2.3 Land Use

Prior to zonal allocation of the planning parameters by study area estimated in Sec. 2.2 Statistical Framework, it is necessary to establish a land use plan. In this study, which is primarily a transportation study, no new land use scheme is made, and instead, those land use plans already issued are reviewed in Sec. 2.3 Land Use in Kot. Medan and its Surroundings of the 'Short-Term Improvement Study'.
Land use plans provided by Cipta Karya are:

- 'MASTER PLAN KOTAMADYA MEDAN', Dinas Planologi Kotamadya Medan, 1974; and
- 'MEDAN URBAN DEVELOPMENT, HOUSING, WATER SUPPLY AND SANITATION PROJECT', Engineering-Science, Inc., and Sinotech Engineering Consultants, Inc., 1979~1980.*)

Notes: *) The study was still in progress as of Oct. 1979.

The major differences between the above two are that:

- In the former, residential development is planned even in the flood prone areas along the Medan-Belawan corridor; but
- In the latter, the residential development is kept away from the area with the elevation below +5.0m.

After a careful review of both of them described in the 'Short-Term Improvement Study'*), the study team respects the opinion of the latter in zonal allocation of planning parameters.

Note: *) Refer to Sec. 2.3: Land Use of Kot. Medan and its surroundings in the short-term improvement study.

2.4 Zonal Allocation of Planning Parameters

2.4.1 General

The planning parameters estimated for each study area in Sec. 2.2 Statistical Framework are allocated to each zone in this section. Those planning parameters are compiled in:

- Table 2.2.2: RESIDENTIAL POPULATION BY STUDY AREA;
- Table 2.2.5: EMPLOYED POPULATION BY STUDY AREA;
- Table 2.2.8: NUMBER OF JOBS BY STUDY AREA;
- Table 2.2.9: TRAFFIC-RELEVANT STUDENTS AT STUDYING PLACES BY STUDY AREA; and
- Table 2.2.11: TRAFFIC-RELEVANT STUDENTS AT RESIDENTAL PLACES BY STUDY AREA.

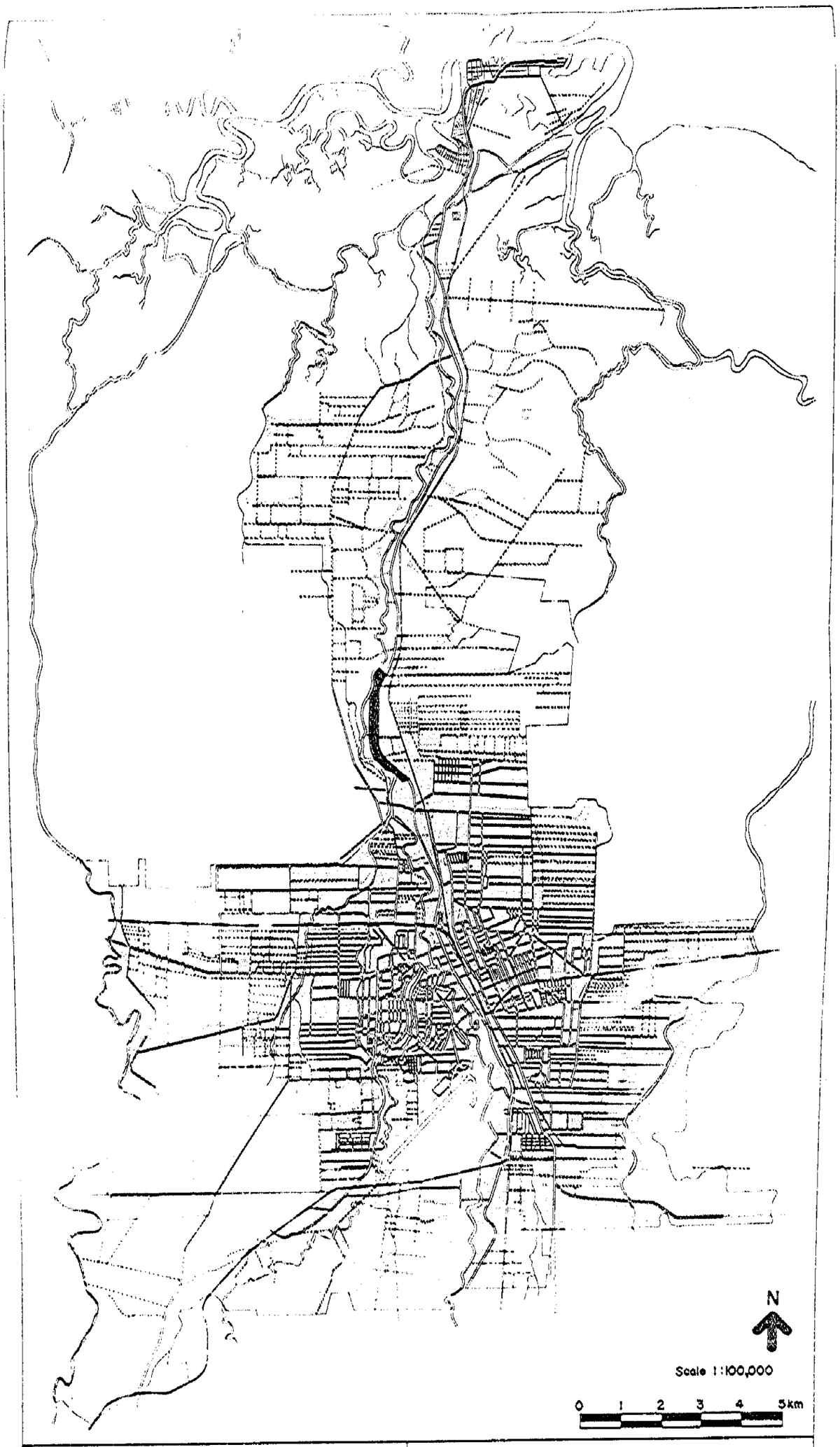


Fig. 2.3.1
Present Land Use, (1974)
Source: MASTER PLAN KOTAMADYA MEDAN

Medan Area Transportation Study

Legend

- Commercial/Administrative Area
- Residential Area
- Land with Development Plan
- Industrial Area

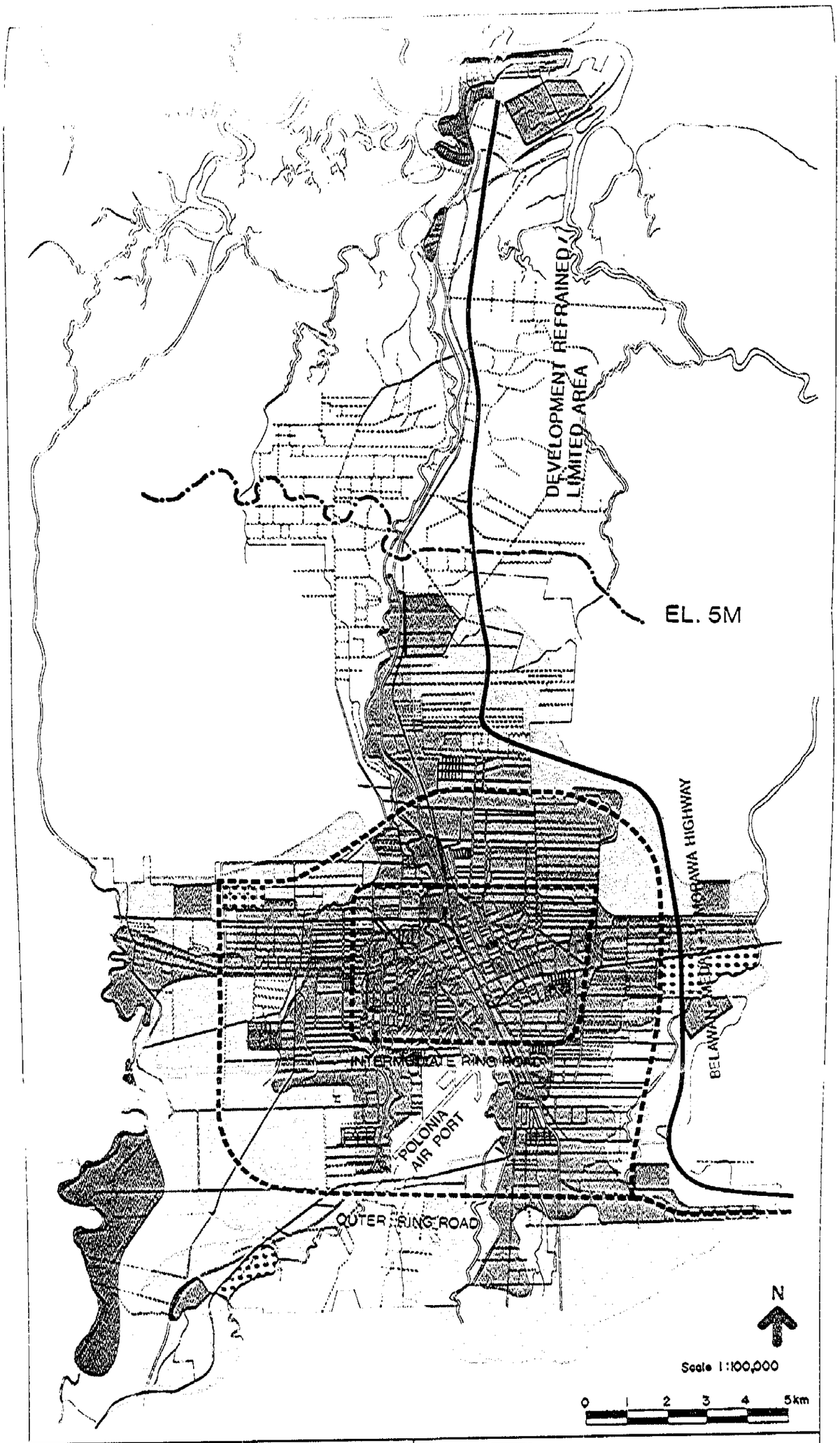


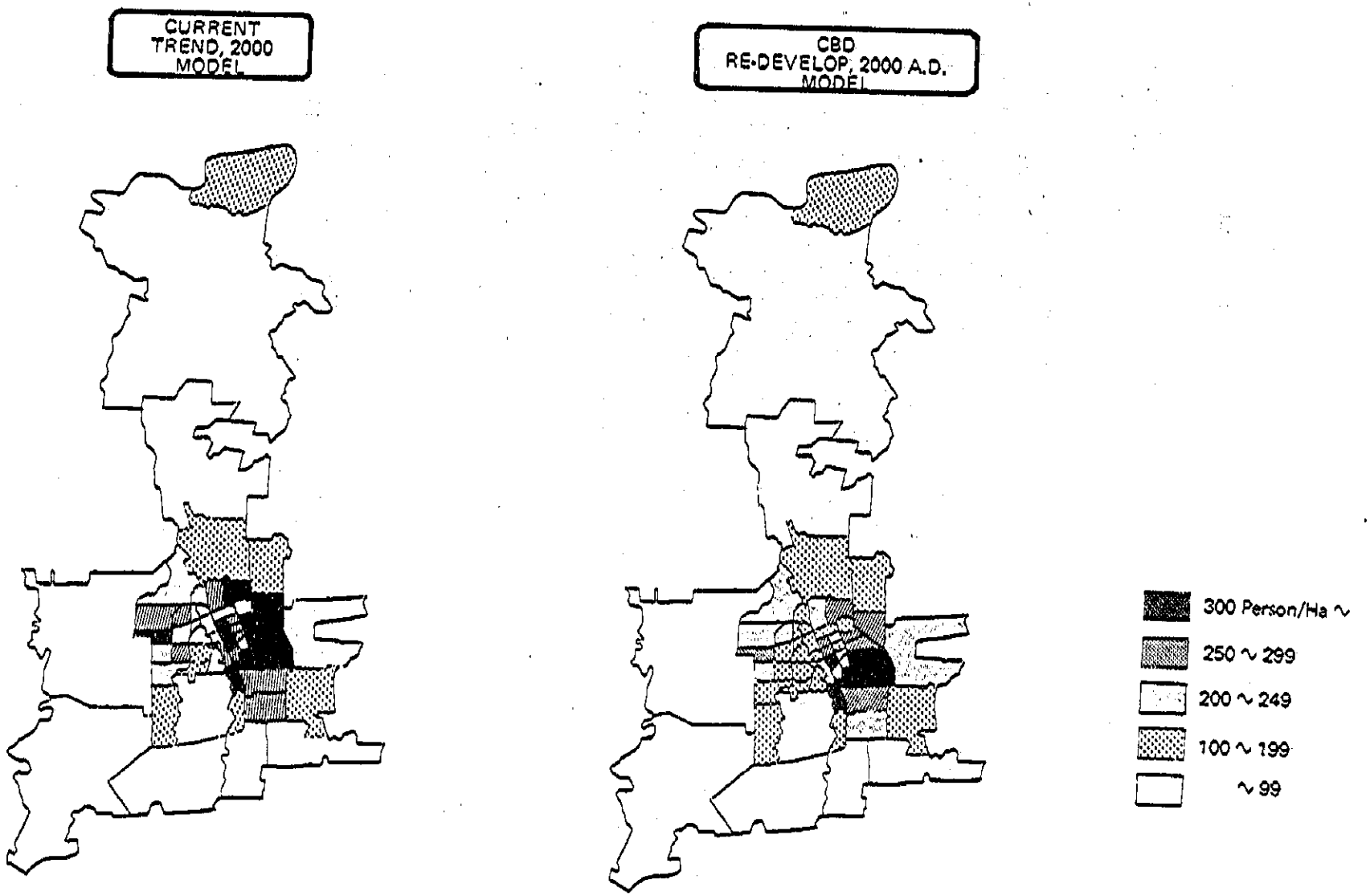
Fig. 2.3.2
PROPOSED LAND USE PATTERN BY MUDS

Source: MEDAN URBAN DEVELOPMENT, HOUSING, WATER SUPPLY AND SANITATION PROJECT

Medan Area Transportation Study

Legend
- Major Built-up Area
- Infill Area
- New Development Area
- Environmental Protection Area
- Employment Area

Fig. 2.4.1 Population Density by Zone and by Development Model



2.4.2 Residential Population by Zone

Medan Urban Development Study presents an example of future population estimates for each Kecamatan*).

Note: *) 'TECHNICAL MEMORANDUM NO. 21', Medan Urban Development Housing, Water Supply and Sanitation Project, 1979.

According to this example, the population growth rate for the central 4 Kecamatans, called the Internal Study Area in this study, during 1976-1995 is estimated to be 1.5%/yr. in an average, and this is close to that of the Internal Study Area for the Re-development Model in this study. Among the rest of Kecamatans, Kec. Medan Belawan's population growth rate is estimated to be as low as 1.1%/yr. and Kec. Medan Labuhan and Deli, a large part of which has flooding problems, is estimated to add their population by 6.3%/yr. and 2.7%/yr., respectively.
For other Kecamatans the growth rate is estimated to be more than 3.0%/yr., and especially for Kec. Medan Tuntungan about 8.0%/yr., is estimated due to the large scale housing development project planned.
In this study, firstly the population planned to be accommodated in committed housing projects *) is set aside from the population increase during 1978-1985. Then, the remaining increase is distributed over Kecamatans proportionately to the allocation plan by Medan Urban Development Study. After allocating the population by Kecamatan to each zone in it using the land use plan, the housing projects' portion is added to the zonal population obtained above in each specific zone in which those housing projects are committed.

Note: *) Those listed in Table 2.4.2: COMMITTED SMALL & MEDIUM SIZE HOUSING PROJECTS in the 'Short-Term Improvement Study' in addition to Medan I, II and II Low Cost Housing Projects.

Zonal Allocation for 2000 is made by distributing the population increase in each study area during the period 1985-2000 proportionately to the Medan Urban Development Study allocation plan to Kecamatans during 1985-1995, and then the increased portion for each Kecamatan is zonally distributed using Fig. 2.3.1: MAP OF PRESENT LAND USE and Fig. 2.3.2: LAND USE PATTERN PROPOSED BY MUDS as a guide.

2.4.3 Employment Structure by Zone

(1) Employed Population by Zone

(a) Sector I

The Sector I employed population by study area in Table 2.2.5: EMPLOYED POPULATION BY STUDY AREA is distributed over zones proportionately to the area of agricultural use*).

Notes: *) In measuring area of land use in each zone on Fig. 2.3.1: MAP OF PRESENT LAND USE, the use of land is classified into:

- Commercial/Administrative Area;
- Residential Area;
- Industrial Area; and
- Others.

The use of land in Fig. 2.3.2: LAND USE PATTERN PROPOSED BY MUDS is classified into:

- Built-up Area;
- Infill Area;
- New Development; and
- Others.

The agricultural area is assumed to be in proportion to 'Others' in the above two maps, and for the area outside Kot. Medan, the External and the Outer Study Area, since there is no land use map available, the agricultural area is assumed to be in proportion to the total area of each zone.

(b) Sector II and III

Firstly, the total employed population including all of three sectors in each study area is distributed in proportion to zonal residential population based on the assumption that the rate of employment does not vary for each zone.
Then, the Sector I employed population in each zone allocated previously is subtracted from the total employed population by zone estimated above.

(2) Number of Jobs by Zone

The number of jobs in Sector II and III by study area is estimated in Sec. 2.2.3, jobs are allocated to each zone through 3 steps as shown below:

1st-Step: The jobs in each study area are divided into 3 portions, namely those to be allocated proportionately to Commercial/Administrative area*), to residential population and Industrial Area, for their zonal allocation.

Notes: *) In Fig. 2.3.2: LAND USE PATTERN PROPOSED BY MUDS, the Built-up Area is considered to have a similar character with the commercial/Administrative Area.

