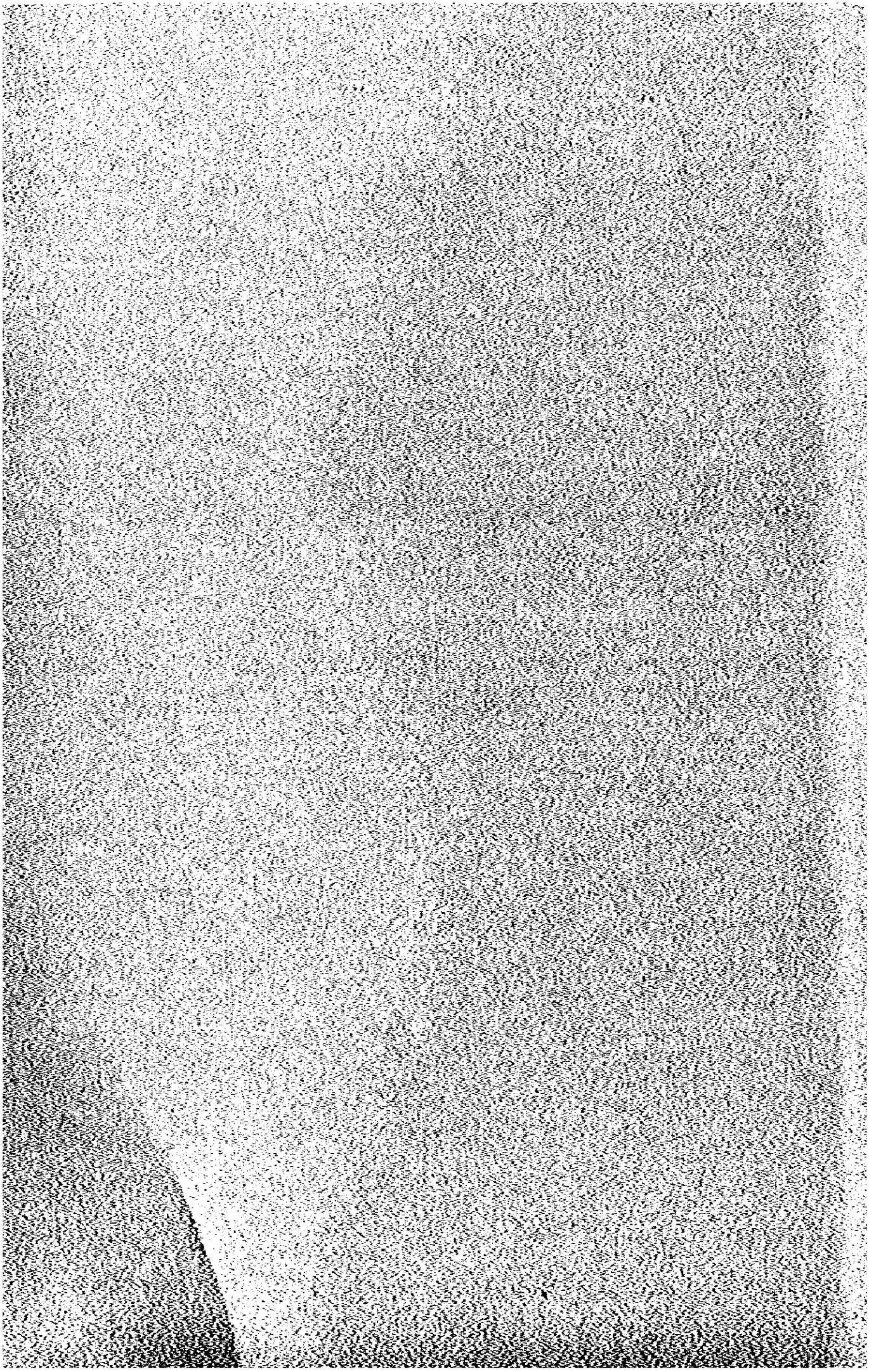
Table 3-4-11 Number of Freight Cars by Type Owned by State Railway in North Sumatra (1979)

Type	Total number
Box Car	517
Flat Car	234
Tank Car	1,200
Open Car	171
Animal Car	44
Special Service Car	66
Total	2,232

Source: PJKA-ESU

Chapter 4.

TRAFFIC ANALYSIS OF PRESENT SITUATION



Chapter 4. TRAFFIC ANALYSIS OF PRESENT SITUATION

4.1 Traffic Characteristics

4.1.1 Trip-End Analysis

(a) Number of Trip-Ends by Transport mode in Medan.

Table 4-1-1 Number of Trip-Ends by Vehicle Type in Medan Area. (1978)

Type of Vehicle	Trip Ends	Registered No. of Vehicles	Unit Trips per Vehicle/day
Sedan	169,702	21,998	3.85
Motor Cycle	523,970	120,978	2.17
Becak Mesin	159,706	1,935	41.3
Bicycle	237,440	-	-
Bus	4,594	334	13.8
Bemo	32,822	2,571	12.8
Truck	65,430	13,932	2.35
Total	1,193,664	161,748*	5.91

Note: *Excluding bicycle
Source: Results of O-D survey concluded by Bina Marga.

From this table it was made clear that the motorization with sedans has not yet started in Medan City; motorcycles, becaks, bicycles, that are easier in availability and in purchasing, determine the general trend in vehicle utilization. A part of the reasons for this fact is that all automobiles such as sedans and trucks are imported, and consequently they are expensive, keeping a difficulty for the common citizens to afford to own them.

The present unit trips per vehicle for sedans, motorcycles, and trucks are considered reasonable in general. A rather high figure for Becak Mesin of 41.3 trips per vehicle reflects its current taxi-like convenient function in Medan City.

(b) Trip-Ends by Zone

The present number of trip ends for all vehicles against zonal population in central four Kecamatans in Medan are shown in Figure 4.1.1. Numbers of trip-ends by zone are conspicuous in the zones surrounding Medan Pasar and scattered commercially developed zones.

(c) Trip-Ends by Person Trip

The present numbers of trip-ends in person-trip are shown in Table 4.1.2 by type of transport mode and by trip purpose. Although there

appear some passengers with commuting purpose under "Railway", who seemed to misunderstand the question by O-D survey interviewer or were special cases, and it is not likely that the figure reflects the real situation.

Table 4-1-2 Trip-End Composition by Trip Purpose and by Type of Transport Mode, Medan City. (Oct. 1979)

(Unit: 1000 Trip Ends per day)

Trip Purpose	Sedan	Bus	Bemo	Motor Cycle	Becak	Bicycle	Railway	Total
Commuting	133.2	93.1	87.9	200.5	101.7	75.0	0.6	692.0
Shopping	28.1	26.8	25.3	57.6	35.8	23.5	0.02	197.2
Return Home	162.0	180.1	170.0	307.0	160.7	110.2	1.5	1,091.4
Others	150.7	66.8	63.0	215.4	124.1	74.0	1.8	695.7
Total	473.8	366.8	346.2	780.6	422.3	282.7	4.0	2,676.4

Source: Results of O-D Survey Conducted by the JICA Study Team

Truck is excluded from the transport modes, and bus and Bemo are added in the table, as the table is a comparison of person trips. The present overall passenger trip ends in Medan are well balanced among transport modes (exclusive of railway), reflecting character of modes.

The trip purpose classification reveals that following the highest rate of 41% by "return home" and "commuting" of 25% stands for second, which are followed by "shopping" of 7%.