Table 2.4.1 Protection of Residential Population and Density by Kampung and Study Area for Short-Term & Long-Term

(Population: Persons, Density : Persons/Ha)

		1978		1985		2000			
						Current Trend Model		CBD Re-development Model	
		Population	Density	Population	Density	Population	Density	Population	Density
1.	Gang Buntu I	5,558	265	5,607	277	7,206	343	5,818	277
2.	Pusat Pasar I	4,210	156	4,875	181	6,969	258	5,291	196
3.	Pusat Pasar II	2,927	165	3,361	198	4,538	267	3,594	211
4.	Pasar Baru	8,237	329	8,791	352	9,630	385	8,184	327
5.	Aur I	4,124	193	5,032	203	7.051	294	5,025	209
6.	Kasavan I	2,925	113	3,292	127	5,936	231	4,156	160
7.	Gang Buntu II	5,568	278	5,897	295	7,128	356	5,871	294
8.	Pandan Hilir I	6,425	184	7,162	205	9,155	262	7,431	212
9.	Sei Rengas I	5,584	159	6,204	222	8,437	301	6,521	233
10.	Sei Rengas II	5,187	155	6,116	218	7,699	275	6,442	230
11.	Aur II	6,936	393	7,936	222	10,576	294	7,958	221
12.	Kandan	9,187	126	11,044	151	16,569	227	11,590	158
13.	Petisah Tengah I	3,578	81	4,356	136	7,358	230	5,389	168
14.	Kasavan II	4,874	111	5,906	134	10,073	229	7,334	167
15.	Sidodadi I	5,619	145	6,481	171	8,582	226	6,901	182
16.	Sidodadi II	7,789	169	8,741	190	11,377	247	9,160	199
17.	Pandan Hilir	7,231	233	7,934	255	9,648	311	8,013	259
18.	Pandan Hulu	7,262	222	20,627	271	25,004	329	21,110	278
19.	Sei Rengas II	11,456	383	11,663	389	13,185	440	10,838	361
20.	Kotamaksum	58,885	352	59,814	358	68,366	409	55,739	334
21.	Sei Mati	13,969	349	14,114	353	16,074	402	13,265	332
22.	Anggrung	4,545	85	6,290	116	10,005	185	7,563	140
23.	Mabar Hulu	5,743	85	7,379	114	12,321	190	8 029	124
24.	Petisah Tengah II	3,578	112	4,384	137	7,358	230	5,414	169
25.	Silalas I	2,937	128	3,545	154	5,654	246	4,246	185
26.	Silalas II	2,937	128	3,587	156	5,654	246	4,284	186
27.	Kasavan III	3,558	111	4,676	134	8,033	230	5,814	166
28.	Durian	23,244	219	25,329	239	31,511	297	25,780	243
29.	Sidarame	35,378	254	36,740	287	41,650	324	34,295	268
30.	Sei Kera Hilir	41,527	305	41,912	308	46,908	345	39,068	287
31.	Tegal Sari	54,852	357	55,545	363	63,346	414	52,593	344
32.	Teladan	50,561	187	49,944	230	62,685	289	56,976	263
33.	Sitirejo	43,039	153	54,705	195	71,458	254	67,993	242
34.	Baru	9,497	75	11,322	89	17,838	141	13,559	107
35.	Pelanig	24,233	33	30,634	41	44,454	60	55,015	74
36.	Darat	13,683	109	17,300	137	26,011	206	18,262	145
37.	Petisa Hulu	9,352	151	11,223	181	15,650	252	11,428	184
38.	Petisah Tengah III	7,159	114	8,353	133	14,072	223	10,408	165
39.	Sekip	10,856	177	12,361	203	18,012	295	13,926	228
40.	Silalas	6,397	125	7,515	147	12,329	242	9,104	179
41.	Bogak	79,252	97	96,774	119	142,553	175	129,136	159
42.	Padang Bulan	17,178	52	23,848	72	46,765	142	35,521	108
43.	Baluru	11,547	145	14,067	180	19,434	249	15,959	205
44.	Sei Sikambing D	13,466	133	15,375	217	21,854	308	18,835	266
45.	Sei Putih	38,720	165	45,057	195	65,891	286	57,248	249
46.	Sei Agul	25,531	56	33,035	124	57,073	214	55,249	203
	Internal Study Area	727,903	152	836,133	163	1,139,031	222	970,725	189
47.	Deli	57,543	27	69,725	33	91,956	44	103,442	49
48.	Labuhan	63,569	8	82,562	10	117,212	15	130,212	16
49.	Belawan	72,007	15	80,454	105	96,165	125	105,196	137
50.	Sitoreje	37,747	98	46,501	125	55,829	150	58,342	157
51.	Denai	88,209	117	114,603	152	173,000	229	182,769	242
52.	Kp. Binjei	16,593	24	26,799	38	75,492	108	94,744	136
53.	Tjabang Deli	23,925	33	27,192	37	34,625	47	36,190	49
54.	Medal Durian	21,622	32	26,223	39	36,801	55	39,821	59
55.	Gedung Johor	13,545	14	28,812	57	71,199	52	108,231	79
56.	Tanjungan	20,766	7	111,869	38	164,814	56	197,372	83
57.	Sungal	107,704	37	149,187	45	233,556	82	265,637	92
	Internal Study Area	526,227	25	684,667	38	1,156,659	54	1,324,915	62
58.	P. Sei Tuan	39,580	4	42,921	4	89,126	9	95,875	9
59.	Kp. Kwis	55,358	4	110,116	8	121,561	8	131,089	9
60.	Tg. Morawa	61,402	4	65,594	5	63,455	5	68,292	5
61.	Petumbak	20,634	5	22,657	5	67,918	15	73,061	7
62.	Deli Tua	29,637	4	32,138	4	45,313	6	48,744	6
63.	P. Batu	33,185	3	35,955	3	36,617	3	39,389	3
64.	Sunggal	65,637	6	74,430	7	77,043	7	82,877	8
65.	Kp. Petak	105,020	3	113,584	7	117, 09	4	126,638	8
66.	Binjei	63,791	35	75,681	38	212,627	106	228,726	114
	External Study Area	456,534	5	574,397	5	831,891	8	894,693	8
67.	East	676,677							
68.	South	85,422							
69.	West	640,350							
	Outside Total								
	Grand Total								

Table 2.4.2 Standard for Job Zonal Allocation

	Study Area	1978	2000 Current Trend Model	2000 Re-develop Model
To be allocated by Comm./Admin. Area	Internal	270 jobs/Ha	230	230
	Intermediate	150	150	150
To be allocated by Resid. Pop.	Internal	0.1 jobs/Pop.	0.1	0.1
	Intermediate	0.17*)	0.1	0.1
To be allocated by Industrial Area	Internal	100 jobs/Ha	-	-
	Intermediate	100	70	70

Notes: *) This ratio came out to be relatively high. One of the reasons could be that the residential areas in the Intermediate Study Area contain a considerable amount of local trading activities, at present.

2nd. Step: Within the Internal Study Area, the jobs in the future are re-allocated to each zone assuming the density of its day-time population*). In other words, it is assumed that the magnitude of commercial/administrative activities varies even within the Internal Study Area.

Notes: *) Day-Time Population: Population of an area during the day including excessive flow-in commuting workers and students, (or [Residential Pop.] + [Excessive Flow-in Commuting Workers and Students]).

For the above purpose, a Core District (Zone# 1, 2, 3, 4, 5, 6, 7, 8, 14 and 15) where jobs are mostly concentrated is localized around the Medan Station. This Core District includes about 40 Ha of PJKA's properties including storages, switching yard and staffs' housing and it can be utilized in re-development of the Core District. In 1978 the day-time population density of the Core District is 315 person/ha and the gross floor area ratio*)-1 (F.A.R) is estimated to be approximately 285% assuming the unit floor area per person.*)-2

Notes: *)-1 [Gross Floor Area Ratio] = [Floor Area]/[Ground Area]

*)-2 ° Residents: 7 m^2/person
° Workers at Work Places: 8 m^2/person
° Students: 9 m^2/person

Jobs in 2000 within the Core District are allocated to zones assuming the day-time population as shown in the following table.

Table 2.4.3 Day-Time Population within Core District

Unit: 1,000 persons

	1978	2000	
		Current Trend Model	CBD Re-develop Model
Residential Population	50.8	75.9	59.6
Excessive Flow-in Commuting Workers	49.8-14.1=35.7	70.2-22.7=47.5	16.8-18.0=38.8
Excessive Flow-in Commuting Students	4.3- 3.5= 0.8	7.7- 6.5= 1.2	5.6- 4.9= 0.7
Day-Time Population	87.3	124.6	139.1
(Density)	(315 Person/Ha)	(450 Person/Ha)	(500 Person/Ha)

3rd. Step: The zonal allocation of jobs for the rest of zones within the Internal Study Area made in the 1st. Step is revised not to exceed the day-time population of 450 persons/ha both for the Trend and Re-development Models.
For the Intermediate Study Area the result of the 1st. Step allocation is respected.
For the External Outer Study Area at present, zones are grouped into 5 by the directions of the main transportation axis from the city center of Kot. Medan.
Then, the excessive flow-out commuting workers for each direction are compiled in the Bina Marga's O.D. survey data, and they are broken into zones in each direction taking the residential population and the distance to each zone into account.*)

Notes: *) The total commuting workers for each direction is distributed over zones in it proportionately to a gravity value [G].

$$G = \frac{[\text{Zonal Residential Population}]}{[\text{Distance between Kot. Medan and Each Zonal Center}]^2}$$

By extracting the excessive flow-out commuting workers from the employed population in Sector II and III, the number of jobs in each zones is obtained for 1978.
The number of jobs in each zone within the External Outer Study Area in the future is figured out by distributing the future excessive flow-out commuting workers *)-1 over each zone taking the future zonal residential population*)-2 into account.

Notes: *)-1 See, Table 2.2.8: NUMBER OF JOBS BY STUDY AREA

*)-2 Estimated in '2.4.2 Residential Population by Zone'.

Fig. 2.4.2 PJKA's Properties around Medan Station

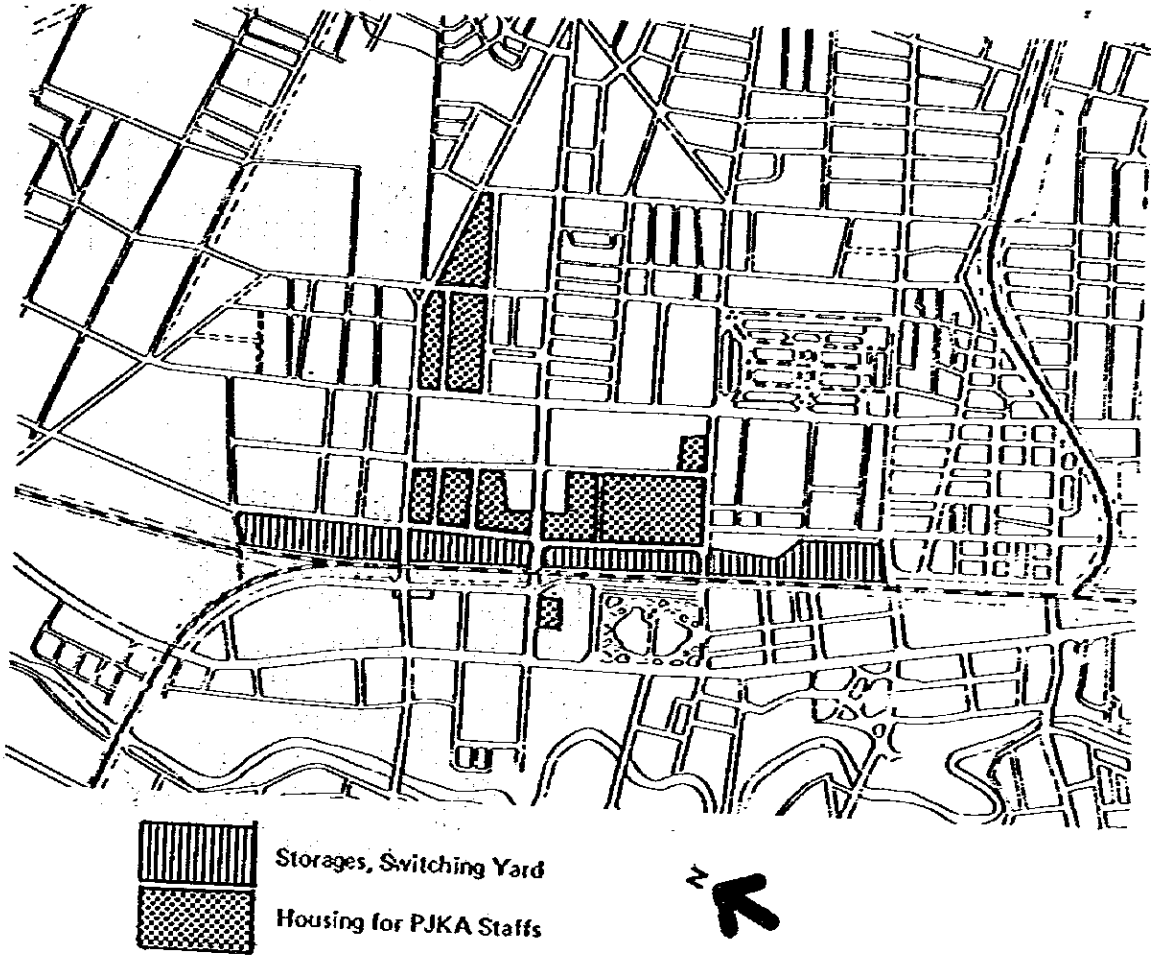


Fig. 2.4.3 Day-Time Population Densities in Internal Study Area

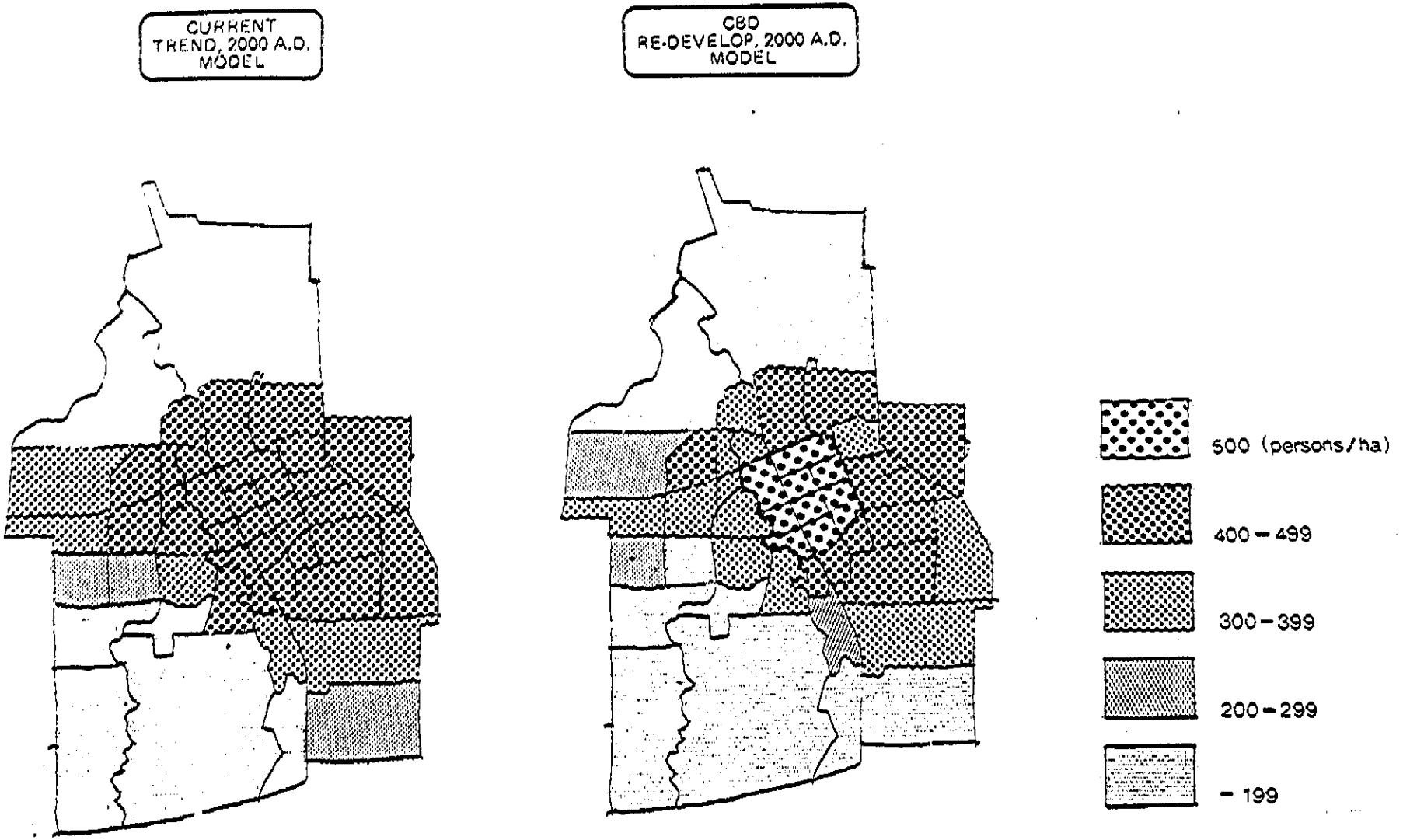
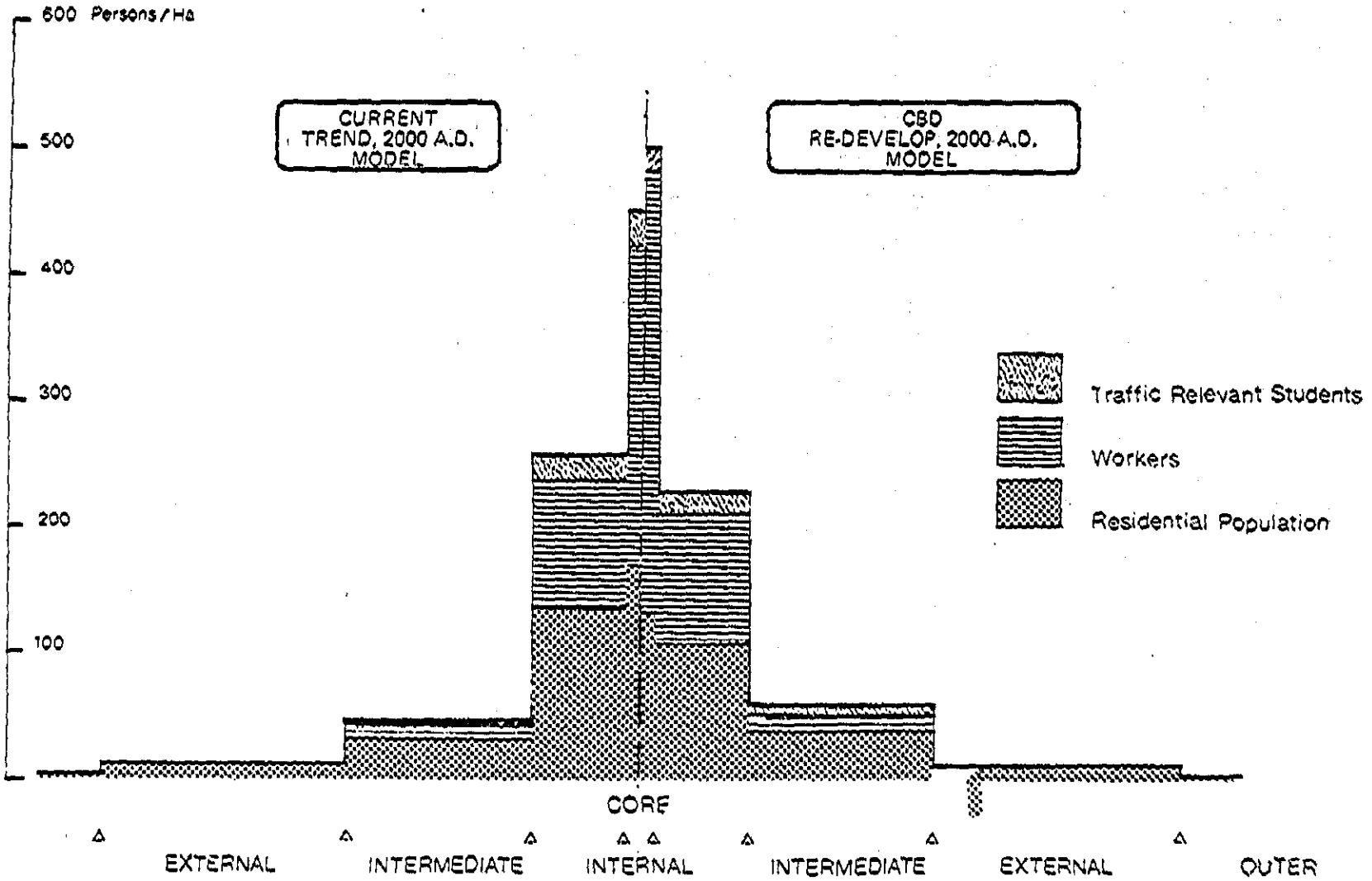