Fig. 4.1.3 shows person-trip generation per 1,000 inhabitants by zone. In general, the figures resembles to generated unit trips for all modes of vehicles, with a high trip-ends in the central part of Medan City where the land use is for commercial purpose.

4.1.2 Desire-Line Analysis

In this section it is presented the general tendency of traffic flows, in Medan City consolidating 69 zones, into 12 larger zones for analysis purpose. All that are shown here correspond to vehicle trips by vehicle mode.

(a) Sedans

Sedan's traffic flows are little in the surrounding areas of Medan, owing partially to the limited number of sedans personally possessed. Main traffic flows are from the Medan Pasar zone and from its adjacent residential areas; the tendency of one-point concentration is easily detected.

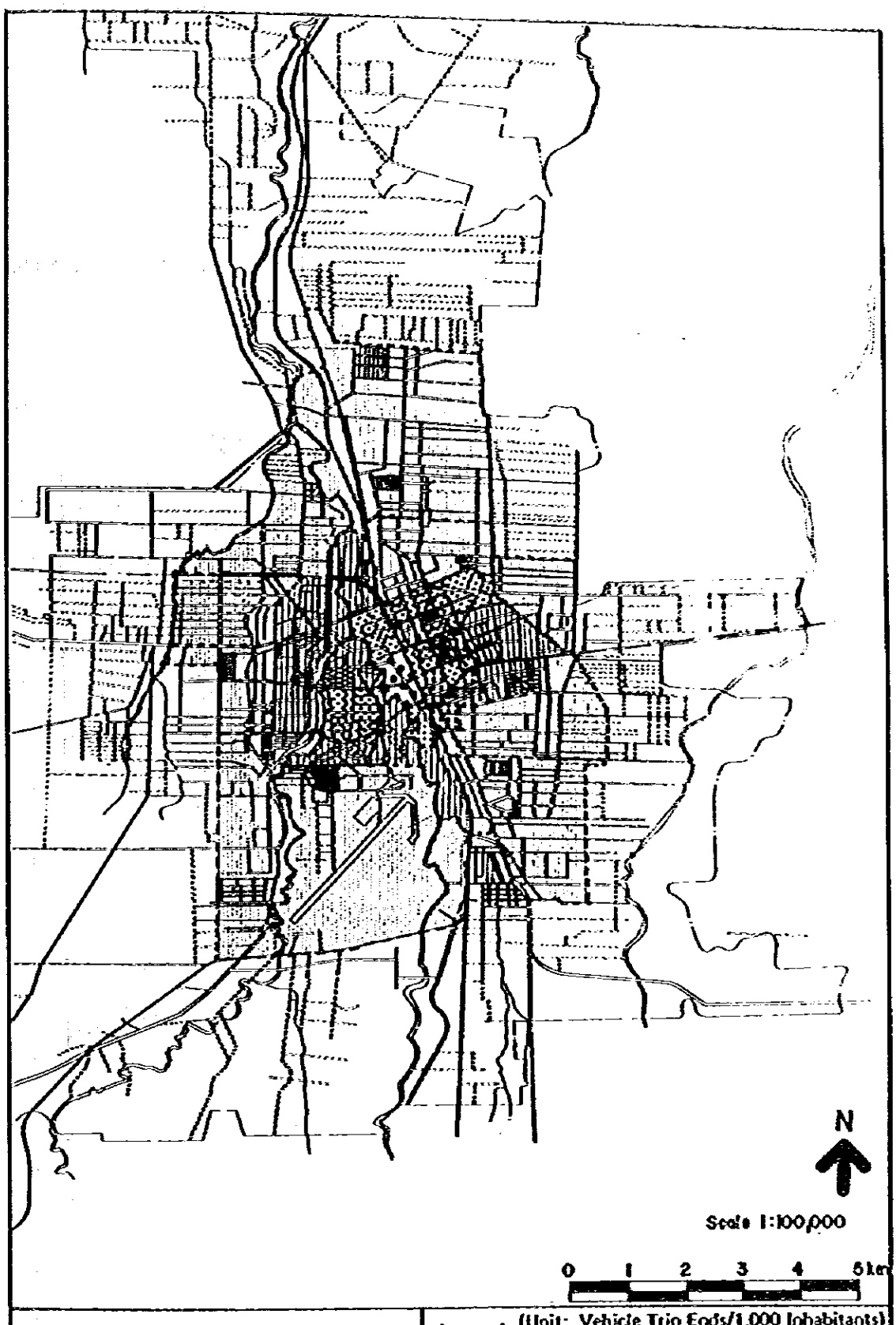


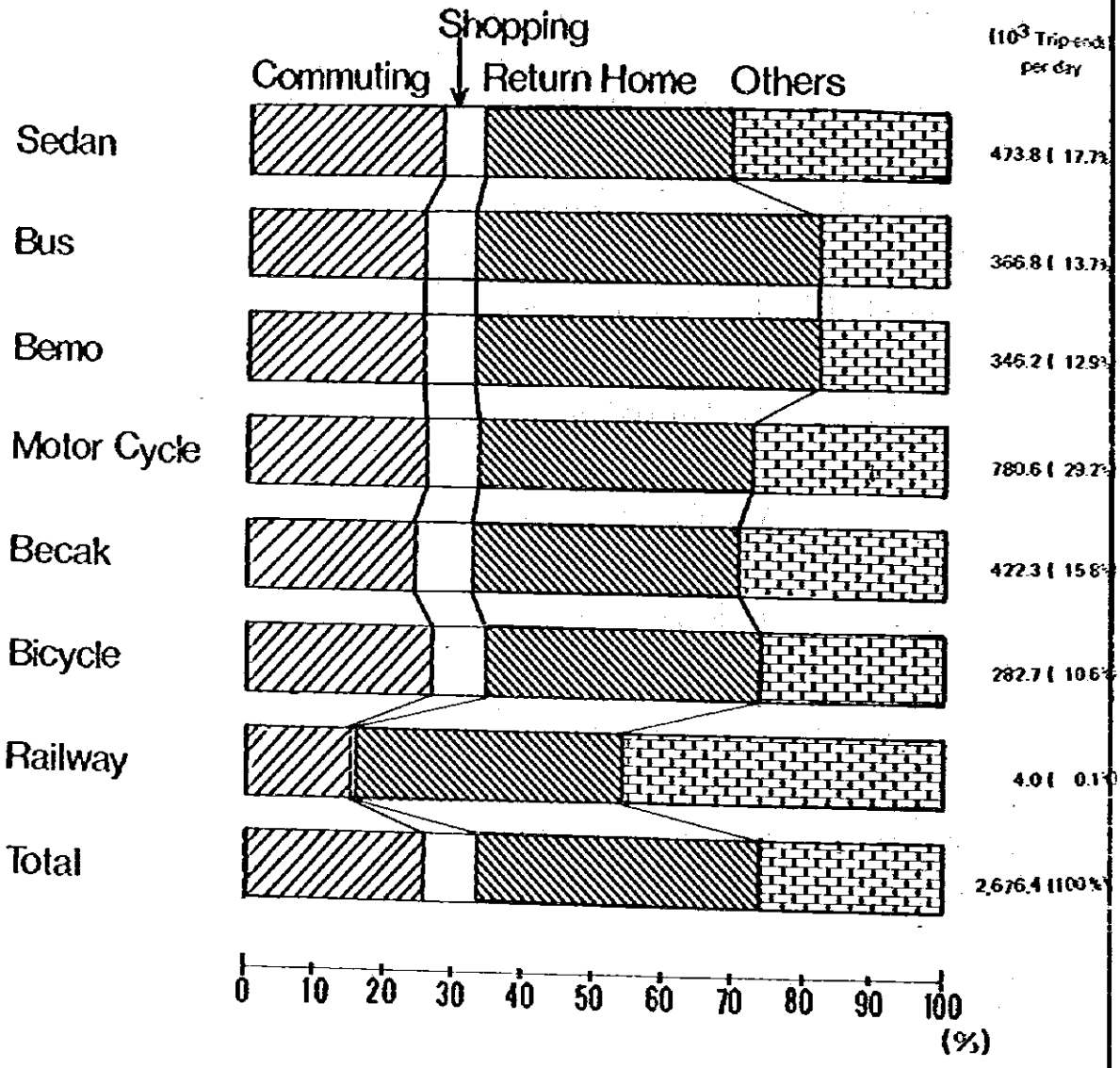
Fig. 4.1.1
Vehicle Trip Ends per Inhabitant by Zone (October 1979)

Legend (Unit: Vehicle Trip Ends/1,000 Inhabitants)

0 —	0.9
1.0 —	2.9
3.0 —	5.9
6.0 —	8.9
9.0 —	11.9

Medan Area Transportation Study

Fig 4.1.2 Purpose Composition of Trip-Ends by Type of Transport Mode (Oct. 1979)



(Refer to Table 4-1-2)

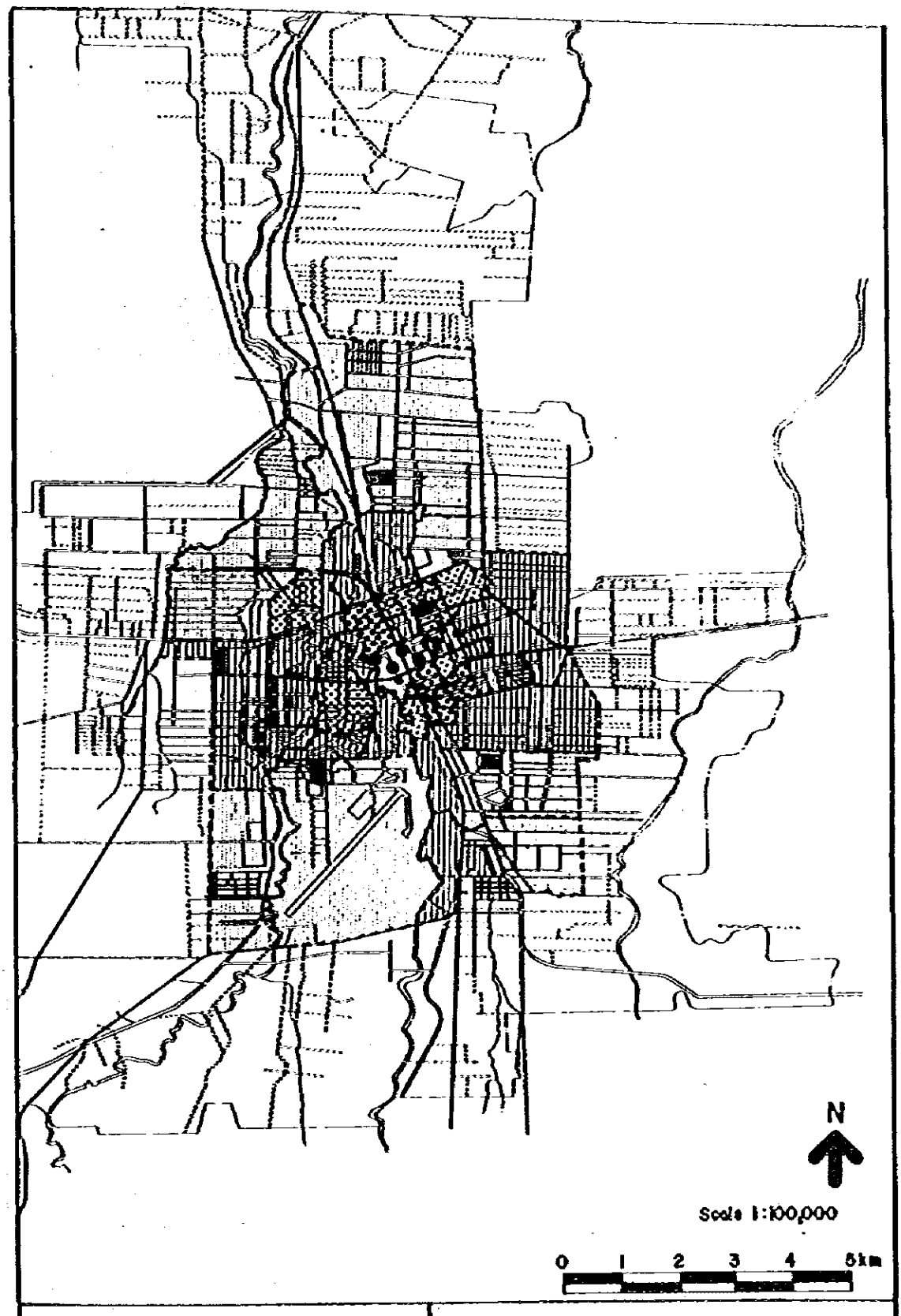


Fig. 4.1.3
Person Trip-Ends per Inhabitant by Zone (October 1979)

Legend (Unit: Person Trip Ends/1,000 Inhabitants)