Fig. 2.4.4 Comparison of Day-Time Population Density by Area between Alternative Development Models



2.4.4 Traffic-Relevant Students by Zone

(1) Traffic-Relevant Students at Studying Places

The traffic-relevant students at studying places in each study area are distributed over zones using the number of SLA students in each Kecamatan provided by the Dept. of Eduction*)-1 and the list of universities/academies with their location provided by Univ. Coordinator of North Sumatra University.*)-2

Notes: *)-1 See Table 2.2.7: Number of Pre-university Schools & Students by Kecamatan, 1979, in the Short-Term Improvement Study'.

*)-2 See Table 2.2.6: Number of University/Academy Students in Kot. Medan, 1976, in the 'Short-Term Improvement Study'.

The future traffic-relevant students at studying places shown in Table 2.2.9: TRAFFIC-RELEVANT STUDENTS AT STUDY PLACES BY STUDY AREA are distributed over zones by distributing the increased portion proportionately to the increased zonal residential population. This is based on the assumption that in the future new school construction will be encouraged in areas of new development.*)

Note: *) To propose locations of new school construction in this study is refrained because of the lack of survey and its heavy impact upon the traffic study.

(2) Traffic-Relevant Students at Residential Places

Assuming the ratio between the traffic-relevant students at residential places and residential population in each zone is consistent with the number of students in Table 2.2.11: TRAFFIC RELEVANT STUDENTS AT RESIDENTIAL PLACES BY STUDY AREA, the future traffic-relevant students at residential places are distributed proportionately to the residential population by zone estimated in Sec. 2.4.2 Residential Population by Zone.

Table 2.4.4 Residential Population, Employed Population, Jobs & Traffic-Relevant Students by Zone, 1978

(Unit: 1,000 persons)

		Residential Population		Employed Population			Jobs	Traffic Relevant Students	
		Resid. Pop.	(Density) Pop./ha	Sector I	Sector II + III	Total		At Resid. Places	At Study Places
1.	Gang Buntu I	5.6	267	–	1.6	1.6	6.3	0.4	0.6
2.	Pusat Pasar I	4.2	156	–	1.2	1.2	7.0	0.3	0.8
3.	Pusat Pasar II	2.8	165	–	0.7	0.7	2.8	0.2	0.2
4.	Pasar Baru	8.2	328	–	2.3	2.3	7.8	0.6	0.5
5.	Aur I	4.6	192	–	1.2	1.2	7.2	0.3	0.1
6.	Kesawan I	2.9	112	–	0.8	0.8	7.6	0.2	0.1
7.	Gang Buntu II	5.6	280	–	1.6	1.6	3.7	0.4	0.6
8.	Pandan Hilir I	6.4	183	–	1.8	1.8	2.1	0.4	0.6
9.	Sei Rengas I	5.6	200	–	1.6	1.6	8.4	0.4	0.9
10.	Sei Rengas II	5.2	186	–	1.4	1.4	4.4	0.4	0.3
11.	Aur II	6.9	192	–	1.9	1.9	2.7	0.5	0.2
12.	Hamdan	9.2	126	–	2.6	2.6	9.5	0.6	0.6
13.	Petisah Tengah I	3.6	113	–	1.0	1.0	2.9	0.2	0.1
14.	Kesawan II	4.9	111	–	1.3	1.3	4.7	0.3	0.2
15.	Sidodadi I	5.6	147	–	1.6	1.6	0.6	0.4	0.6
16.	Sidodadi II	7.8	170	–	2.2	2.2	3.1	0.5	0.8
17.	Pandan Hilir	7.2	232	–	1.9	1.9	0.7	0.5	0.7
18.	Pandan Hulu	17.3	228	–	4.9	4.9	1.7	1.2	1.1
19.	Sei Rengas II	11.5	383	–	3.2	3.2	1.2	0.8	0.7
20.	Kotamatsum	58.9	353	–	16.4	16.4	9.4	4.1	3.5
21.	Sei Mati	14.0	350	–	3.9	3.9	1.4	1.0	0.3
22.	Anggrung	4.5	83	–	1.2	1.2	0.5	0.3	0.1
23.	Madras Hulu	5.7	88	–	1.6	1.6	8.7	0.4	0.4
24.	Petisah Tengah II	3.6	113	–	1.0	1.0	2.4	0.2	0.1
25.	Silalas I	2.9	126	–	0.9	0.9	1.2	0.2	0.1
26.	Silalas II	2.9	126	–	0.9	0.9	0.3	0.2	0.1
27.	Kesawan III	3.9	111	–	1.1	1.1	4.6	0.3	0.3
28.	Durian	23.2	219	–	6.4	6.4	10.1	1.6	1.3
29.	Sidorame	36.4	284	–	10.1	10.1	14.5	2.5	0.8
30.	Sei Kera Hilir	41.5	305	–	11.5	11.5	5.3	2.9	0.9
31.	Tegal Sari	54.7	358	–	15.2	15.2	9.6	3.8	3.3
32.	Teladang	40.6	187	–	11.3	11.3	7.2	2.8	5.7
33.	Sitirejo	43.0	153	–	11.9	11.9	10.7	3.0	2.6
34.	Baru	9.5	75	–	2.7	2.7	1.9	0.7	0.2
35.	Polonia	24.2	33	0.1	6.7	6.8	4.7	1.7	0.5
36.	Darat	13.7	107	0.1	3.8	3.9	2.6	1.0	0.3
37.	Petisah Hulu	9.4	152	–	2.6	2.6	3.7	0.7	0.2
38.	Petisah Tengah III	7.2	114	0.1	1.9	2.0	3.5	0.5	0.4
39.	Sekip	10.8	177	–	3.0	3.0	4.5	0.7	0.3
40.	Silalas	6.4	125	–	1.8	1.8	5.6	0.4	0.2
41.	Binaya	79.3	98	0.6	22.0	22.6	20.4	5.5	7.8
42.	Padang Bulan	17.2	52	0.5	4.7	5.2	5.0	1.2	10.0
43.	Babura	11.5	147	–	3.2	3.2	1.2	0.8	4.4
44.	Sei Sikambing D.	13.5	190	–	3.8	3.8	3.3	0.9	0.4
45.	Sei Putih	38.1	168	–	10.8	10.8	7.2	2.3	1.2
46.	Sei Agul	25.6	96	–	7.2	7.2	2.6	1.8	0.8
	Internal Study Area	727.9	142	1.4	202.4	203.8	226.5	50.5	55.7
47.	Deli	57.5	27	2.9	13.2	16.1	17.9	0.9	0.5
48.	Labuhan	63.6	8	12.9	4.9	17.8	11.6	1.0	0.6
49.	Belawan	72.0	94	1.0	19.2	20.2	14.8	1.2	0.6
50.	Sidorejo	34.8	93	0.1	9.6	9.7	6.0	0.6	0.3
51.	Bandar	88.2	117	0.2	24.5	24.7	15.2	1.4	0.8
52.	Kp. Binjei	16.6	24	0.8	3.8	4.6	3.5	0.3	0.1
53.	Timbang Deli	23.9	33	1.0	5.7	6.7	4.2	0.4	0.2
54.	Kedai Dian	21.6	32	0.8	5.3	6.1	3.8	0.3	0.2
55.	Gedung Johor	19.5	14	1.9	3.6	5.5	3.4	0.3	0.4
56.	Tuntungan	20.8	7	4.8	1.0	5.8	3.6	0.3	0.2
57.	Surgal	107.7	36	3.8	26.3	30.1	18.7	1.7	1.1
	Intermediate Study Area	526.2	25	30.2	117.1	147.3	102.7	8.4	5.0
58.	P. Sei Tuan	39.6	4	7.0	4.8	11.9	4.5	0.6	0.5
59.	Btg. Kuwis	58.4	4	10.3	7.2	17.5	7.0	1.4	0.7
60.	Tg. Morawa	61.4	4	9.7	8.7	18.4	6.4	1.2	0.8
61.	Polumbak	20.9	5	3.3	3.0	6.3	2.6	0.3	0.3
62.	Deli Tua	29.6	4	5.5	3.4	8.9	3.0	0.4	0.4
63.	P. Batu	33.2	3	9.4	0.6	10.0	0.1	0.4	0.4
64.	Sunggal	68.6	6	7.4	13.2	20.6	11.7	1.1	0.8
65.	Kp. Perak	105.0	3	22.2	9.3	31.5	8.0	1.5	1.3
66.	Binjei	69.8	3	1.1	19.8	20.9	19.1	4.6	4.6
	External Study Area	486.5	5	75.9	70.0	145.9	62.4	11.5	9.8
67.	East	625.8	2	68.8	119.0	187.8	117.7	6.6	6.5
68.	South	79.0	1	19.1	4.6	23.7	4.4	0.8	0.8
69.	West	592.2	1	114.5	63.2	177.7	62.6	6.1	6.1
	Outside Total	1,297.0	1	202.4	186.8	389.2	184.7	13.5	13.4
	Grand Total	3,037.6	2	309.9	576.3	886.2	586.3	83.9	83.9

Table 2.4.5 Residential Population, Employed population, Jobs & Traffic Relevant Students by Zone, 1985

(Unit: 1,000 Persons)

	Residential Population		Employed Population			Jobs	Traffic Relevant Students	
	Resid. Pop.	(Density) Pop./ha	Sector I	Sector II + III	Total		At Resid. Places	At Study Places
1. Gang Bunto I	5.8	27.6	–	1.6	1.6	6.4	0.5	0.6
2. Pusat Pasar I	4.9	181	–	1.4	1.4	6.9	0.4	0.9
3. Pusat Pasar II	3.4	200	–	0.9	0.9	3.4	0.3	0.3
4. Pasar Baru	8.8	352	–	2.5	2.5	7.3	0.7	0.6
5. Aur I	5.0	208	–	1.4	1.4	6.7	0.4	0.2
6. Kesawan I	3.3	127	–	0.9	0.9	7.1	0.3	0.2
7. Gang Bunto II	5.9	295	–	1.6	1.6	4.4	0.5	0.6
8. Pandan Hilir I	7.2	206	–	2.0	2.0	5.1	0.6	0.7
9. Sei Rengas I	6.2	221	–	1.8	1.8	7.8	0.5	1.0
10. Sei Rengas II	6.1	218	–	1.6	1.6	5.6	0.5	0.5
11. Aur II	8.0	222	–	2.2	2.2	5.5	0.7	0.4
12. Hamdan	11.0	151	–	3.0	3.0	16.1	0.9	0.9
13. Petisih Tengah I	4.4	138	–	1.2	1.2	5.1	0.4	0.2
14. Kesawan II	5.9	134	–	1.6	1.6	2.4	0.5	0.4
15. Sidodadi I	6.5	171	–	1.8	1.8	1.8	0.5	0.7
16. Sidodadi II	8.7	189	–	2.5	2.5	6.8	0.7	0.9
17. Pandan Hilir	7.9	255	–	2.2	2.2	2.1	0.6	0.8
18. Pandan Hulu	20.6	271	–	5.8	5.8	5.1	1.7	1.7
19. Sei Rengas II	11.7	390	–	3.3	3.3	3.6	0.9	0.7
20. Kotamatsum	59.8	358	–	16.6	16.6	24.4	4.8	3.7
21. Sei Mati	14.1	353	–	3.9	3.9	1.8	1.1	0.3
22. Anggrung	6.3	117	–	1.8	1.8	0.8	0.5	0.4
23. Madras Hulu	7.4	114	–	2.0	2.0	14.3	0.6	0.7
24. Petisih Tengah II	4.4	138	–	1.2	1.2	4.8	0.4	0.2
25. Silalas I	3.5	152	–	0.9	0.9	3.2	0.3	0.2
26. Silalas II	3.6	157	–	1.0	1.0	0.9	0.3	0.2
27. Kesawan III	4.7	134	–	1.3	1.3	6.4	0.4	0.2
28. Durian	25.3	239	–	7.1	7.1	17.6	2.1	1.7
29. Sidorame	36.7	287	–	10.2	10.2	13.5	3.0	0.9
30. Sei Kera Hilir	41.9	308	–	11.6	11.6	15.9	3.4	1.0
31. Tegal Sari	55.9	363	–	15.4	15.4	15.7	4.5	3.4
32. Teladang	49.9	230	–	13.9	13.9	13.5	4.0	2.3
33. Sitirejo	54.7	195	–	15.3	15.3	11.0	4.4	4.6
34. Baru	11.3	89	–	3.2	3.2	2.3	0.9	0.5
35. Pelonia	30.6	41	0.1	8.5	8.6	5.6	2.5	1.6
36. Darat	17.3	137	0.1	4.8	4.9	3.2	1.4	0.9
37. Petisih Hulu	11.2	181	–	3.2	3.2	3.4	0.9	0.5
38. Petisih Tengah III	8.4	133	0.1	2.4	2.5	8.9	0.7	0.6
39. Sekip	12.4	203	–	3.4	3.4	9.4	1.0	0.6
40. Silalas	7.5	147	–	2.1	2.1	8.8	0.6	0.4
41. Binjai	96.8	119	0.6	26.9	27.5	36.2	7.8	10.7
42. Padang Bulan	23.8	72	0.5	6.6	7.1	0.9	1.9	11.1
43. Babura	14.1	181	–	3.9	3.9	1.8	1.1	4.8
44. Sei Sikambing D.	15.4	217	–	4.4	4.4	1.0	1.2	0.7
45. Sei Putih	45.1	196	–	12.6	12.6	16.5	3.7	2.3
46. Sei Agul	33.1	124	–	9.2	9.2	4.0	2.7	2.1
Internal Study Area	836.1	163	1.4	232.7	234.1	370.0	67.8	73.9
47. Deli	72.5	35	3.1	17.3	20.4	18.0	4.9	2.5
48. Labuhan	85.9	11	13.0	11.1	24.1	12.0	5.8	3.8
49. Belawan	83.6	109	1.1	22.3	23.4	17.7	5.6	2.0
50. Sibolangit	49.1	132	0.2	13.5	13.7	6.1	3.3	2.3
51. Bandar	121.0	160	0.3	33.6	33.9	17.0	8.2	5.3
52. Kp. Binjei	28.9	41	0.8	7.3	8.1	3.8	1.9	1.8
53. Tumbang Deli	28.3	39	1.0	6.9	7.9	4.3	1.9	0.8
54. Kedai Durian	27.5	41	0.8	6.9	7.7	3.8	1.9	1.0
55. Gedung Johor	56.1	41	1.9	13.8	15.7	3.6	3.8	10.4
56. Tuntungan	104.8	35	4.8	24.5	29.3	4.5	7.1	15.5
57. Sungal	147.2	50	3.8	37.4	41.2	18.2	9.9	6.6
Intermediate Study Area	804.9	38	30.8	194.6	225.4	110.0	54.3	52.0
58. P. Sei Tuan	42.3	4	7.4	5.7	13.1	3.6	1.2	1.0
59. Big. Kuwis	108.6	8	10.9	21.3	33.7	18.6	2.8	2.6
60. Tg. Morawa	65.0	5	10.2	9.9	20.1	0.9	2.5	1.6
61. Percimbak	22.1	5	3.5	3.3	6.8	0.7	0.7	0.5
62. Deli Tua	31.3	4	5.8	3.9	9.7	1.3	1.0	0.8
63. P. Batu	35.2	3	9.9	2.5	10.9	0.5	1.1	0.9
64. Sunggal	72.6	7	7.8	14.7	22.5	7.0	2.4	1.8
65. Kp. Perak	111.2	4	23.4	11.1	34.5	4.5	3.2	2.7
66. Binjei	86.0	4	1.2	25.5	26.7	21.3	6.1	5.7
External Study Area	574.3	5	80.1	97.9	78.0	58.4	21.0	17.7
67. East	588.9	2	57.9	124.7	182.6	117.0	14.3	14.0
68. South	74.3	1	16.1	6.9	23.0	5.1	1.8	1.8
69. West	557.3	1	36.3	76.5	172.8	72.8	13.4	13.2
Outside Total	1,220.5	1	170.3	208.1	378.4	194.9	29.5	29.0
Grand Total	3,435.8	3	282.6	733.3	1,015.9	333.3	172.6	172.6