Medan Area Transportation Study

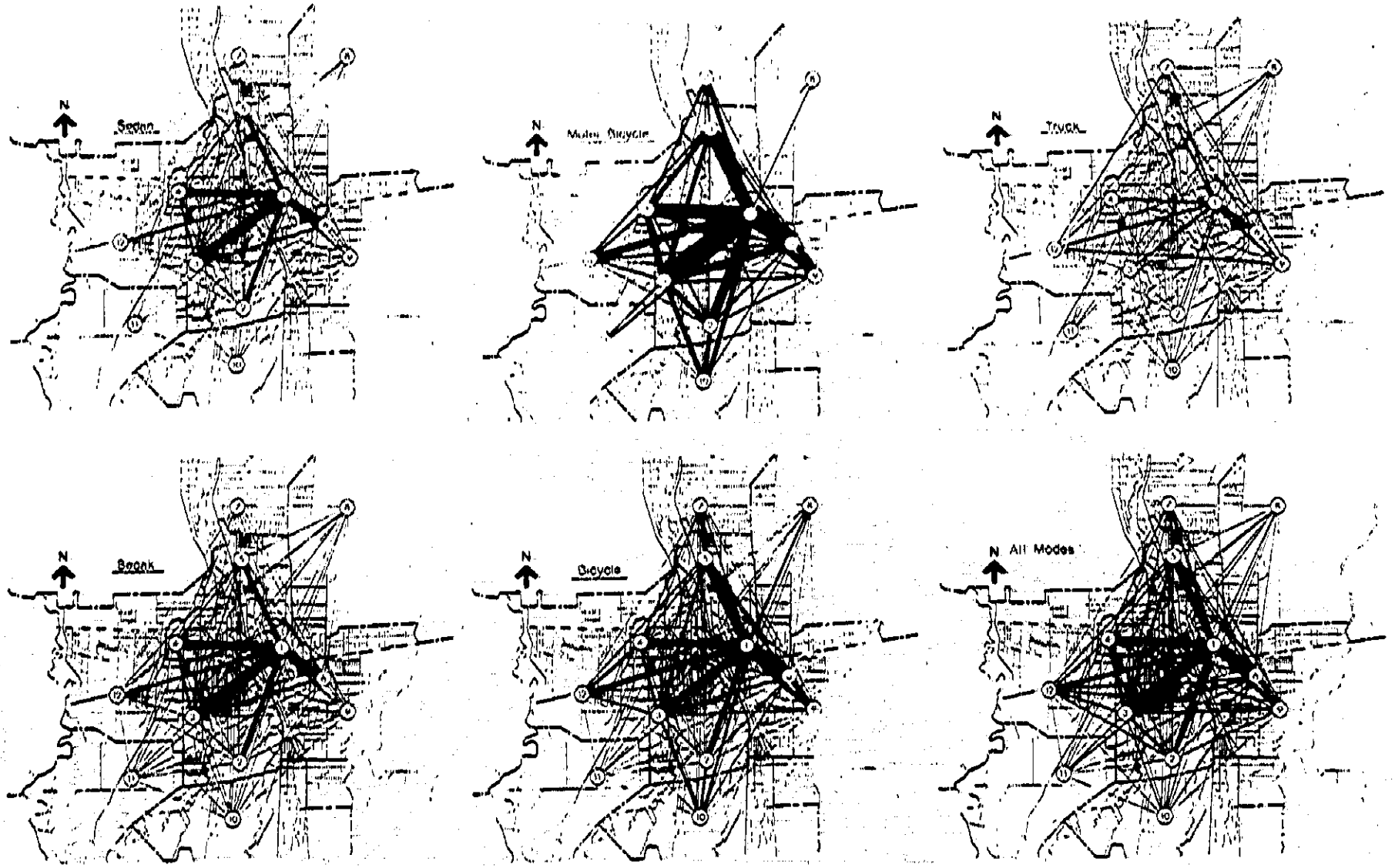


Fig. 4.1.4 Desire-Lines by Transport Mode, Medan City (Feb., 1978)

(b) Motorcycles

It is obviously shown that main passenger flows in Medan are attributable to motorcycles. One-point concentration into Medan Pasar area and substantial flows among surrounding areas are characteristic.

(c) Bicycles

The general pattern of bicycle flows are quite similar to that of motorcycles, showing the one-point concentration into Medan Pasar and flows between centroids on the outskirts, and the volume of flows are less than those of motorcycles.

(d) Becaks

Their pattern resembles to that of sedans and the one-point concentration toward the central zones is conspicuous. This is attributable to the fact that Becaks are a constituent of public transportation system, whose needs are scattered around in central Medan. Presently Medan Municipal Government is planning to revise the present zonal regulations for Becak operation, and yet it will be necessary to take a well-thought-of measure, considering Becak drivers' livelihood as a forced change of natural needs often invites strong local resistance.

(e) Trucks

Since trucks have to do with the transportaion of commodities their pattern of desire-lines somewhat differs from that of the transport modes described already. Concentration in the central zones with warehouses and stores, and also movements toward Belawan deserve to be noted.

From the above mentioned it may be concluded that in terms of traffic flows sedans and becaks have similar patterns, while motorcycles and bicycles show similar patterns. Trucks show a pattern different from those of passenger-related vehicles, but reflecting the distribution of old warehouses and their locational relationships with Port of Belawan.

4.1.3 Distribution of Trip Length by Transport Mode

Fig. 4.1.5 shows the trip-length distribution by transport mode, which tells the actual urban transport situation of Medan City very well. Most urban trip length distribution falls within 10 to 12.5 km, forming a group of trips in Medan Area including Belawan. For trip lengths longer than those figures the distribution is subject to the distances between Medan and surrounding towns and villages. The largest number of trips are distributed in the range between 2.5 and 5.0 km, corresponding to the trips within the city boundary of Medan.

Average trip length of those transport modes are shown in Table 4.1.3, from which one can tell the role of each transport means in Medan. That is, sedan, motorcycle, and bicycle stand in the similar range of about the 5.6 - 6.5 km, indicating similar passenger needs. Bus shows a

comparatively high value of 11.1 km as the figure is influenced by intercity buses included.
Bemo, most of which resembles to Bus in its demands, stands at 3.9 km, comparatively lower than private transportation means, because its service is restricted in the intra-city service. Becak is the lowest in the comparison of trip length, reflecting both the influences from zonal operation limit, and from passengers' needs. Railway shows the highest average trip length of 25.5 km due to the fact that limited numbers of railway station with long station interval in the city area, and consequently, there is no short-distance passenger.

As a whole, putting railway aside on account of the speciality, it can be concluded that private transportaion modes show similar average trip lengths; and Public transportaion modes, on the other hand, take their shares of long trips by mode in the following order as bus, Bemo and Becak, from which it seems that a well adjusted balance is kept among modes of transport through their shares and characteristics.

Table 4-1-3 Average Trip Length by Mode of Transport, Medan City (1979)

Mode	Average Trip Length
	km
Sedan	6.3
Bus	11.1
Bemo	3.9
Motor Cycle	5.6
Becak	3.6
Bicycle	5.8
Railway	25.5
Average	6.6

Source: Results of O-D survey conducted by the JICA Study Team.

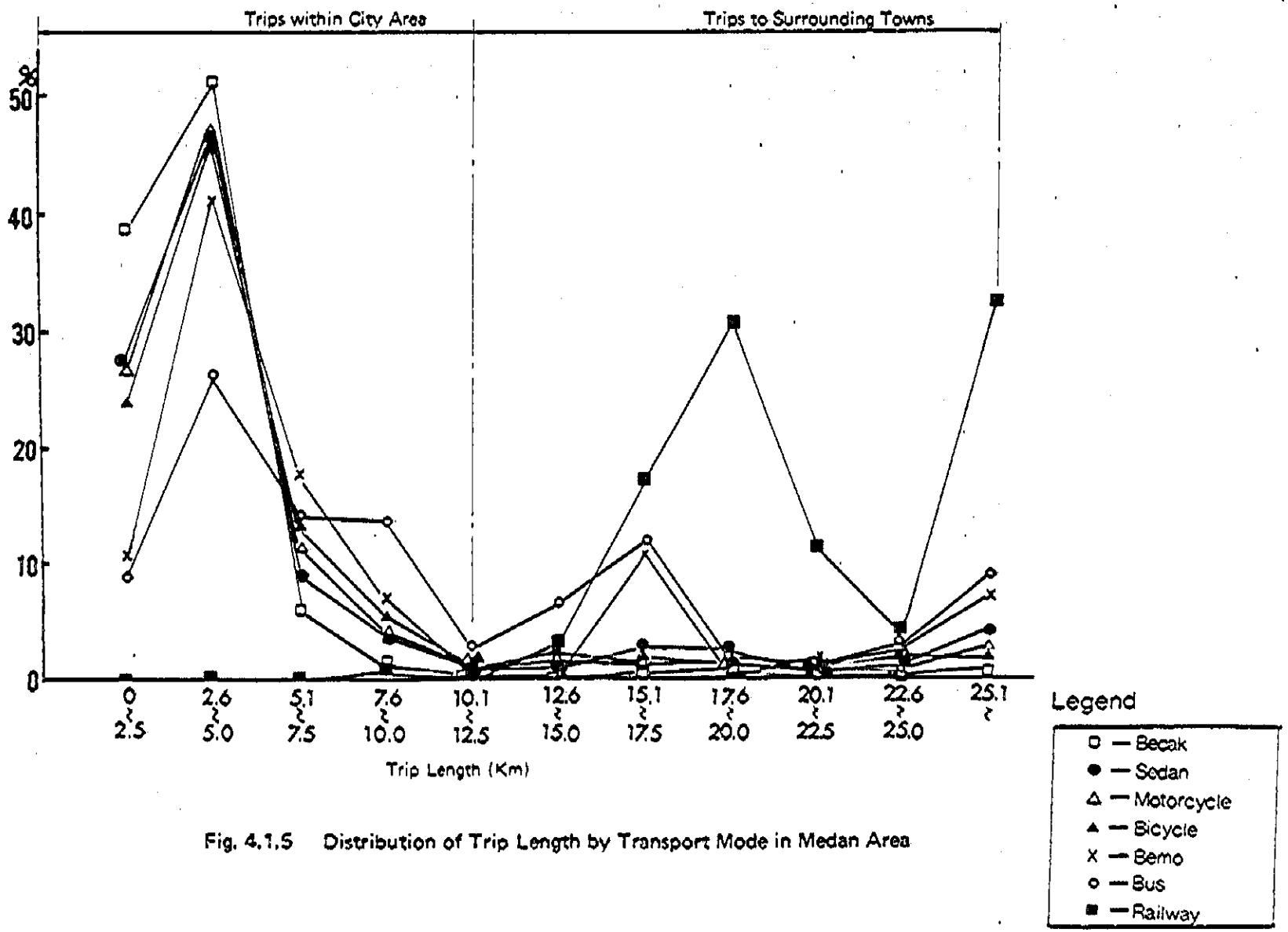


Fig. 4.1.5 Distribution of Trip Length by Transport Mode in Medan Area

4.1.4 Modal Split

Fig. 4.1.6 shows what kind of vehicles are mostly used for given distances in Medan City. This will help grasp the characteristics of current transport users in Medan. This Fig. contains a substantial difference in the number of data, and some explanation is necessary. As it is seen in Sec. 4.1.3, most of the trip lengths fall within the upper limit 10 to 12.5 km, and any figures below this limit can safely be taken up for comparison. However, figures above this limit are collected for railway only, and, which data being not numerous enough and the graph fluctuating, one has to take them just for reference. Each mode has the following features.

(a) Sedan

In this mode the sharing rate tends to decrease in the range up to 10 km as the distance increase. This probably corresponds to the distribution of sedan owners, showing a stable share.

(b) Bus

The sharing rate of bus increases as the distance increases, reflecting the character of bus transportation in Medan. This tendency is conspicuous in the trip length in excess of 5 to 7.5 km. As all the bus routes radiate from Pasar Sambu, a bus terminal at the center of the city, over 30-40% of all those passengers who cross the city boundaries are using buses.

(c) Bemo

The sharing rate is rather low within the range of 0 to 10.0 km, yet the tendency is similar to that of buses, serving effectively for public transportation. What differs from bus is that after exceeding 10.0 km the sharing rate shows a sudden decrease, indicating clearly the domain of Bemo's service different from bus.

(d) Motorcycle

The graph for motorcycles resembles that of sedans. That is to say, its share is kept stable based on the homogeneous distributions of motorcycle owners, notwithstanding trip length. It is worhwhile to notice that motorcycle maintains a constant high sharing rate, keeping an important position in the urban transport of Medan today.

(e) Becak Mesin

It is evidently shown that Becak Mesin is only for shor trips, for the sharing rate decreases as the distance increases. It is also attributable to zonal operating regulations on Becaks and the passengers' initiative choice of mode.

(f) Bicycle

Bicycle shows the same tendency as those of Sedan and motorcycle; but its sharing rate increases after exceeding 10 km.
It is because many lower-income groups live near the boundary of

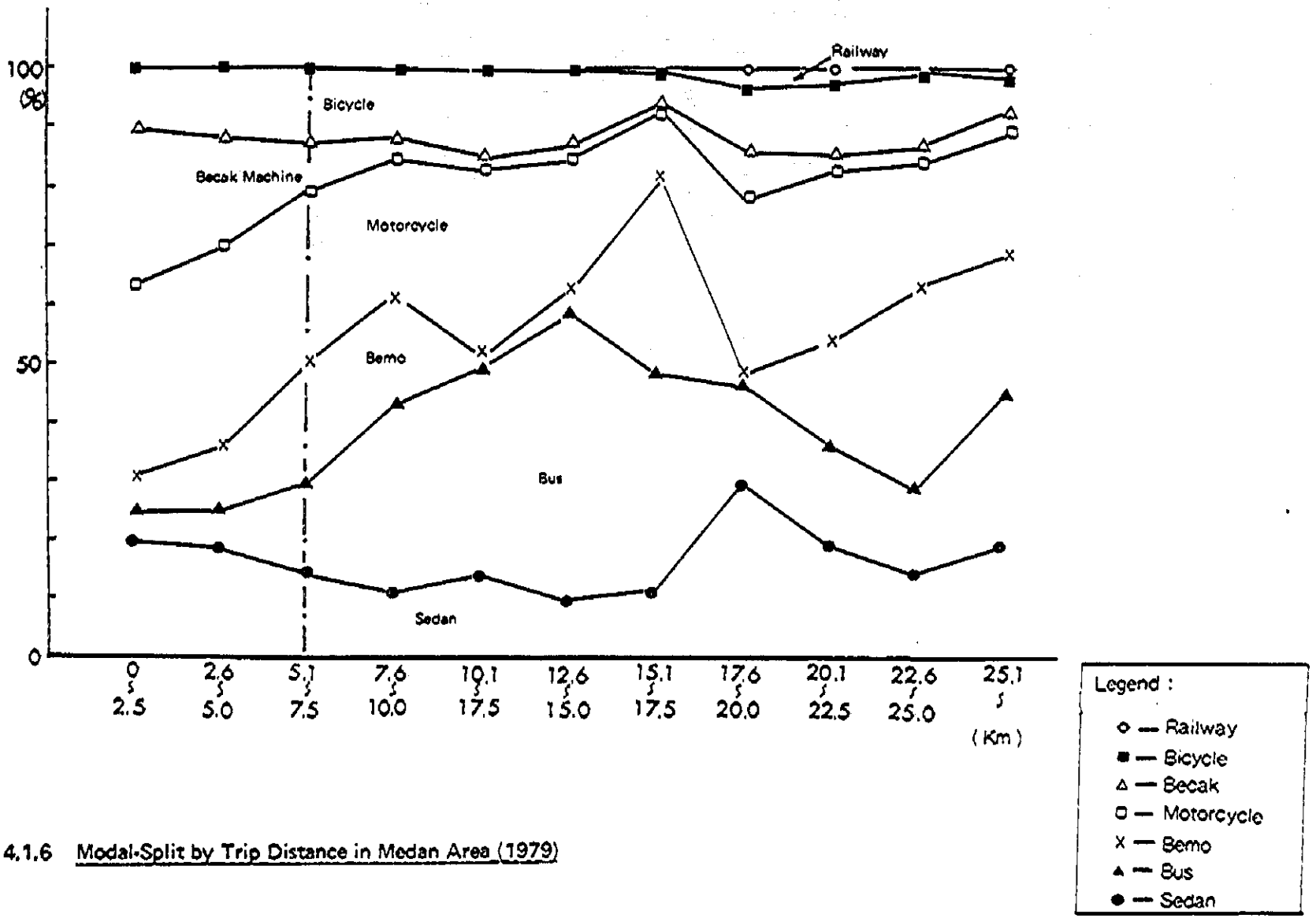


Fig. 4.1.6 Modal-Split by Trip Distance in Medan Area (1979)

the city and their bicycles outnumber sedans and motorcycles privately owned. However, bicycle in general shows a stable share.