Table 2.4.6 Residential Population, Employed Population, Jobs & Traffic Relevant Students by Zone, [Trend, 2000]

(Unit: 1,000 Persons)

	Residential Population		Employed Population			Jobs	Traffic Relevant Students	
	Resid. Pop.	(Density) Pop./ha	Sector I	Sector II + III	Total		At Resid. Places	At Study Places
1. Gang Buntu I	7.2	343	–	2.2	2.2	6.1	0.6	0.8
2. Pusat Pasar I	6.9	256	–	2.1	2.1	7.0	0.6	1.2
3. Pusat Pasar II	4.5	265	–	1.3	1.3	4.7	0.4	0.4
4. Pasar Baru	9.6	384	–	2.9	2.9	3.6	0.8	0.7
5. Aur I	7.0	292	–	2.1	2.1	6.3	0.6	0.5
6. Kesawan I	6.0	231	–	1.8	1.8	7.6	0.5	0.5
7. Gang Buntu II	7.1	355	–	2.1	2.1	3.0	0.6	0.8
8. Pandan Hilir I	9.1	260	–	2.7	2.7	9.4	0.8	0.9
9. Sei Rengas I	8.4	300	–	2.5	2.5	4.9	0.7	1.3
10. Sei Rengas II	7.7	275	–	2.3	2.3	7.2	0.7	0.7
11. Aur II	10.5	292	–	3.1	3.1	9.2	0.9	0.7
12. Hamdan	16.5	226	–	4.9	4.9	18.9	1.4	1.6
13. Petisah Tengah I	7.3	228	–	2.2	2.2	8.4	0.6	0.6
14. Kesawan II	10.0	227	–	3.0	3.0	11.8	0.9	0.9
15. Sidodadi I	8.5	224	–	2.5	2.5	10.7	0.7	1.0
16. Sidodadi II	11.3	246	–	3.4	3.4	11.5	1.0	1.2
17. Pandan Hilir	9.6	310	–	2.9	2.9	7.2	0.8	1.0
18. Pandan Hulu	24.8	326	–	7.4	7.4	13.0	2.1	2.2
19. Sei Rengas II	13.1	437	–	3.9	3.9	3.1	1.1	0.9
20. Kotamatsum	67.9	407	–	20.4	20.4	18.9	5.8	4.7
21. Sei Mati	16.0	400	–	4.8	4.8	3.6	1.4	0.5
22. Anggrung	9.9	183	–	3.0	3.0	1.1	0.8	0.9
23. Madras Hulu	12.2	188	–	3.7	3.7	15.9	1.0	1.3
24. Petisah Tengah II	7.3	22.8	–	2.2	2.2	8.7	0.6	0.6
25. Silalas I	5.6	243	–	1.7	1.7	5.9	0.5	0.5
26. Silalas II	5.6	243	–	1.7	1.7	6.3	0.5	0.4
27. Kesawan III	8.0	229	–	2.4	2.4	9.6	0.7	0.6
28. Durian	31.3	295	–	9.4	9.4	70.9	2.7	2.4
29. Sidorame	41.2	322	–	12.4	12.4	24.5	3.5	1.5
30. Sei Kera Hilir	46.6	343	–	14.0	14.0	24.3	4.0	1.6
31. Tegal Sari	63.0	412	–	18.9	18.9	23.5	5.3	4.3
32. Teladang	62.3	287	–	18.7	18.7	35.6	5.3	8.8
33. Sitirejo	71.0	253	–	21.3	21.3	16.0	6.0	6.6
34. Baru	17.8	140	–	5.3	5.3	1.9	1.5	1.3
35. Polonia	44.2	59	–	13.3	13.3	4.5	3.8	3.3
36. Darat	25.8	205	–	7.7	7.7	5.7	2.2	2.0
37. Petisah Hulu	15.6	252	–	4.7	47	1.7	1.3	1.0
38. Petisah Tengah III	14.0	222	–	4.2	4.2	16.6	1.2	1.3
39. Sekip	17.9	293	–	5.4	5.4	12.2	1.5	1.3
40. Silalas	12.3	241	–	3.7	3.7	14.3	1.0	1.0
41. Binjai	141.7	174	–	42.5	42.5	42.2	12.0	16.3
42. Padang Bulan	46.5	141	–	13.9	13.9	12.8	3.9	13.9
43. Babura	19.3	247	–	5.8	5.8	4.3	1.6	5.4
44. Sei Sikambing D.	21.7	306	–	6.5	6.5	17.5	1.8	1.5
45. Sei Putih	65.5	285	–	19.7	19.7	42.8	5.6	4.8
46. Sei Agul	56.6	212	–	17.0	17.0	10.4	4.8	5.0
Internal Study Area	1,131.9	220	–	339.6	339.6	550.3	96.1	110.7
47. Deli	92.5	44	1.7	26.0	27.7	17.8	8.4	5.0
48. Labuhan	117.9	15	14.5	20.9	35.4	16.3	10.6	7.8
49. Belawan	96.8	126	–	29.0	29.0	65.1	8.7	3.6
50. Sidorejo	56.2	151	–	16.9	16.9	5.6	5.1	3.2
51. Bandar	174.1	230	–	52.2	52.2	45.5	15.7	11.9
52. Kp. Binjei	76.0	109	0.2	22.6	22.8	8.8	6.9	7.6
53. Timbang Deli	34.9	48	0.4	10.1	10.5	6.4	3.1	1.6
54. Kedai Durian	37.0	55	–	11.1	11.1	3.7	3.3	2.2
55. Gedung Johor	71.6	52	0.5	21.0	21.5	7.2	6.5	12.3
56. Tuntungan	165.8	56	3.1	46.6	49.7	19.2	15.0	23.1
57. Sungal	241.0	82	0.3	72.0	72.3	27.9	21.7	18.3
Intermediate Study Area	1,163.8	54	20.7	328.4	349.1	223.5	105.0	96.6
58. P. Sei Tuan	59.8	6	5.8	12.5	18.3	6.3	2.1	2.4
59. Btg. Kuwis	153.6	11	9.0	37.9	46.9	30.4	6.4	6.0
60. Tg. Morawa	92.0	7	2.8	19.3	28.1	4.2	5.1	3.6
61. Potumbek	31.3	7	2.2	7.4	9.6	1.1	1.5	1.2
62. Deli Tua	44.3	6	4.6	8.9	13.5	2.6	2.0	1.7
63. P. Batu	49.8	4	8.1	7.1	15.2	0.8	2.3	2.0
64. Sunggal	102.1	10	6.7	24.7	31.4	7.9	5.0	4.0
65. Kp. Perak	157.3	5	19.9	28.2	40.1	13.5	7.0	6.2
66. Binjei	141.0	6	0.1	43.0	43.1	32.1	9.9	9.4
External Study Area	831.8	8	65.2	189.0	254.2	98.9	41.9	36.5
67. East	665.5	2	47.5	171.1	218.5	161.4	26.6	26.1
68. South	84.0	1	13.2	14.4	27.6	12.9	3.4	3.3
69. West	629.7	1	79.0	27.8	106.8	123.3	25.0	24.8
Outside Total	1,379.2	1	139.6	313.3	452.9	297.6	55.0	54.2
Grand Total	4,506.7	4	225.5	1,170.3	1,385.8	1,170.3	298.0	298.0

Table 2.4.7 Residential Population, Employed Population, Jobs & Traffic Relevant Students by Zone, [Re-develop, 2000]

(Unit: 1,000 Persons)

	Residential Population		Employed Population			Jobs	Traffic Relevant Students	
	Resid. Pop.	(Density) Pop/ha	Sector I	Sector II + III	Total		At Resid. Places	At Study Places
1. Gang Buntu I	5.8	276	–	1.7	1.7	7.9	0.5	0.6
2. Pusat Pasar I	5.3	196	–	1.6	1.6	9.2	0.4	1.0
3. Pusat Pasar II	3.6	212	–	1.1	1.1	6.0	0.3	0.3
4. Pasar Baru	8.2	328	–	2.5	2.5	7.0	0.7	0.5
5. Aur I	5.0	208	–	1.5	1.5	8.7	0.4	0.2
6. Kesawan I	4.2	162	–	1.3	1.3	10.1	0.3	0.3
7. Gang Buntu II	5.9	295	–	1.8	1.8	5.8	0.5	0.6
8. Pandan Hilir I	7.4	211	–	2.2	2.2	2.2	0.6	0.7
9. Sei Rengas I	6.5	232	–	1.9	1.9	6.5	0.5	1.0
10. Sei Rengas II	6.4	229	–	1.9	1.9	6.8	0.5	0.5
11. Aur II	8.0	222	–	2.4	2.4	9.1	0.7	0.4
12. Hamdan	11.5	158	–	3.4	3.4	17.2	1.0	1.0
13. Petisah Tengah I	5.4	169	–	1.6	1.6	8.0	0.4	0.3
14. Kesawan II	7.3	165	–	2.2	2.2	15.9	0.6	0.6
15. Sisingamangaraja I	6.9	182	–	2.1	2.1	14.0	0.6	0.8
16. Sisingamangaraja II	9.2	200	–	2.8	2.8	11.6	0.8	1.0
17. Pandan Hilir	8.0	258	–	2.4	2.4	7.2	0.7	0.8
18. Pandan Hulu	21.1	278	–	6.3	6.3	16.2	1.8	1.8
19. Sei Rengas II	10.8	360	–	3.2	3.2	5.9	0.9	0.6
20. Kotamatsum	55.7	331	–	16.7	16.7	32.0	4.7	3.2
21. Sei Mati	13.3	333	–	4.0	4.0	3.3	1.1	0.2
22. Anggrung	8.0	148	–	2.4	2.4	0.8	0.7	0.6
23. Madras Hulu	8.0	123	–	2.4	2.4	5.9	0.7	0.8
24. Petisah Tengah II	5.4	169	–	1.6	1.6	8.0	0.4	0.3
25. Silalas I	4.2	183	–	1.3	1.3	5.8	0.3	0.3
26. Silalas II	4.3	187	–	1.3	1.3	5.8	0.4	0.3
27. Kesawan III	5.8	165	–	1.7	1.7	8.8	0.5	0.3
28. Darma	25.8	243	–	7.7	7.7	24.6	2.2	1.8
29. Sidorame	34.3	268	–	10.3	10.3	29.3	2.9	0.6
30. Sei Kera Hilir	39.0	287	–	11.7	11.7	30.8	3.3	0.6
31. Tegal Sari	52.6	344	–	15.8	15.8	22.0	4.5	3.0
32. Teladang	57.0	263	–	17.1	17.1	20.6	4.8	8.2
33. Sitirejo	68.0	242	–	20.4	20.4	15.8	5.8	6.3
34. Baru	13.6	107	–	4.1	4.1	1.4	1.2	0.8
35. Pelonia	55.0	74	–	16.5	16.5	5.5	4.7	4.6
36. Darat	18.3	145	–	5.5	5.5	4.8	1.6	1.0
37. Petisah Hulu	11.4	184	–	3.4	3.4	1.1	1.0	0.5
38. Petisah Tengah III	10.4	165	–	3.1	3.1	14.7	0.9	0.9
39. Sekip	13.9	228	–	4.2	4.2	14.3	1.2	0.8
40. Silalas	9.1	178	–	2.7	2.7	11.8	0.8	0.6
41. Banyan	129.2	159	–	38.8	38.8	40.8	11.0	14.7
42. Padang Bulan	35.5	103	–	10.6	10.6	3.6	3.0	12.6
43. Sei Sikambing C.	16.0	205	–	4.8	4.8	1.6	1.4	5.0
44. Sei Sikambing D.	18.9	266	–	5.7	5.7	9.4	1.6	1.1
45. Sei Putih	57.2	249	–	17.2	17.2	27.1	4.9	3.8
46. Sei Agul	54.3	203	–	16.3	16.3	5.4	4.6	4.7
Internal Study Area	970.1	189	–	291.2	291.2	550.3	82.4	90.6
47. Deli	103.5	49	1.7	29.4	31.1	20.8	9.3	6.4
48. Labuhan	130.2	16	14.5	24.6	39.1	17.5	11.6	9.3
49. Belawan	105.2	137	–	31.6	31.6	70.9	9.4	4.7
50. Sidorejo	58.3	157	–	17.5	17.5	5.8	5.2	3.4
51. Bandar	182.8	242	–	54.8	54.8	47.1	16.4	13.0
52. Kp. Binjei	94.8	136	0.2	28.2	28.4	10.9	8.5	10.0
53. Tembung Deli	36.2	49	0.4	10.5	10.9	7.1	3.2	1.8
54. Kedai Durian	39.8	59	–	11.9	11.9	4.0	3.6	2.5
55. Gedung Johor	108.2	79	0.5	32.0	32.5	10.8	9.7	16.9
56. Tembungan	197.4	65	3.1	56.1	59.2	22.8	17.7	27.0
57. Sunggal	268.6	92	0.3	80.3	80.6	31.4	24.1	21.7
Intermediate Study Area	1,325.0	62	20.7	376.8	397.5	249.1	118.7	116.7
58. P. Sei Tuan	65.3	6	5.8	15.1	20.9	7.7	2.6	2.3
59. Stg. Kerbau	167.6	12	9.0	44.6	53.6	35.4	6.1	5.7
60. Tg. Morawa	100.3	7	8.8	23.3	32.1	1.2	4.9	3.4
61. Percut Sei Tuan	34.1	8	2.2	8.7	10.9	1.0	1.4	1.1
62. Deli Tua	48.3	6	4.6	10.8	15.4	3.1	1.9	1.6
63. P. Brayan	54.3	4	8.1	9.3	17.4	1.6	2.2	1.9
64. Sunggal	182.1	10	6.7	29.1	35.8	7.9	4.8	3.8
65. Kp. Perak	171.6	5	19.9	35.0	54.9	16.6	6.7	5.9
66. Binjei	141.0	6	0.1	45.0	45.1	32.4	9.9	9.4
External Study Area	894.7	8	65.2	220.9	286.1	106.9	40.5	35.1
67. East	635.1	2	47.5	155.6	203.1	114.8	27.3	36.8
68. South	80.1	1	13.2	12.5	25.6	10.9	3.5	3.4
69. West	601.1	1	79.0	113.3	192.3	108.3	25.6	25.4
Outside Total	1,316.3	1	139.6	281.4	421.0	261.0	56.4	55.6
Grand Total	4,506.7	4	225.5	1,170.3	1,395.8	1,170.3	293.0	293.0

2.5 Planning for Medan Station Area

(1) Present Situation

Although Medan Railway Station plays presently not an very important role in the urban transport scene, it is expected to become a major transport terminal when the railway commuter service is commenced in the future. The total number of railway users at Medan Station in 2000 A.D. is estimated to grow up to 78,432 persons/day excluding transferring passengers for the 'Low Motorization Model', as will be described in Chapter 4. Presently, there is no facilities for the feeder transport system around the station except a few road-side parking lots on the west side of the station. There is no wicket on the east side and those who are destined to the east side area have to use the pedestrain bridge, while the east side accommodates higher day-time population than the other.
As one of the short-term improvements wickets, and bus and taxi berths are proposed to be provided on the east side. Both sides of the railway yard are to be connected with an underpass as shown in Fig. 7.3.5 Plan of Eastside Station, in the 'Final Report on Short Term Improvement'.

(2) Planning Conditions

As will be described in the later chapter, several alternative cases are proposed for the long-term railway improvement. The Improvement Alternative No. 5, in which the railway lines are to be continuously elevated, is adopted for the planning for Medan Station area after being selected by the preference expressed by the Government of Indonesia as of the first priority. As shown in Fig. 2.4.2 PJKA's Property around Medan Station there is a considerable tract of PJKA-owned land, and most of them are possibly released for re-development. In order to create an effective transport terminal, several kinds of urban transport facilities are proposed to be attached to the railway station such as:

- Public Parking spaces;
- Bus Berths; and
- Station Plaza.

(3) Public Parking Lots

As will be mentioned in Sec. 6.4: Parking System the demand for parking space within the 500m radius from the station will be shared by:

- Road-side Parking (20%);
- Parking space attached to large commercial/administrative buildings (60%); and
- Public and private parking lots (20%).

Among the above three kinds, 300 ~ 500 public parking lots are proposed around the station.

(4) Bus Berths

As one of the short-term solutions, up-grading of the present Pasar Sambu Bus Terminal is proposed in Sec. 7.3.4 Improving Sambu Bus Terminal in the 'Short-Term Improvement Plan'.
To meet the future demand 35 berths are preferably planned around the station, separating them on both sides of the station.

(5) Station Plaza

A station plaza is a set of facilities which serve for model transferring between railway and feeder system or among feeder systems. When the railway is elevated, both sides of railway can be served by a station plaza separately, being linked with the area pedestrain circulation network effectively.

(6) Construction Costs

Construction costs of above facilities are estiamted elsewhere in Chapter 6 such as:

- Sec. 6.1: Railway Facilities;
- Sec. 6.3: Bus Transport; and
- Sec. 6.4: Parking System.