(g) Railway

Due to scarcity of short-distance railway passengers it is not easy to compare railway with other modes of transportation. Its present share is only for extremely restricted distances, posed by the sparsely located railway stations in Medan City.

4.1.5 Fluctuations of Traffic Volume

(a) Hourly Fluctuation

Studies are conducted on hourly fluctuation of traffic in Medan utilizing the results of survey conducted by Bina Marga in Feb. 1978 and of Medan Area Transportaion Study conducted in Oct. 1979. Fluctuations in five Corridor roads that connect Medan with surrounding areas are shown in Table 4.1.4. Although figures vary depending on their locations, they all fall within the ranged 9 to 15% with very special exceptions. Peak hours take place from 7 to 8 a.m. and from 17 to 19 p.m., naturally corresponding to commuting hours and home-coming hours. At such stations No. 24 - No. 31 shown in Fig. 4.1.7, that are located outside of four central Kecamatans, the morning peak is generally higher than others. This probably is attributable to the fact that commuting is concentrated in the morning peak hour by workers and students, while in home-coming trips in the evening is earlier by students and later by workers, resulting in less concentration.

Further, Table 4.1.5 shows peak factors in central Medan. Except for stations A5 and A7, it shows the peak hour ratio of 9 to 10% from which it seems that traffic volume itself is urbanized and the whole fluctuational range of traffic becomes narrower.

Table 4-1-4 Peak Hour Ratio of Traffic Volume on Corridor Roads Mean City (1978)

Station No.	Peak Ratio (%)	Peak Time	To/From the Center of Medan
1	13.2	7- 8	To the Center of Medan
2	6.7	7- 8	From "
3	22.8	7- 8	To "
4	14.2	17-18	From "
5	7.8	7- 8	To "
6	9.1	18-19	From "
7	14.4	7- 8	To "
8	9.5	17-18	From "

Source: Results of Traffic Counting Survey Conducted by the JICA Study Team.

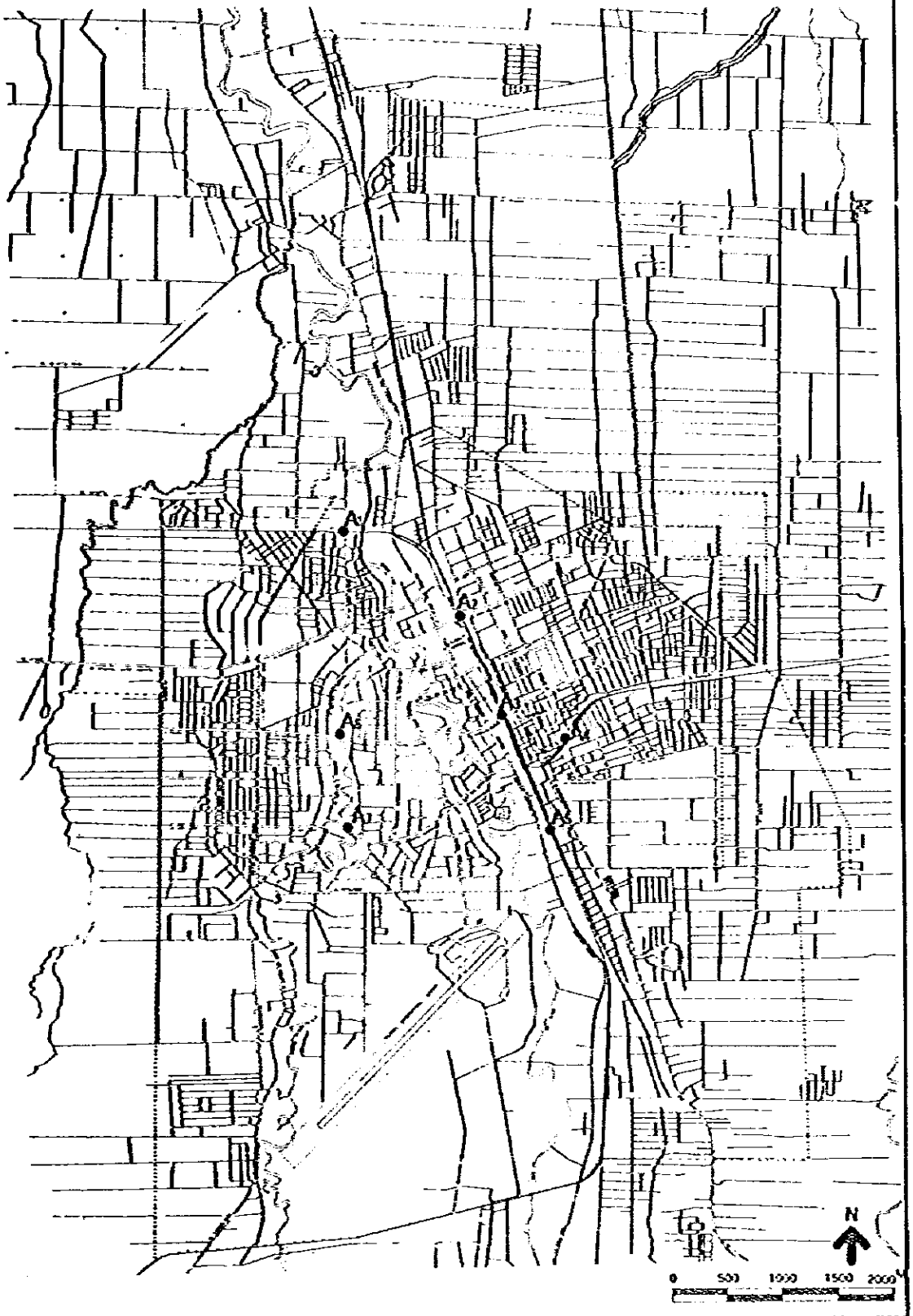


Fig. 4.1.7
Survey Stations for Peak hour Traffic Counting (October 1979)

Legend

Medan Area Transportation Study

Table 4-1-5 Peak Hour Ratio of Traffic Volume, Inside the CBD, Medan City

Station No.	Peak Ratio (%)	Peak Time	To/From the Center of Medan
A-1	10.1	8- 9	To the Center of Medan
A-1	11.9	17-18	From "
A-2	11.0	7- 8	From "
A-3	9.3	16-17	To "
A-4	9.8	18- 9	To "
A-5	8.7	14-15	To "
A-6	9.5	7- 8	From "
A-7	15.4	7- 8	To "
A-7	13.3	7- 8	From "

Note: Station number, refer to Fig. 4.1.7.

(b) Seasonal Fluctuation

A study on the seasonal fluctuations of the urban traffic of Medan was made in Belawan-Medan-Tg. Morawa Highway Study, in which it is reported that the traffic data for the four years for the period 1973 ∿ 1976 shows no conspicuous seasonal fluctuation. Therefore, any seasonal fluctuation of urban traffic is not taken into consideration in Medan Area Transportation Study, either.

4.1.6 Travel Speed

A travel speed survey was carried out on several routes by the JICA Study Team. The survey routes are shown in Fig. 4.1.8.