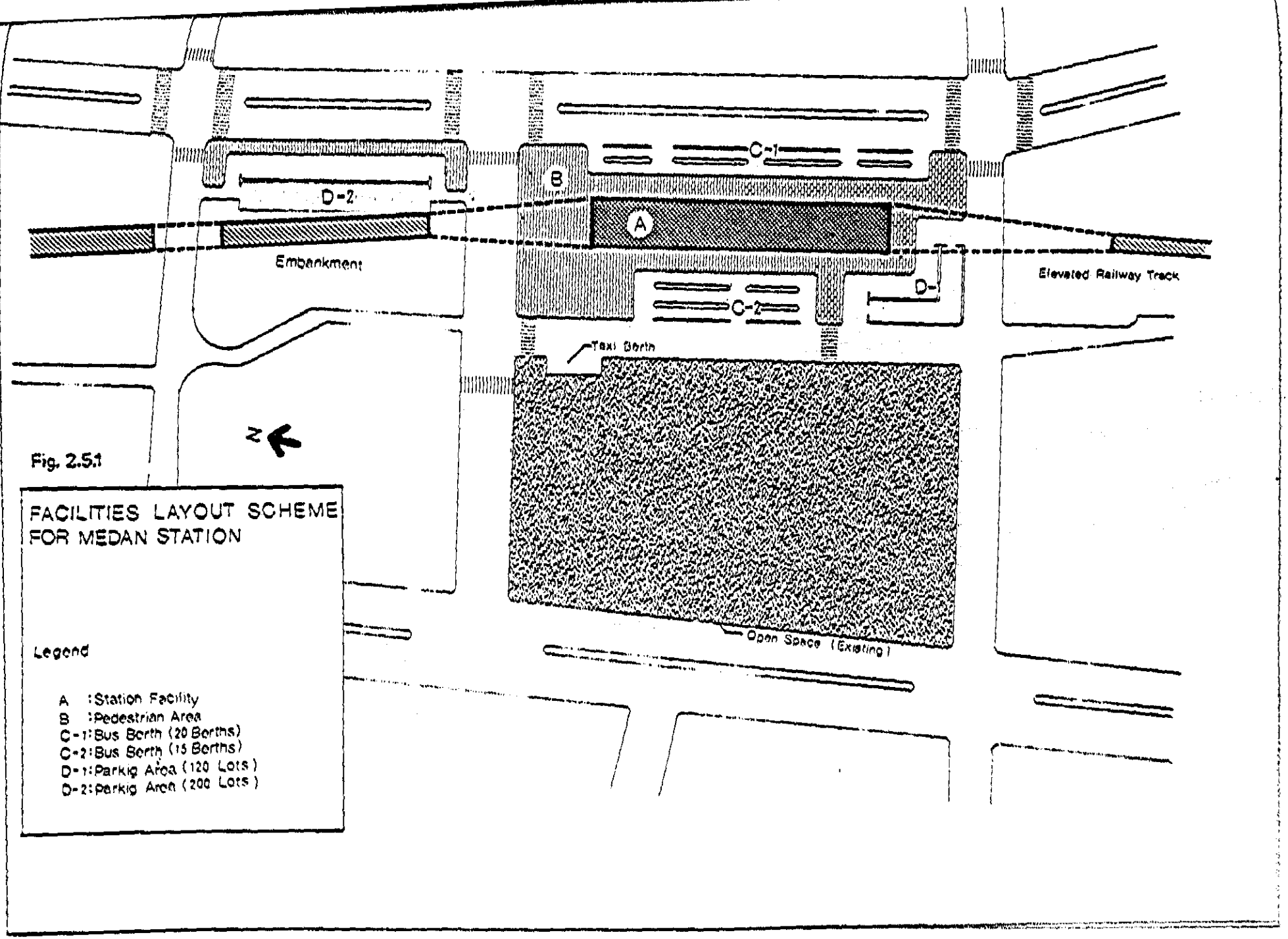


Fig. 2.5.1

FACILITIES LAYOUT SCHEME FOR MEDAN STATION

Legend

A :Station Facility
B :Pedestrian Area
C-1:Bus Berth (20 Berths)
C-2:Bus Berth (15 Berths)
D-1:Parkig Area (120 Lots)
D-2:Parkig Area (200 Lots)

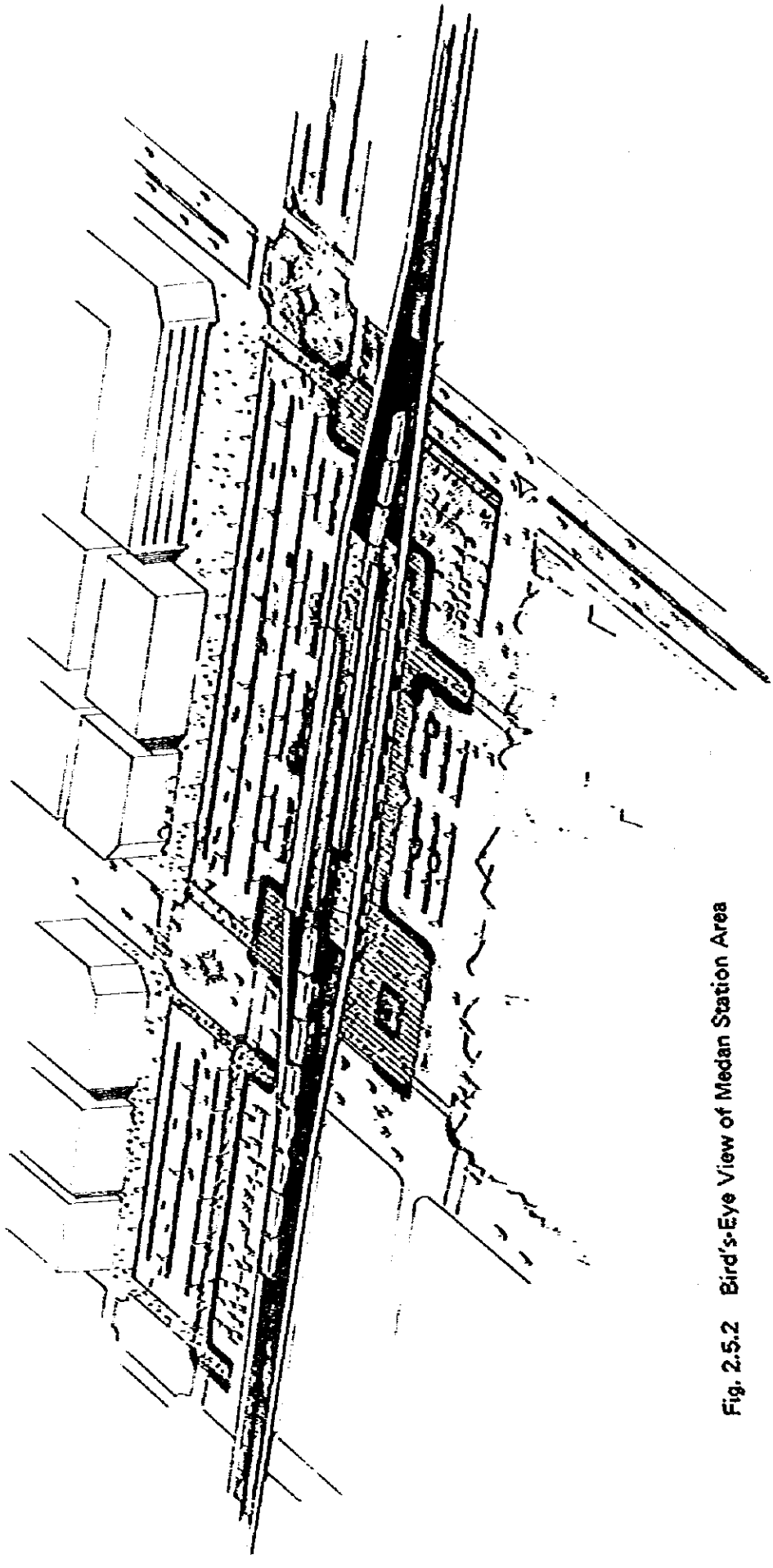


Fig. 2.5.2 Bird's-Eye View of Medan Station Area

2.6 Pedestrian Mall

In Sec. 7.3.4: Improvement of Sambu Bus Terminal in the 'Final Report on Short Term Improvements, improvements of the existing Sambu Bus Terminal is proposed. As will be described in Sec. 6.3: Bus Transport, around 1990 the bus terminal will be moved to the area around Medan Station. It would be a good idea to convert this area to pedestrian path with public open space, where no vehicle entrance is allowed. At present the downtown area on the east side of the railway track has not much public open space, while the west side has more open space around public buildings as a result of lower building coverage. So, the Sambu Bus Terminal site after relocation could provide a precious pedestrian territory when properly designed.

2.7 Growth Poles

Medan City at present is on the way of the CBD formations. Although, the growth rates of residential population within the central 4 Kecamatums have declined recently, the commercial/administrative facilities are still mingled with residential spaces. As the central district becomes a specialized center of business activity, its residential conditions have become deteriolated year by year.

Under such circumstances, in this project, it is assumed that the residential development within the suburban areas will be accelerated as the redevelopment of the central district proceeds. In this process, in many cases, patterns of urban development appears, such that:

- The central district starts growing in a multi-directional way forming sub-centers usually around transportation terminals; and

- Along with residential development within suburbs centered by community centers with commercial/institutional facilities, those with wider service areas grow outstandingly to become regional centers.

Evolution of the above two kinds of growth poles proceeds simultaneously, the former in the central district and the later in the suburbs.

Hereafter, areas with high possibility to accommodate those centers are selected as in Fig. 2.7.1: Potential Growth Poles for Future Development and the character of each area is described.

A: This is the present CBD centered by Medan Station. The potential of this location as a CBD will become much greater in the future when the commuter service by railway is commenced. Also, as mentioned in Sec. 2.5: Planning for Medan Station Area, terminal facilities such as bus terminals, taxi berths and public parking lots will be organized to become the central transportation terminal in the future.

In this area re-development project should be carried out simultaneously with widening of arteries and elevation of railway tracks. At this moment, those facilities such as wholesale markets or storages which create traffic congestions, and also those which will become unnecessary to be situated in the central district when a large portion of its residential population moves out to suburbs. Also, disaster prevention measures and preservation of historic districts should be considered.

B: Those locations grouped into B are connected each other by Intermediate Ring Road, and they are expected to share the role of the CBD in the future when the built-up area expands. Also, at the same time, each location is situated in the vicinity of transportation terminals on the major radial corridors and can possibly give some impact upon development along.

B-1: This is located around Medan Passar Station where a considerable amount of commercial/administrative facilities are accumulated, and at the same time, the density of residential population is considerably high. Remodeling of Medan Passar Station is required for the future commuter service operation.

Taking this opportunity, recognition of transportation facilities attached and re-development of the surrounding commercial administrative areas should be carried out.

B-2: At present, in this area, there are not many commercial/administrative facilities. The present inter-city bus terminal is planned to be converted to that of city bus. When the railway station is constructed, this will become an important transportation node in the suburban area.

There are public recreation facilities around, and this can be a good location for educational and institutional facilities.

B-3: This is located on the linear built-up area toward Binjei, and commercial facilities to serve local communities already exist. 'The Master Plan Kotomadya Medan' (1974) proposes to expand the commercial/business districts westward and development in this location could give an impact on this trend.

B-4: At present, there are not many urban facilities. In the future, along with the residential development around, this will become a center of community service in this area.

C: Those in the C Group are located around interchanges between the Outer Ring Road and major radial highways. In the vicinity of these interchanges railway stations and inter-city bus terminals are situated as transportation terminals in suburban areas. Also, some of them are around sites of large-scale housing projects or industrial development projects.

Most of these locations are, at present, rather under developed and development scheme for them should be established along with these new residential area development or industrial estate development projects.

Development of these areas will promote that of further outside region as well as that of now under developed in-between zones of Intermediate and Outer Ring Roads.

C-1: The Medan Denai Housing Project has been already under way, and in the near future when Belawan-Medan-Tg. Morawa Tollway is in operation this area will increase its geographic importance. Facilities to be situated in this area would be community servicing commercial/institutional facilities as well as industrial facilities to take advantage of being around cargo terminal planned by the MUDS.

C-2: In this area already small scale manufacturing enterprizes are found along major arteries.

When the interchanges and bus terminals are constructed, accessibility to the main goods flow will become stronger. Therefore, this location is suitable for industrial development. Also, commercial/institutional facilities to serve residential communities around should be considered.

C-3: The MUDS gives high priority of residential development to this location because of relatively favorable condition of land acquisition in this area. In this area, commercial/ institutional development around the new railway station should be promoted, and like the B.2 Area construction of Polonia Air Port will add more importance to this area.

C-4: This area is very under developed at present and along with residential development, commercial/institutional development around the railway station should be promoted. This area is in the proximity of North Sumatra State University and will be an alternative site of educational or recreational facilities.

C-5: This area has a same kind of character as the C-1 Area, and along with growth of Kod. Binjei as one of satellite towns of Medan City, development of this area will promote linear development of this corridor.

C-6: This area is located on the linear built-up area along the Medan-Belawan Corridor. When the Medan Industrial Estate is completed, the Medan Industrial Estate and small and medium sized housings in both private and public sectors are planned, and in the future commercial/institutional facilities would become necessary.

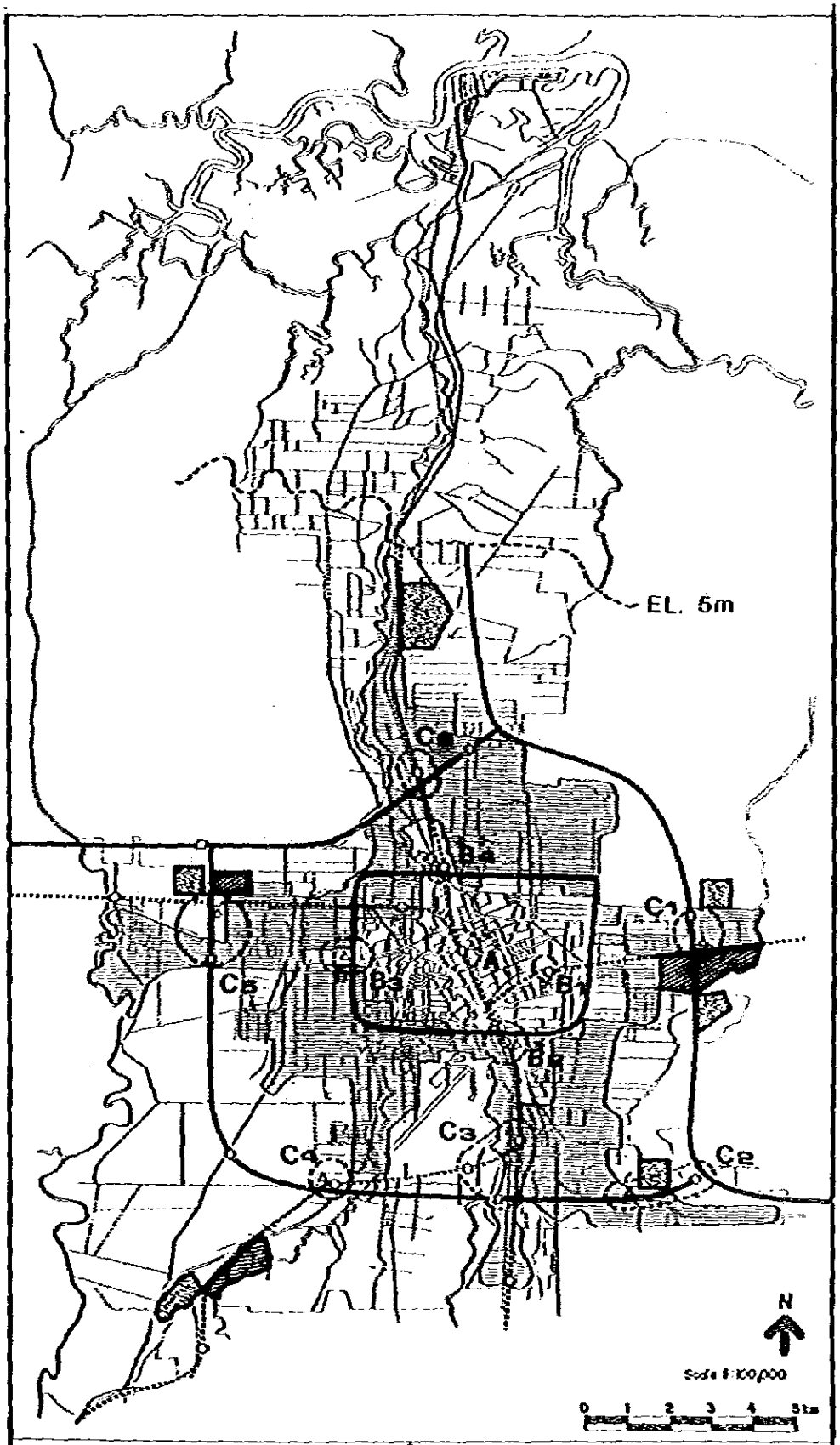


Fig. 2.7.1 Potential Growth Poles for Future Development

Legend

Medan Area Transportation Study

Chapter 3 TRANSPORT DEVELOPMENT PLAN

Chapter 3. TRANSPORT DEVELOPMENT PLAN

3.1 Planning Policies

3.1.1 General Description

In regarding to formulating a Master Plan of Medan Urban Transport System the planning policies can be summarized as follows:

(a) To keep necessary urban functions of the city;
(b) To conserve the area environment;
(c) To secure land spaces for the future public use; and
(d) To save energy resources.

Keeping the necessary urban functions is to intend in formulating a Transport Master Plan for Medan City to enable the urban economic activities, which are the main sources of urban traffic movements, to function well and, on the other hand, to secure a safe and convenient transport system easily available to the majority of citizens in their daily urban lives under the premise that Medan City, which is presently of the population of 1.2 million and is expected to expand up to that of 2.3 million in future, will remain as the political, economical and cultural centers of Sumatra Island in future as well.

Conservation of the area environment is to keep the right land use by means of allocating optimum population density by zone, to identify improvements necessary for the existing urban transport facilities based on the concept to solve the urban air pollution problem including traffic vehicles, waste gas which is becoming one of the urban problem already, and also to prevent traffic accidents and possible disasters in future.

Securing appropriate land space for the future public use includes securing spaces necessary for municipal roads in the whole city area, which will result in facilitating citizens' urban lives in wider meaning, and securing, in advance of actual needs, spaces necessary in future for municipal water supply, and sanitary works, parking facilities as well as facilities to be needed in future in the operation of the city's urban transport system.

From the point of view of saving energy resources the main issue is to consider the urban transport problem from the viewpoint of effective utilization of petroleum resources which is recently discussed widely throughout the world, and also consequently, to select appropriate modes of transport for the urban transport system of the city.

3.1.2 Concept

The basic concept in formulating the long-term improvements are as follows:

(a) Basis in Land Use Planning

In regard to the land use planning proposals made in Medan Urban Development Study are considered more resonable than that shown

in Master Plan of Medan City; consequently, the former is adopted as the base of land use planning in this study.

In relation with the transport planning the followings are the problems existing in land use planning:

i) Frame in Planning

Two proposals are made for allocation of night-time population under the premise of the following two cases:

- To leave the CBD in its present trend of urban development (The Current Trend Model);
- To preserve the satisfactory urban environment of the CBD by redevelopment (The CBD Re-Development Model).

ii) Problem of Warehouses in CBD

Presently a group of old warehouses is existing in the CBD to store imported commodities hauled by truck from Port of Belawan before distribution into the city and the hinterland. Those facilities are proposed to relocate from this present locations to appropriate peripheral areas of the city as a means of re-organization of the distributing activities of the city, by which the urban transport activities are to be enhanced.

iii) Opening Railway Land in CBD for Re-Development

Presently, in the heart of Medan City there exist a freight yard, a coach yard, a locomotive depot and a group of warehouses of railway and residences for railway officials beside its facilities for passengers, occupying a considerable large lot of land. A considerable amount of fund will be expected to be needed to the railway for improvement of railway facilities by opening such land for new urban development by relocating those railway facilities to the peripheral areas of the city except for those for passengers, by which the redevelopment of the CBD can be expected to stimulate.

(b) Urban Size and Transport Network

Medan City is expected to expand up to the size of 2.3 millions in population by 2000 A.D. In the transport planning of a city like such a size anticipated in Medan it is necessary to expand the existing transport facilities as well as to increase the rate of dependence upon a mass transport system as evidenced in examples of cities of similar urban sizes in developed countries. This fact means that it is inevitably expected in future to face such a situation that, the urban traffic with a high peak rate as in the case of Medan City can not be handled only with the private vehicle fleet because of its low transport efficiency and the limited traffic capacities of the existing road network including vehicle parking capacity in the CBD.
In order to solve those transport problems in Medan City the positive

participation by railway in the regular commuter service is essential, because the railway main-line network occupies presently a strategic position in the city area; consequently, an integrated transport system, well-balanced between railway and road networks and their capacities, is considered essential to be established.

(c) Separation of Freight Train Operation from CBD

The major pay-load of railway transportation in North Sumatra as well as in the national total of Indonesian State Railway has been freight, which trend is also expected to remain not so much changed in the considerable future, but the situation in a large city area as Medan where the railway has to participate positively in the urban transport service is somewhat different, where a special attention should be paid to adjust the existing relations between freight and the passenger transportation. The problems to be adjusted are the possible effects on the road traffic such as the increase in the daily total of closing time of railway crossings existing in the CBD and the negative effects on the community by noises and vibrations due to the operation of freight trains passing through the CBD and affiliated shunting operation; its solution will finally lead to the relocation of a freight yard and the construction of a new freight line detouring east side of the city boundary and reaching to a new freight yard to be constructed halfway on Belawan-Medan Line.

(d) Improvement of Railway Crossings

Although the daily total of closing time at railway crossings is not so long at present, but it will increase noticeably if the railway commences the commuter service. In addition, the total volume of road traffic crossing the railway at 4 crossings existing in the CBD has reached approximately 300,000 daily including bicycles in 1979; and its expected increase in future will inevitably worsen the existing traffic jams in the CBD.

In order to cope with such a situation a certain measure should be taken to grade-separate the railway and the road at those crossings. Through such grade separations it is expected from the municipal side that the mutual road traffic flows from the areas on both sides of the railway, which had been hindered till then, will be facilitated; and consequently, the urban activities across the railway can be expected to enhance.

(e) Future Aspect of Becak

Becak exists as an traditional mode of transport, peculiar to Indonesia, providing its users of short-trip distances with a convenient transport service and also providing the low-income group with numerous chances of employment. Consequently, Becak is now essential for its both users as well Becak drivers at present. But Becak gives a negative effect on the road traffic because of its excessive width and its low transport efficiency due to its low operating speed and is at present, considered to be really one of the causes inducing the present traffic congestion in Medan City.

From such viewpoint it is considered favorable if Becak is replaced in Medan City with Bemo, Daihatsu, or mini-bus but will be still serve for residents in the surrounding area as the long-term urban transport solution by 2000 A.D. Special legislative steps should be taken for employment of Becak drivers in replacing Becak with other modes of transport. Consequently, the replacement needs to be carried out gradually as well as flexibly.

3.2 A General View of the Urban Transportation in Medan City

Generally the problem of urban transportation can be considered in connection with a desirable state of transport system. Based on the planning policies which are mentioned in Sec. 3.1 as a more concrete project of the improvement of transport facilities, the items to be discussed can be summarized as follows:

(a) Correspondence with Urban Size

Actually, this can be expressed by the size of population and the urbanized area of the city. The size of the city has a correlation to installation of urban traffic facilities. That is, considering the case of commuting to working places and schools, it can be said that the smaller the city size is, the higher the rate of private car users become, and the larger the city becomes in size, the dependence on the public transport system, especially on the mass-transport system, arises.

(b) Establishment of Integrated Transport System

This is not only a measure for each separate transport mode such as road vehicles or railway but by combining them effectively, a policy for the whole transport system is kept in mind. Actually, the integrated transport system should be considered from two points of view; adjusting the competitive relationship between several transport modes, and the problems of transport energy for effective utilization of petroleum resources, which is presently an imminent national problem being discussed in many countries.

(c) Convenience for Users

In this category the improvement of transport facilities is considered from the viewpoint of convenience for users. The followings are the objectives to be kept in mind in urban transport planning.

i) Door-to-door convenience;

ii) Comfortableness in riding;

iii) Reduction in waiting time, and securing transit convenience;

iv) Shortening of travel time;

v) Shortening of walking distance; and

vi) Others.

Summarizing the categories (a) to (c) discussed above, we will examine their relevancies to Medan Area from two points, namely "the relationship between her urban size and transport modes", and "transport modes from the viewpoint of energy efficiency".

3.2.1 Relationship between the Urban Size and Transport Modes

The relationship between the urban size and transport modes can be chiefly considered as that among its population, the private transport and the public transport. Moreover, as for the public transport, it can be considered as the relationship between bus and railway, which represents the mass-transport system.

Table 3-2-1 and Fig. 3-2-1 show travel patterns of commuting and business trips in 50 cities in U.S.A. classified by their urban sizes.

Table 3.2.1 Means of Transport for Commuting by Urban Size Class

(Fifty Typical Cities in U.S.A.) (Unit: %)

Means of Transport \ Population (in 1000)	Under 50	50 ∫ 100	100 ∫ 250	250 ∫ 500	500 ∫ 1,000	Over 1,000	Average
Passenger car by owner drivers	67.4 (50.7)	56.1 (44.5)	59.9 (44.7)	48.7 (36.5)	46.6 (38.7)	39.6 (29.4)	47.4 (37.0)
Taxis	18.3 (33.5)	18.4 (29.5)	17.8 (29.8)	14.7 (25.8)	12.2 (21.3)	11.9 (19.4)	13.7 (23.3)
Public transport modes	14.3 (15.8)	25.5 (26.0)	22.3 (25.5)	36.6 (37.7)	41.2 (40.0)	45.8 (51.2)	38.9 (39.7)
Total	100	100	100	100	100	100	100

Source: HRB, Bulletin N.203

Notes : 1) Upper figures in each means of transport is the percentage of a total of business and commuting trips.

2) Lower figures in each means of transport is the percentage of returning home trips.

3) Number of sampled cities by urban size in population are as follows:

under 50,000	5 cities
50,000 - 100,000	12 cities
100,000 - 250,000	20 cities
250,000 - 500,000	3 cities
500,000 - 1,000,000	6 cities
over 1,000,000	4 cities

It is obvious from the Table 3-2-1 and the Fig. 3-2-1 that the sharing ratio by the public transport modes rises with the increase of population. The reason seems to lie in the difficulty to improve the city roads beyond a certain level from the points of both the ratio and the density of urban roads, and that it is physically impossible to cover the demand for private transport completely. It is desirable to provide such a mode of transport which is capable to transport mass with a limited transport facilities and public transport modes such as bus, railway, and subway come to play their important parts. It can be also said that when it is intended to satisfy all the potential demands for private transport, it will cause a collapse in the balance of transport supply and traffic demand including the problem of parking facilities, and becomes a obstacle for the users' conveniences; and consequently, the dependence on public transport modes will increase. Although it is difficult to compare the values mentioned in the above Table with others at the same level, considering the differences in characters between cities and states, the general tendency that the dependence on public transport modes increases along with the increase in the urban size, the same situation is expected to take place in case of Medan Area when considering the population of 2.3 millions in the year 2000 A.D. This aspect will form the basic concept of the Master Plan of transport project.

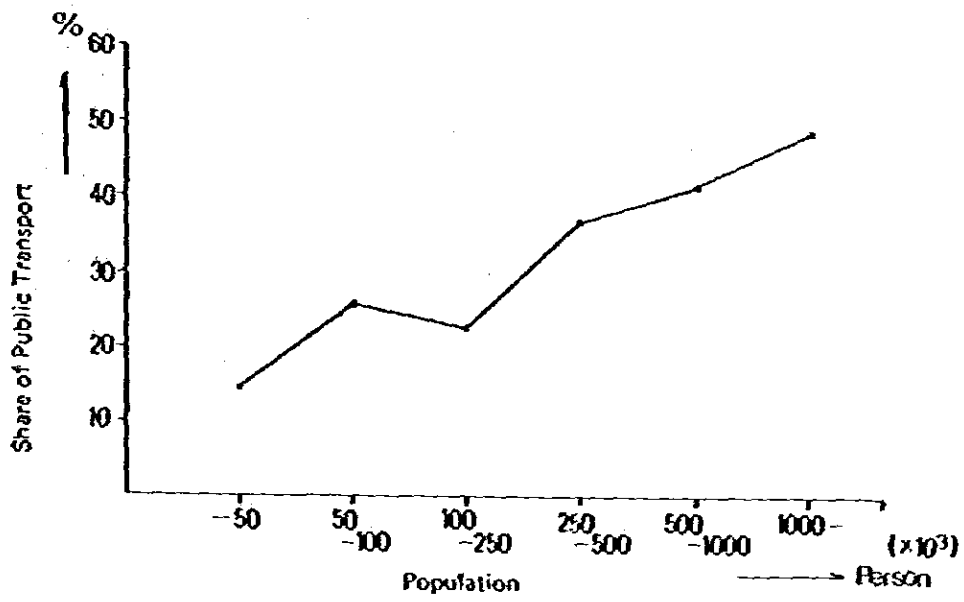


Fig. 3.2.1 Share of Public Transport by Population Size of Fifty Typical Cities in U.S.A.

Fig. 3-2-2 shows the present situation of Medan City compared with large cities of similar size in other countries. According to the Fig. 3-2-2, the present public transport modes of Medan seem to be at a certain level. But considering the high average number of actual bus-users, and the shortage in the number of units in bus fleets; in other cities where their motorization is over the rate of 15 buses per 100,000 citizens, are raising the sharing ratio of public transport by introducing subways. In this sence, Medan City may be considered to be almost reaching at such border line.

Moreover, in view of future changes in Medan's motorization in comparison with the registered number of vehicles mentioned in Chapter 2, the following two points come into question:

i) A shift from motor-cycles which are presently widely used to passenger cars;

ii) An increase in the ratio of the registered number of vehicles accordingly.

Therefore, it may be anticipated that the rate of private transport in Medan City will increase towards the year 2,000 A.D., due to the increase in the potential demand in the private transport.

In view of these situations, it is necessary to expand the public transport system of Medan, which is rather poor at present, coping with its future population size which is expected to be 2.3 million in 2000 A.D. Concerning the contents of these public transport system, bus takes presently the main role in Medan. However, it is easily anticipated that it will be difficult to meet the whole future urban transport needs only by bus as it is evident when compared with other foreign cities of the similar sizes.

Fortunately, there exists a railway in Medan mainly depending on freight transportation with limited passenger transport service. It is necessary to establish in future a desirable urban transport system for the whole city by effectively utilizing this existing railway system.

3.2.2 Transport Modes from Viewpoint of Energy Efficiency

It can be said that the power for every transport mode at present is more or less supplied by energy generated from petroleum resources. As it is not realistic to look for a transport mode of not using any power energy, but it is essential to devise a powerful transport mode of high energy efficiency from the aspect of energy saving, which is a current pressing problem of the world.

There seem to be two ways of approach to accomplish effective utilization of energy; one is to eliminate the wasteful competition between transport modes, and the other is to consider an interactive energy efficiency between transport modes. But both can be essentially approached as the problem of energy for transport modes, a comparison is herewith made between the respective transport modes for passengers and freight with respect to energy consumption.

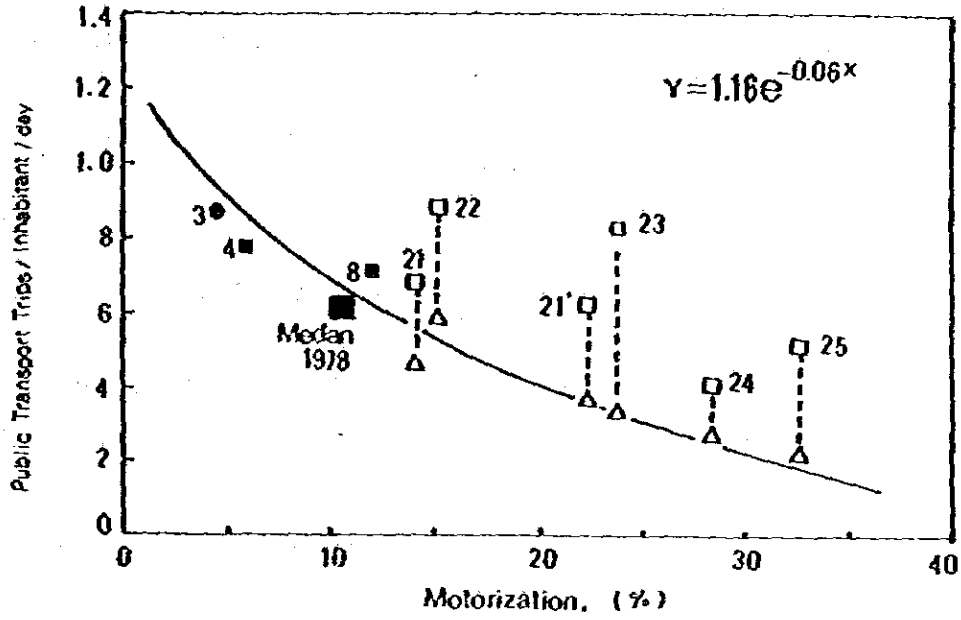


Fig. 3.2.2-1 Public Transport Trip Rate vs. Motorization

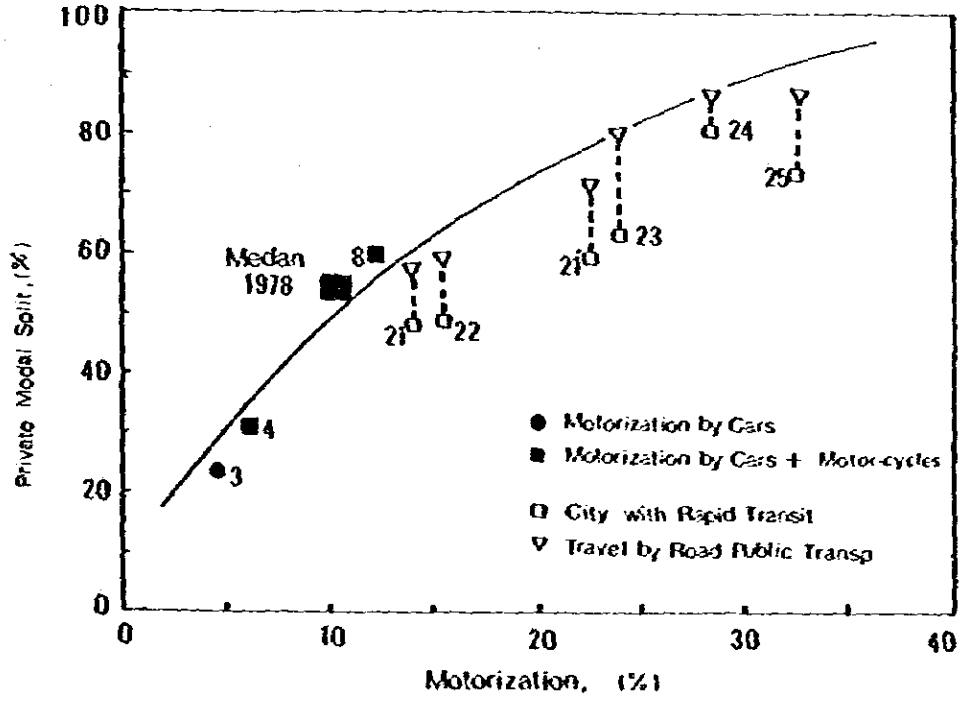


Fig. 3.2.2-2 Private Transport Modal Split vs. Motorization

Source: Travel Characteristics in Cities of Developing and Developed Countries, World Bank Staff Working Paper No. 230, March 1976.

It is shown in Table 3-2-2 that the energy consumption rate per passenger-km of public transport modes such as railway and bus account for about one seventh of that of passenger cars, naturally representing a quite high energy efficiency. As for the freight transport, railway also account for about one sixth of truck per ton-km.

Although it is difficult to discuss the future outlook of transport system only from such energy efficiency, it shows a direction of city traffic system in future.

Table 3.2.2 Comparison of Energy Consuming Efficiency by Transport Mode (1975)

Transport Mode		Trillion Kilocalorie	Billion Ton-Km	Kilocalorie(ton 10^3)/ Ton-Km
Passenger	Marine Transport	15	5	3.00
	Aviation	15	20	0.75
	Railway	28	324	0.09
	Bus	12	110	0.11
	Passenger Vehicle	173	251	0.69
Freight	Marine Transport	52	184	0.28
	Railway	10	47	0.21
	Truck	165	130	1.27

Source: Transport Bulletin Report, Japan Feb. 1978

3.3 Alternatives

3.3.1 Summary of Improvement Alternatives for Long-Term

In this report such a measure is taken into consideration to analize the most optimum urban transport master plan in 2000 A.D. in Medan City that the alternatives are widely formulated in each step and after selecting the optimum plan, the alternatives in next stage are studied. The summarizing of the alternatives in each step is shown in Fig. 3.3.1 which classifies the alternatives into these stages. The details are described as follows:

i) Original Classification

The aims of this stage are to formulate the fundamental direction in planning of landuse, railway facilities, road facilities and others as a first step. The plans are classified by such items as Current Trend Model and Re-development Model in landuse, railway participation in urban transport or not, how to improve the railway crossings in the center of Medan City, how to operate the railway freight trains and so forth.