An average travel speed on arterial roads was about 20 km/hr. in the central area and about 30 km/hr. in the surrounding areas. The survey was carried out in the morning peak hours, in the evening peak hours and the off-peak hours. During the peak hours period traffic congestions have been observed on the following roads.

- Jl. Jenderal Gatot Subroto (Survey Route 7)
- Jl. Merbabu (Survey Route 2)
- Jl. Haryono, MT (Survey Route 22)
- Jl. Prof. H.M. Muhamad Yamin SA (Survey Route 19)

Especially, on both Jl. Merbaru and Jl. Prof. H.M. Muhamad Yamin SA, the situation was unfavorable because of the narrow width of the road and the large volume of traffic where the speed of a sedans was as low as that of Becak and bicycles.

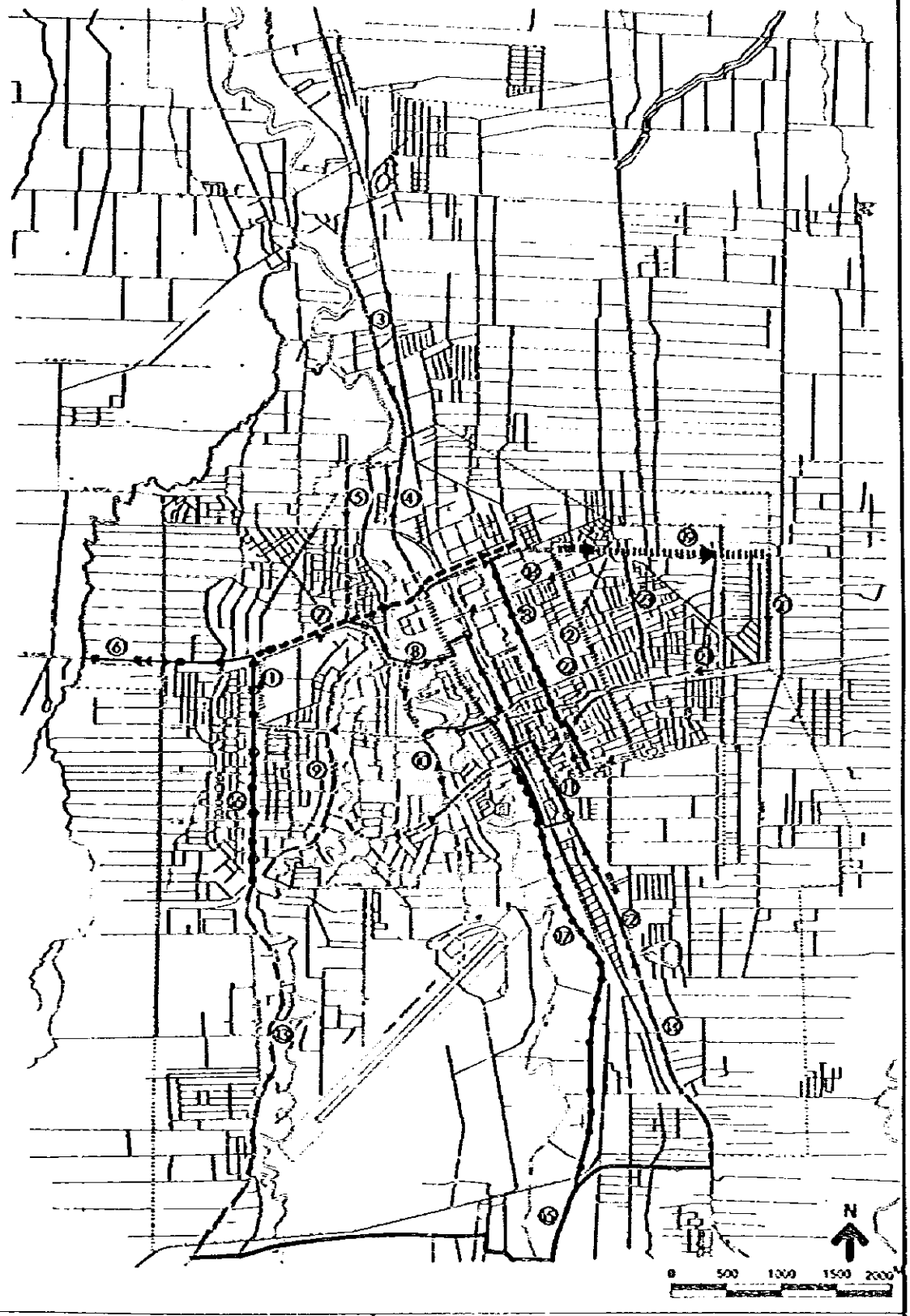


Fig. 4.1.8
Travel Speed Survey Routes
Medan City, (October 1979)

Legend

① Survey Route No.

Medan Area Transportation Study

4.2 O-D Table and its Adjustment

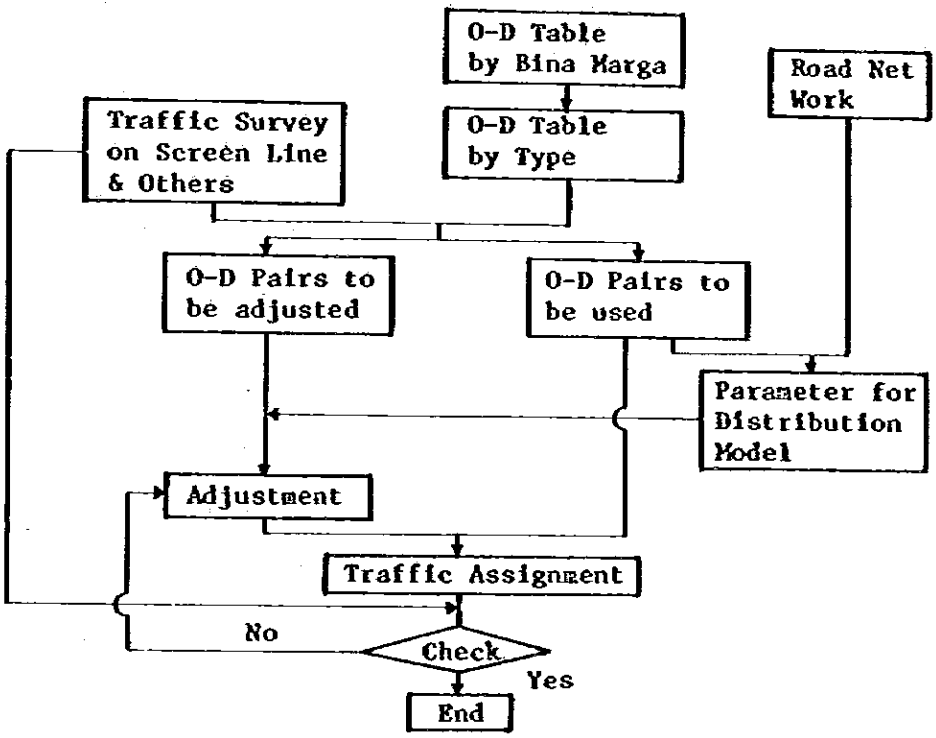
Bina Marga's study of Feb., 1978 in Medan was a road O-D survey by means of road-side interviewing. Some additional survey for such trips between unstudied areas in the study needed to be carried out by The JICA Study Team in October 1979 in order to supplement the Bina Marga's O-D Table, and the following steps were taken for this purpose:

(a) Selection of O-D Pairs

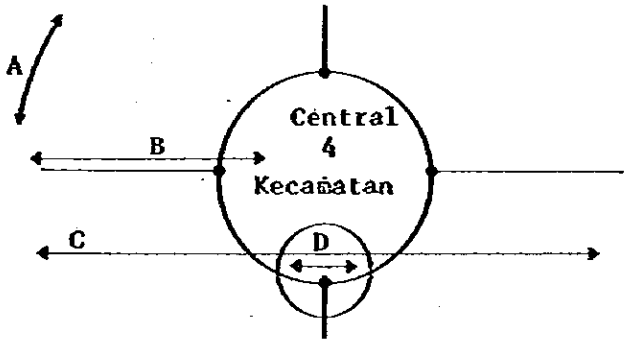
In the O-D Table by Bina Marga zone-pairs were classified into two groups, namely, one group is made directly to the study, and the other group is such trip which needs some adjustments due to the location of survey stations on the location of by road spots.