Seven alternatives of basic relation between railway and road systems for the Long-Term were discussed and were explained to the Government of Indonesia at this stage to select an optimum one to be further studied in details. After serious discussions in March 1980 with the Government of Indonesia, upon the recommendation of Alternative No. 5 as optimum one, by the JICA Study Team the Government Indonesia also agreed on this selection and requested the Study Team to evaluate Alternative No. 5 under additional various conditions.

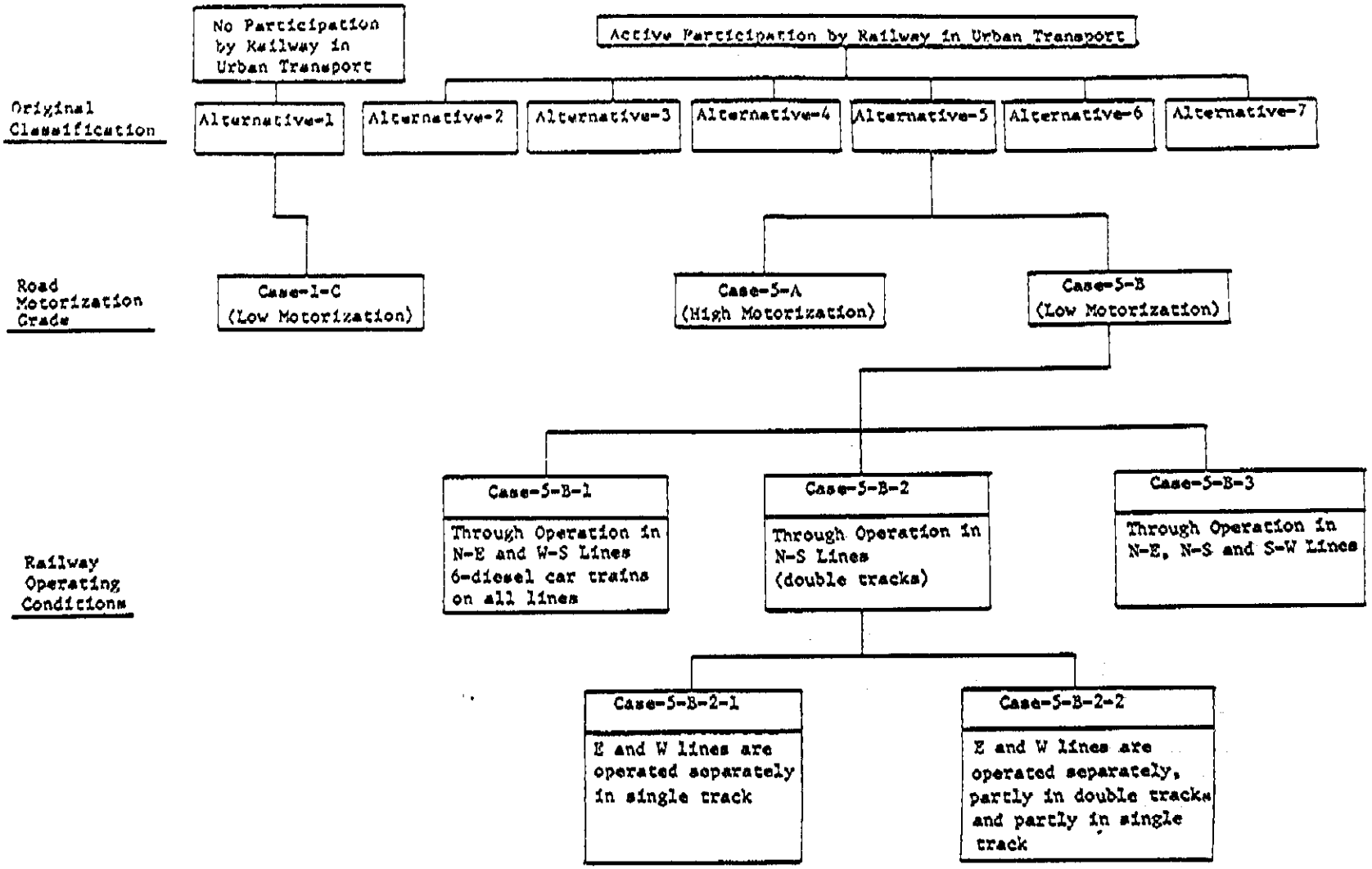
ii) Road Motorization Grade

The alternatives in Road Motorization Grade are proposed by the Study Team and are formulated to study which plan has priority, Low Motorization or High Motorization. The former is the plan which solve the urban transport problems to enhance the public transport considering the saving energy policy and control of sedan motorization, and the latter is the plan which presumes the natural growth of private transport, especially sedan, without any administrative restrictions on such private motorization. However, the three alternative cases are eventually compared including the case developed from the alternative 1 which is presumed that the railway doesnot participate in urban transport.

iii) Railway Operating Condition

These alternative plans are developed from the Case 5-B which is selected as the optimum plan in Road Motorization Grade and are formulated from the viewpoint of the railway operating conditions. As the details are described in 3.3.5, Alternatives in Train Operating System, the plans are formulated by such items as which lines are directly to be connected in train operation, how many platforms are necessary in Medan Railway

Fig. 3.3.1 Selecting Process of Optimum Plan Out of Alternatives



Station and the viewpoint of train cars efficiency. The optimum plan is selected comparing to those items.

The above mentionings are the concept of the alternatives in respective stage and Chapter 5, evaluation is assigned to discuss the measures and results how to select the optimum one.

3.3.2 Alternatives in Land Use Planning

As mentioned in Chapter 2 the proposals made by Medan Urban Development Study are adopted in this land use planning for Medan City in future. As for the frame in planning two types of frame are proposed as alternatives, namely, the Current Trend Model and the CBD Re-development Model.

The characteristics of those two alternatives are as follow:

(a) The Current Trend Model

Presently in Medan City the character of land use is the accumulation of night population in the CBD, inducing deterioration of housing environment there. The Current Trend Model is such that the current trend of urban development is estimated to continue in future as before as the result of leaving the situation in its natural growth of population distribution without taking any necessary legislative step to limit the zonal population density at the appropriate value.

(b) The CBD Re-development Model

In the contrast of the former Model, the CBD Re-development Model is proposed in which the night population density is intentionally limited, particularly in the CBD at the appropriate density, then the housing environment is improved, the peripheral area of Medan Railway Station is positively re-developed, which will be expected to result in increasing the economic potentiality of the commercial zone. Through taking such steps the commercial zones are clearly distinguished from its surrounding residential zones, and the favorable urban environment is kept in both types of urban zone.

A problem common to both land use models is the problem of a group of warehouses located in the CBD. Their relocation problem should be dealt with as a problem of the urban transport as well as that of land use, in which some solution must be sought out to cope with the problem of large trucks entering the CBD to load and unload commodities at those warehouses. From such point of view warehouses in the CBD including those of railway are proposed to be relocated to the vicinity of Outer Ring Road which has easy access to all arterial roads entering the city, by doing so removing the source of generating truck traffic from the CBD is attained. As for the spaces opened by relocation of warehouses it is proposed to use for redevelopment into public as well as commercial facilities.

3.3.3 Transport Facility Improvement Planning

The base in establishing alternative improvements in this respect is not to study each mode of transport separately but to study all existing modes

as an integrated transport system as a whole; nevertheless, for the easy explanation of the problem railway facilities and the road facilities are herewith described separately.

(a) Railway Facilities

i) Medan Station

The existing CBD is separated by the railway into its east side and its west side portions. The solution of unifying both portions of the CBD presents the problem of relocation of the Station. As a conclusion two alternatives of solution can be considered; namely, the one is the case in which the railway participates in the urban commuter service positively, in which Medan Station is considered to remain at the present location as a symbol of the City; and the other is the case to facilitate the communication between both sides of the Station, in which the functions of the present railway station are divided into two and are relocated one as Medan North Station at 2 km on Binjei Line for passenger trains on lines to Medan-Binjei and Medan-Belawan and the other as Medan South Station at the location of Medan Pasar Station for passenger trains on lines of Medan-T. Tinggi, Medan-Batu and Medan-Pancur Batu.

ii) Railway Main Line in CBD

Concerning the railway main line existing in the CBD two alternatives of improvement are proposed; namely, the one is the case when the main line remains at the present location, in which it is intended to reduce the closing time of railway crossings to the road traffic, which should be planned on the operation side of the railway, and the other case is such that the railway and the roads in the CBD are grade-separated in order to eliminate all restrictions to both due to crossings are eliminated. On the other hand, as a solution of facilitating communication between the east and the west sides the main line in the CBD is removed completely in which case a railway network for freight train operation is proposed to form by the construction of a new line detouring the eastern boundaries of the city and linking with Medan-Belawan Line at Titipapan.

iii) Grade Separation between Railway and Road

The problem of grade separation between railway and road in the CBD mentioned in (ii) is studied in two alternatives; namely the one is to elevate the portion of railway existing in the CBD, the other is to build fly-over road bridges at railway crossing.

iv) Freight Yard, Warehouse, etc.

Because of various demerits to the urban development of the existence of a railway freight yard and a locomotive depot in the CBD, their relocation to somewhere on Medan-Belawan Line outside of the CBD is considered. In case of coach yard its relocation to the vicinity of new freight yard is considered due to the same reason.

In case of warehouses their appropriate relocation site is considered appropriate in the vicinity along some arterial road in the peripheral area of the city where is easily accessible from all arterial roads entering into Medan City because their present relation with truck is dominant.

v) Access to Medan Station from East Side

This problem, which is common in all cases in which Medan Station remains as a central passenger station of the city, needs a solution to provide residents living and employees working on the east side of the station with access to the station from east side, because the present station has its booking office only on the west side while the concentration of population and the employment on the east side is similarly important as in the west side is; consequently, by opening a booking office, passenger affiliated facilities on the east side of the station and a passage-way leading to the existing platforms from the east side is considered to improve the service not only for long-distance passengers but also commuters as well.

vi) Re-opening Medan-Pancur Batu Line and Batu-Line

Both Medan-Pancur Batu Line and Medan-Batu Line have not been in use for approximately ten years, but their re-opening is intended by the State Railway. In this study their re-opening is considered as an effective measure to provide commuter service from those directions to Medan City and also to cope with possible housing projects to be developed along the south-western portion of Outer Ring Road in the Third 5-Year Plan period.

(b) Road Affiliated Facilities

i) Road Network

As for the road network of Medan City and its surroundings five corridor roads radiating from the CBD of the city are considered as regional arterial roads; and Outer Ring Road and Intermediate Ring Road are considered as the main feature of the road network in the central four kecamatans. In addition, the future road network is studied, taking into consideration the land use, the railway network and the mesh size of the road network. Concerning their details they are to be referred to their improvement alternatives presented in later chapters.

ii) Operation of Binjei Bypass and Outer Ring Road as Tollway

In this study one feature is to study both Binjei Bypass and Outer Ring Road as tollway; this is, of course, concerned to their financing but also it is one of the requests made by Bina Marga on this urban transport study. If Binjei Bypass and Outer Ring Road are opened as tollway, certain adjustment should be made in the relation with Belawan-Medan-T. Morawa Tollway, which is to be located similarly by-passing the CBD on the east side of the city.

iii) Public Transport Facilities

The present public transport facilities are actually bus and Bemo systems; and consequently, when they are considered in Medan Urban Transport System in the year 2000 A.D. strengthening of the bus system, including mini-bus, is an important problem. Based on such a viewpoint a special consideration is paid in this study to enable the bus and the mini-bus networks keep their service at such a level that convenient urban transport services are secured to be easily available to the majority of citizens who have no private transport measure of their own.

And also bus and Bemo are placed in this study in such positions not to compete but to cooperate one another, supplementing mutually with their characteristic performance with their full transport capacities. Nevertheless, Bemo has its own problem of small seating capacity and its low speed; therefore, it is considered reasonable that Bemo be replaced with mini-bus gradually in future.

One more feature in addition to the bus network in the long-term improvements is the consideration to arrange circulating bus routes. Presently, despite of inter cities or intra-city services, bus and Bemo networks of the city are all radiating from the center of the CBD. From the viewpoint of keeping homogenious transport density in the city area certain lateral links between radiating routes are considered essential. The proposal to establish circulating bus routes is a response to such a need.

As the last category in the planning policy in the relation of railway and bus, the adjustment between railway network and bus network is considered. Originally both modes of transport have the similar transport characteristics. But basically the railway, which is able to be a mass transport facilities, carrying more passengers per coach, superior to bus in safety, capacity and speed, are considered to be a backbone of the urban transport system in areas where both modes are existing and the railway being fed by bus routes. Such concept could keep an important balance of functions between modes of transport in the integrated transport system.

iv) Bus-Lane on Roads

It is very important in studying bus transport as problem of the urban transport that how to solve the actual operational and administrative problems. Truly speaking, operating buses using same road spaces commonly together with other types of vehicles in a mixed traffic is expected to reduce the speed of bus when the road traffic increases. Such traffic situation will weaken the function of bus which is the second capable mass transport facility succeeding railway, and will result in the lowering of its service level, which will lead to the reduction of bus users.

The most effective measure to maintain the service level of bus in such urban area is to establish bus lane in each direction on arterial roads in peak hours solely assigned for the bus use. In this study establishing bus-lanes is positively considered as a solution of traffic problem.

v) Bus Terminals

In formulating the long-term solutions for the year 2000 A.D. two separate bus terminals are considered, namely, one for intra-city buses and the other for inter-cities buses.

vi) Railway Station Plaza

In case when the railway participates positively in the urban commuter service and Medan Station remains as a passenger station at its existing location it is expected that number of passengers to be handled at Medan Station will noticeablly increase and will raise a problem how to efficiently transfer those passengers between railway and other modes of transport at the station. By making use of the former railway property to be opened by relocation of railway warehouses to somewhere, passenger transferring facilities between different modes could be spaceously provided by locating a station plaza of sufficient area, accommodating vehicle parking spaces for private cars, a bus terminal, a terminal for Bemo or mini-buses and also a taxicab pool.

(c) Other Transport-Affiliated Facilities

In other transport-affiliated facilities there are included public parking facilities for vehicles, and facilities of Port of Belawan and also Polonia Airport.

As for parking facilities, publicly operated parking spaces including parking houses are considered in the CBD. As for Port of Belawan and Polonia Airport separate development projects are underway; therefore, this urban transport study does not include the study of their improvements.

Improvement items described already are finally summarized in Table 3.3.1 under a common assumption among improvement alternatives that the Belawan-Medan-T. Morawa Highway is to be opened within the period of the Third 5-Year Plan.

Any improvement alternative is a combination of the following categories namely, land use pattern, urban transport condition, improvement of railway facilities, improvements of road facilities and improvement of bus transport system including Bemo. In this report it is intended to make clear the relation between the railway and the road and to formulate the basic railway network for the long-term; consequently, the detailed road improvements and improvement of bus and Bemo system were formulated in the further study after improvement alternatives of higher priority were selected through the discussion with the Indonesian side.

Table 3.3.1 Components of Combination in Urban Transport Planning for Medan Area

Land Use Pattern	Urban Transport Condition	Improvement Items of Railway Facilities	Improvement Items of Road Facilities	Improvement Items of Bus Transport System including Bemo
- Current Trend Model; CBD Re-development Model.	- Positive participation by railway; Continuation of present situation (Non-participation by railway).	- Railway facilities remain unchanged; - Improvement of safety devices of railway crossings; - Grade separation of main lines in the CBD from crossing roads; - Relocation of freight yard, locomotive depot and coach yard to Titipapan and Pulu Brayan - Relocation of railway warehouses; - Relocation of Medan Station - Re-opening of Pancur Batu Line and Batu Line for Passenger service; - New construction of a line for freight trains detouring east side of the City to reach a freight yard to be constructed at Titipapan on Medan-Belawan Line; - Construction of new stations to handle commuters in Medan City Area; - Assignment of diesel and electric rail car fleet.	- Strengthening of urban road network; - Tollway operation of Binjei Bypass; - Completion of the remaining portion of Outer Ring Road; - Tollway operation of Outer Ring Road; - Establishing bus lane in each direction on arterial roads only in peak hours; - Providing Railway Station Plazas for convenient transferring between bus and railway - Improvement and/or relocation of bus terminals. - Establishment of truck terminal accompanied with warehouse	- Rationalization of bus operating organizations; - Strengthening and adjustment of existing bus and Bemo route networks; - Opening new circulating routes linking laterally the existing routes radiating from the center of the CBD; - Strengthening bus fleet; - Strengthening bus motor pools and repair shops;

Following the planning policies described in Sec. 3.1 seven improvement alternatives were formulated using selected appropriate combinations of the afore-mentioned component categories. They are explained one by one in the followings and briefly summarized in Table 3.3.2.

(d) Improvement Alternative Case 1

This case is a combination of the Current Trend Model in land use pattern and non-sharing urban transport by railway. This case is not intended to be one of the Master Plan of Medan Transport System but is intended to study the undesirable urban environment, particularly such ones to be induced in the CBD if only the urban road network receives the full burden of urban transport demands in 2000 A.D. and the railway network facilities remain unchanged. The current trend model in land use pattern will permit to continue the natural growth of population in the CBD, without any control on the growth of population there which is expected to worsen the urban environment.

This case is expected to need a large amount of public investment in strengthening the existing urban road networks, construction of public vehicle parking spaces or houses in the CBD etc., in order to cope with the estimated total urban traffic demands. Consequently, Outer Ring Road, a part of which is expected to be completed in the Third 5-Year Plan period by the municipal government of Medan is assumed to be operated as a tollway in order to cover some part of the big public investment necessary for the urban road network.

In addition, all railway crossings existing in the CBD still remain at grade, and consequently the traffic jams around railway crossings will be escalated rather than they are at present.

The proposed improvement to be made on the railway is only to install the safety devices to warn the railway gate-men and road users the approaching trains automatically and to improve crossing barrier.