Fig. 4-2-1 Flow Chart on Adjustment of Bina Marga's O-D Table

(A)



(B)



Legend:

● Roadside Survey Spots

In Fig. 4.2.1 (B) trip A indicates such trip outside the central four Kecamatans, trip B indicates the trip that crosses the boundary, trip C indicates the trip that passes through the central four Kecamatans, and trip D indicates the trip that takes place within the central four Kecamatans. For trips B and C Bina Marga's O.D data, are used owing to the nature of our study. Also trip A is not problematic ones in the short-term improvement plan, and consequently, no special amendment is necessary. However, for a long-term improvement plan, trip A is concerned to the facility planning, and consequently adjustments are made on trip A using the attached model.

Trip D is the most important flow in studying the urban traffics in Medan, and therefore, investigation was made on the location of road-side interviewing stations with a view to by-road spots distribution. In the central Medan, one-way traffic system is widely applied; taking advantage of this one-way traffic system quite a number of trips were interviewed. The zone pairs to be amended on Bina Marga's, zoning, are shown in Table 4.2.1. Strictly speaking, not all of other trips were interviewed in 100%, but such traffic is considered to be negligible.

(b) Distribution Model

This is to formulate a traffic distribution model of zone pairs for the purpose to amend trips that can not be grasped of its whole trips. A gravity model is made based upon the accurate data of zone pair trips obtained through the road-side interviewing.

$$T_{ij} = K \frac{T_i^{\alpha} \cdot T_j^{\beta}}{D_{ij}^{n}}$$

T_{ij} : Number of trips between i and j zones;

D_{ij} : Time-distance between zones i and j;

T_i : Concentrated traffic taking place in zone i;

T_j : Concentrated traffic taking place in zone j;

α, β, n & K: Parameters

At first, two separate gravity models are formulated, one for commercial areas and the other for residential areas, but finally one model applicable to both types of area is formulated because separate models have a problem in their rate of relativity.

Parameters are as follows:

Parameters of Gravity Model for Distribution of Zone Pairs

Parameter	Value	Remarks
α	0.04821	
β	0.06242	
n	-0.39654	
K	56.6161	
R	0.7552	Corelation Coefficient

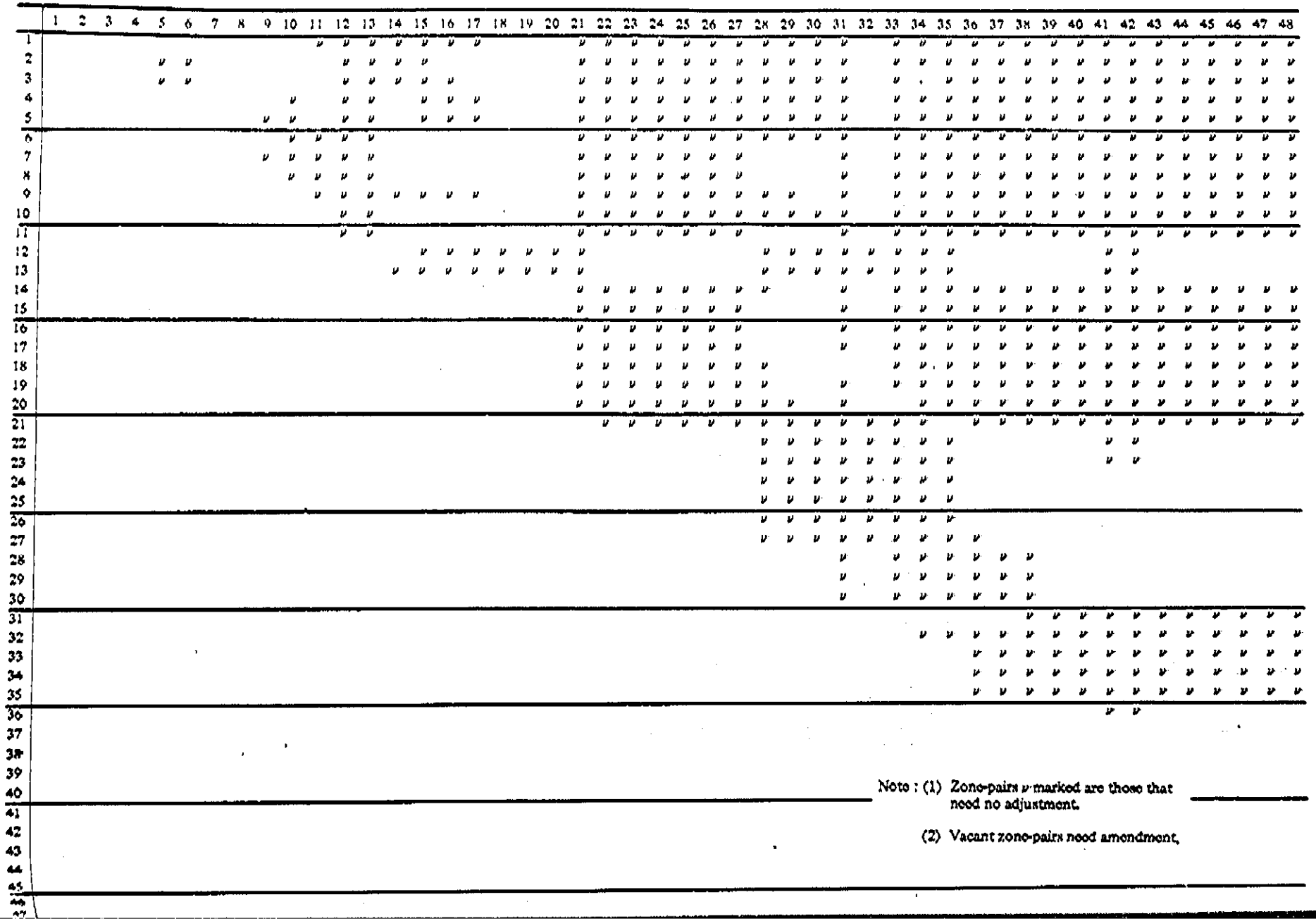
(c) Amendment of Trips

Those O-D zone-pair trips that need amendment are replaced with the zone-pair trips estimated with the gravity & model.

(d) Checking of O-D Table

The adjusted O-D data are distributed to the existing road network, a comparison of traffic volume is made at the location of screen lines, and if the adjusted volume is not still appropriate, then adjustment is repeated once again in such zone-pairs. The O-D Table for each transport mode of Medan, 1978 was completed through such a process above-mentioned. The analysis to follow are based on this adjusted O-D Table.

Table 4.2.1 O-D Pairs



Note : (1) Zone-pairs ν marked are those that need no adjustment.

(2) Vacant zone-pairs need amendment.