The followings are the main features in improvements in road facilities and the bus transport system, including Bemo and its service.

i) Improvement of Road Facilities

- Strengthening existing road network;
- Widening of some arterial roads and intensifying signalization of intersections to increase their traffic capacities;
- Construction of public vehicle parking spaces and/or parking buildings in the CBD;
- Completion of the remaining portions of Outer Ring Road and Intermediate Ring Road;
- Operation of Outer Ring Road and Binjei Bypass as a tollway.

ii) Improvement of Bus Transport System, including Bemo

- Rationalization of bus operating organization;
- Strengthening and adjustment of existing radial bus routes;
- Opening new circulating bus routes;
- Strengthening existing bus fleet;
- Improvement/Relocation of bus terminals;
- Strengthening motor pool and repair-shops for bus fleet.

(e) Improvement Alternative Case 2

This case is a combination of the Current Trend Model in land use pattern with the railway transport sharing urban transport service positively. This case is realized by relocating a freight yard and a locomotive depot from Medan Station to Titipapan on Medan-Belawan Line and warehouses to the peripheral area in the vicinity of interchanges to be constructed along Belawan-Medan-Tg. Morawa Highway and Outer Ring Road, reducing Medan Station to a genuine passenger station. By such relocation of freight-related railway facilities to the outside of the CBD freight trains of all main lines entering Medan originate and terminate at Titipapan freight yard, passing through the CBD.

One of the reason of relocating freight yard is intended to eliminate the closing time of railway crossings for road traffic and switching operations, and such step enables the road traffic across the railway in the CBD to be kept more efficiently, but the closing time due to passings of passenger trains still remains with improved safety devices of crossings. The main features of this improvement plan are as follows:

i) Improvements of Railway Facilities

- Relocation of a freight yard and a locomotive depot to Titipapan, and warehouses to the peripheral area of the city;
- A east-side station building with a waiting room, a booking office, etc., together with a concourse and an access to platforms are constructed for easy access to Medan station of passengers from zones in the east side of the railway;
- Improvement of Medan Pasar Station and construction of several additional new stations in the city area in order to handle commuters;
- Pancur-Batu Line and Batu Line are to be rehabilitated and/or re-constructed for their re-opening the passenger service;
- Assignment of appropriate number of units of diesel rail cars and installing their inspecting and repairing facilities.

ii) Improvements of Road Facilities and Bus Transport System

- Same as in Case 1 but less in strengthening existing road network and their capacities;

- Operation of Outer Ring Road and Binjei Bypass as a tollway;

- Strengthening of existing bus route network including Bemo and opening of circulating bus routes linking radial bus routes laterally;

- Establishing a bus-lane in each direction on arterial roads only in peak hours;

- Improvement and/or relocation of bus terminals;

- Construction of truck terminals for storage and distribution of commodities;

- Construction of station plaza on both side of Medan Station.

- Re-development of freed railway warehouse and residence areas in and around Medan Station should be considered separately.

(f) Improvement Alternative Case 3

In this case it is intended to re-develop the CBD following the population frame set for the purpose in the land use pattern to improve the urban environment. Railway participates positively to share the appropriate portion of the estimated urban traffic demands, for which purpose the role of city core is given to Medan Station. Sharing the urban transport by railway increases the closing time traffic movements between the east side and the west side of the railway are considered as its solution in this case, by which the railway crossings in the CBD are grade-separated. The traffic conditions of railway and the necessary improvements on railway facilities are same as in Alternative Case 2.

In this case the improvement of road facilities are same as in Alternative Case 2 except for construction of flying-over bridges of roads at railway crossings in the CBD, and Outer Ring Road and Binjei Bypass are assumed to be operated as a tollway.

In this case railway crossing problem in the CBD is solved completely. Improvements for the bus transport system, including Bemo, are same as in Alternative Case 2.

The re-development of freed railway warehouse area and railway employees' residence area in and around Medan Station, which is expected to bring about various noticeable benefits, should be seriously studied separately.

(g) Improvement Alternative Case 4

In this plan the land use follows to the CBD Redevelopment Model because of the same reason mentioned in Alternative Case 3 and the railway participates positively in the urban transport. In the railway system all crossings in the CBD are open to road traffic in daytime, limiting the operation of freight trains only in night-time in order to reduce the traffic hazards due to closing time of crossings so as to facilitate the urban traffic across the railway in day-time. For this purpose the present Medan Station is divided into two passenger stations and are relocated, one on Medan-Binjei Line at 2 km from Medan Station, and another on Medan-T. Tinggi Line at 3 km from Medan, a little east of the present Medan Pasar Station. In this case the operation of passenger trains is completely abolished on the main line between Medan North and Medan South stations, consequently passenger trains for Medan-Belawan Line and Medan Binjei Line originate and terminate at Medan North Station, while passenger trains for Medan-T. Tinggi Line, Medan-Pancur Batu Line, and Medan-Batu Line originate and terminate at Medan South Station. Therefore a small coach cleaning yard is to be provided both in Medan North Station as well as in Medan East Station.

The improvement of road facilities and bus transport system, including Bemo, are same as in Alternative Case 2. In this case it is assumed that Outer Ring Road and Binjei Bypass be operated as a tollway.

This case is a little inconvenient to railway passengers, particularly to commuters originating from and destinating at the central part of the CBD because both new passenger stations are a little away rather than in Case 1, Case 2 and Case 5 but the railway crossing problem in the CBD will be considerably reduced. What is the balance between those merits and demerits is the major objective of its evaluation.

The re-development of the freed railway warehouse area and railway employees' residence area in and around Medan Station, which is expected to bring about various benefits, should be studied separately.

(h) Improvement Alternative Case 5

In this case the land use pattern is assumed to be the CBD Re-development Model as in Case 3, combined with the positive participation of railway in the urban transport service.

After all freight-related railway facilities are relocated as in alternatives Case 2, Case 3 and Case 4 it is intended in this case that the railway is characterized to use the present location of Medan Station in most efficient way by utilizing its strategic position in the CBD and by remodelling it into a characteristic station as a core symbol of the city possessing all kinds of convenient functions necessary as a passenger station.

In addition to this, a noticeable increase is expected in the closing time of railway in crossings in the CBD due to the increased number

of trains and also the subsequent effects on the road traffic, the railway in the central part of the CBD is elevated over a distance of approximately 2.9 km including Medan Station so as to eliminate the railway crossing problem completely and to utilize the space under the elevated structure for railway's own purposes as well as for profit-raising purposes such as concessions and vehicle parking spaces, etc. By means of such improvements all railway station offices, waiting rooms and affiliated passenger facilities can be located on the ground level and under the elevated structure of railway tracks and platforms. Structures are limited only for the portion of station and crossing roads, the rest portions of the elevated tracks are to be built on the filled embankment with retaining wall. A detouring line for freight trains is to be constructed from Bandar Chalipah on Medan-T. Tinggi Line (9.4 km from Medan) to Titipapan on Medan-Belawan Line.

The followings are the main features of improvement:

i) Improvements of Railway Facilities

- Improvement categories are same as in Alternative Case 2 except that the railway is to be elevated in the central part of the CBD.

- Construction of a detouring line for freight trains.

ii) Improvements of Road Facilities and Bus Transport System

Improvement categories of road facilities and those for the bus transport system, including Bemo, as same as in Alternative Case 2.

(i) Improvement Alternative Case 6

This case is the combination of the CBD Re-development Model in the land-use pattern and the railway's positive participation in the urban transport as in Alternatives Case 3, Case 4 and Case 5; but a particular emphasis is placed on the effective land use in the CBD, and the expected effects of railway on the road traffic due to the future estimated increase of frequency of train operations is intended to be avoided completely.

For such purpose the portion of the railway main lines lying in the CBD is removed, by which the freed railway right-of-way is opened for effective re-development of the CBD. The same locations of two passenger stations are same as in Alternative Case 4 is applied for the passenger service.

As for the freight train operations a new detouring line reaching at Titipapan freight yard is to be constructed for the freight trains of Medan-T. Tinggi Line.

The characteristics of this improvement plan are briefly summarized as follow:

- The locations of Medan North and Medan East passenger stations are a little inconvenient to those commuters who want to use

railway, originating from and destinating at the central part of the CBD, for the purpose to eliminate the railway crossing problem in the CBD completely without their grade-separation by flying-over bridges by road or elevating railway.

- Re-development of freed railway right-of-way in addition to freed railway warehouse area and railway employees' residence area existing in the CBD, which is expected to bring about various noticeable benefits, should be studied separately.

The main features of this improvement plan are as follows:

i) Improvements of Railway Facilities

The improvements of railway facilities are same in Alternative Case 4 except for the removal of railway facilities in the CBD completely and the construction of a line for the freight trains of Medan-T. Tinggi Line detouring the east side of the city, reaching at Titipapan Freight Yard on Medan-Belawan Line.

ii) Improvements of Road Facilities and Bus Transport System

The improvements of road facilities and bus transport system, including Bemó, is same as in Alternative Case 2.

(j) Improvement Case 7

In this case the land-use pattern is assumed to be the CBD Re-development Model as in Alternative Case 3, combined with the positive participation of railway in the urban transport service.

In the relation between the railway and the road this case is a variation of Case 5, in which the construction of a freight main line detouring the CBD is postponed for the time being to save the interest of its cost of construction.

After all freight-related railway facilities were relocated as in Alternative Case 2 the railway in the CBD is elevated as in Alternative Case 5; but it is intended in this case that the railway is characterized to use the present location of Medan Station in most effective way by utilizing its strategic position in the CBD only for commuting service by remodelling it into a simplified commuting station as a core symbol of the city and by relocating station facilities for long-distance trains into Medan North and Medan South stations, where long distance trains for Binjei direction originate and terminate at Medan North Station while those for T. Tinggi and Rantau Prapat direction at Medan South Station. No long-distance train is expected on Belawan line as well as Pancur-Batu and Batu Lines. The existing main line through the CBD remains on the ground on which freight trains are allowed to be operated only in night time, by which those railway crossings existing in the CBD remain as before but are kept open for the road traffic during day-time. The reason why the station facilities for long-distance trains are separated from those for commuting service is to keep the total cost of railway elevation as minimum from the economic point of view.

The followings are the main features of improvements:

i) Improvements of Railway Facilities:

- Passenger station facilities for long-distance trains are same as those in Alternative Case 4 or in Alternative Case 6.

- Station facilities at Central Medan Station are only for commuting trains and are much smaller than Medan Station in Alternative Case 5.

ii) Improvements of Road Facilities and Bus Transport System:

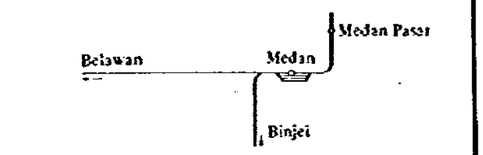
- The improvements of road facilities and the bus transport system, including Bemo, is same as in Alternative Case 2.

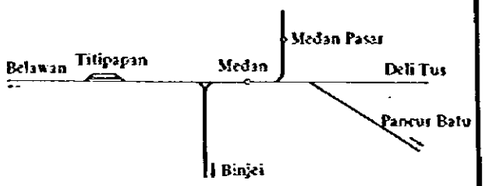
Note: Alternative Case 7 can be considered to be a transit phase reaching the railway network in Alternative Case 5. When the number of freight trains passing through the CBD on the ground level reaches to such a situation that some of them have to be operated during day-time it will result in hindering the day-time road traffic flows again and also the freight train operation through the CBD is considered to be a kind of public nuisance due to its noises and vibrations, it will be an appropriate time to commence the construction of detouring line for freight trains. Then after the completion of the detouring line the railway crossing problem does not exist any more as in Alternative Case 5 and the railway network becomes as same as in Alternative Case 5 except for that the separation of long-distance train operation from Central Medan Station.

Table 3.3.2 Summary of Improvement Alternative Concepts of Medan Area Transport Study

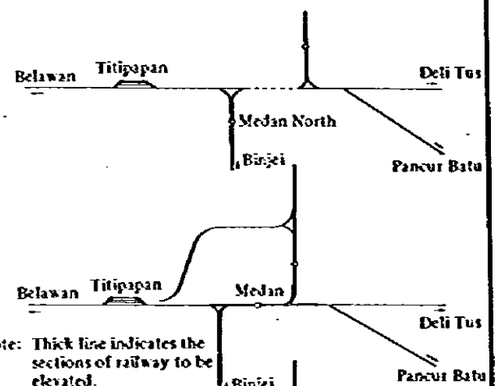
Name of Improvement Alternative	Land Use & Frame	Railway Network: Condition of Transport	Railway Network: Contents of Improvement of Facilities	Road Network: Contents of Improvement of Facilities	Public Transport System: Contents of Improvement in Service & Facilities	Remarks
Case 1	Current Trend Type	- No sharing commuter service; - Existing railway network remains unchanged; - Existing railway crossings remain at grade.	- Improvement of safety devices at railway crossings.	(Road transport system takes full burden of commuter service.) - Strengthening existing road network; - Strengthening existing traffic capacities; - Completion of Belawan-Medan-T. Morawa Tollway; - Completion of Outer Ring Road as a tollway.	- Rationalization of bus operating organizations; - Strengthening and adjusting existing radial bus routes; - Opening new circulating bus routes; - Strengthening bus fleet; - Separation and improvement of existing bus terminals.	- Increase in closing time of railway cossings in the CBD will escalate the road traffic jam around railway crossings; - Environmental conditions in the CBD will turn worse.
Case 2	Same as Case 1	- Sharing commuter service; - Other conditions are same as in Case 1 plus - Re-opening of Pancur Batu Line and Batu Line; - Freight trains originate and terminate at Titipapan Yard.	- Medan Station remains as a passenger station; - Improvement of Medan Pasar Station; - Relocation of freight car yard, locomotive shed and coach yard to Titipapan; - Railway crossings remain at grade with improved safety devices; - Rehabilitation of Pancur Batu and Batu Lines; - Assignment of diesel car fleet.	(Road transport system shares commuter service.) - Same as in Case 1 but less in strengthening existing road network and their capacities than in Case 1; - Completion of Belawan-Medan-T. Morawa Tollway; - Completion of Outer Ring Road as a public highway.	- Same as in Case 1 but less in improvements than in Case 1; - Some bus routes function as feeder routes to railway.	- Reduction of closing time of railway crossings is to be attained compared to Case 1, particularly in day-time by limiting the operation of freight trains only in night-time. - Re-development of freed railway warehouse area and railway residence area in and around Medan Station should be seriously considered separately.
Case 3	CBD Re-development Type	- Same as in Case 2	- Same as in Case 2. - Same as in Case 2.	- Same as in Case 2 except for: Construction of flying-over road bridges at railway crossing existing in the CBD; - Completion of Belawan-Medan-T. Morawa Tollway; - Completion of Outer Ring Road as a tollway.	- Same as in Case 2.	- Railway crossing problem in the CBD will be completely solved by flying-over bridges of road; - Re-development of freed railway warehouse area and railway residence area in and around Medan Station is same as in Case 2.
Case 4	Same as Case 3	- Same as in Case 2 except for opening railway crossings in the CBD during day-time by abolishing operation of passenger trains through the CBD and allowing freight trains to pass through the CBD only in night-time.	- Medan Station is relocated into North Medan and South Medan (Medan Pasar) Stations from where passenger trains originate and terminate.	- Same as in Case 2.	- Same as in Case 2.	- This case is inconvenient to railway passengers, particularly to commuters originating and destinating in the CBD; - Railway crossing problem will not be completely solved but those crossings are to be kept open to road traffic throughout day-time and are to be closed only when freight trains pass through the CBD in night-time. - Re-development of freed railway warehouse area and railway residence area in and around the existing Medan Station is same as in Case 2.
Case 5	Same as Case 3	- Same as in Case 2 except railway is elevated in the CBD allowing all trains operate through Medan Station without any time restriction. - Freight trains of the Eastern line detours the east side of the city to reach Titipapan Yard.	- Medan Station is elevated; - Other improvements are same as Case 2. - Construction of freight train line detouring the CBD reaching to Titipapan.	- Same as in Case 3.	- Same as in Case 2.	- Railway crossing problem in the CBD is to be completely solved by elevating railway; - Re-development of freed railway warehouse area and the railway residence area in and around the existing Medan Station is same as in Case 2.
Case 6	Same as Case 3	- Same as in Case 4 except for removal of railway line in the CBD. - Freight trains of the Eastern line detours the east side of the city to reach Titipapan Yard.	- Same as in Case 4 except for the removal of railway in the CBD and the construction of freight detouring line.	- Same as in Case 3.	- Same as in Case 2.	- The case is inconvenient to railway passengers, particularly to commuters as in Case 4; - The railway crossing problem in the CBD does not exist any more; - This case enables to avoid the railway in the CBD to be elevated in order to solve railway crossing problem; - Re-development of freed railway right-of way in addition to warehouse area and railway residence area in and around the existing Medan Station should be seriously considered separately.
Case 7	Same as Case 3	- Same as in Case 5 except for freight train operation passing through the CBD using the existing line on the ground level only in night-time. - Long-distance pass. trains originate and terminate at North and South Medan stations. - Central Medan Station handles commuting trains only.	- Same as in Case 5 except for freight railway line which is not needed. - North Medan and South Medan stations are constructed as in Case 4.	- Same as in Case 3.	- Same as in Case 2.	- Same as in Case 5 except for remaining nuissance due to freight train operation through the CBD using the existing main line on the ground level only in night-time. All existing railway crossing are kept open for road traffic during day time.

SCHEMATIC RAILWAY NETWORK PLAN

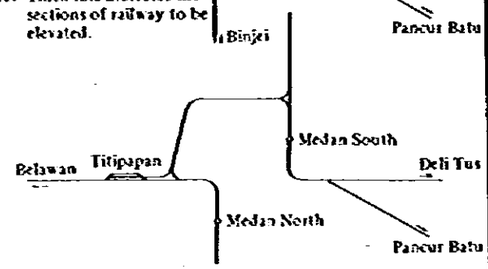


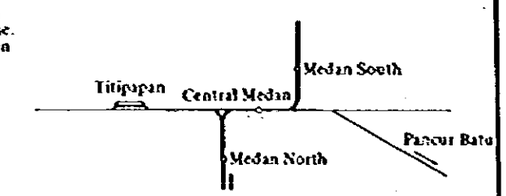


Same as Case 2



Note: Thick line indicates the sections of railway to be elevated.





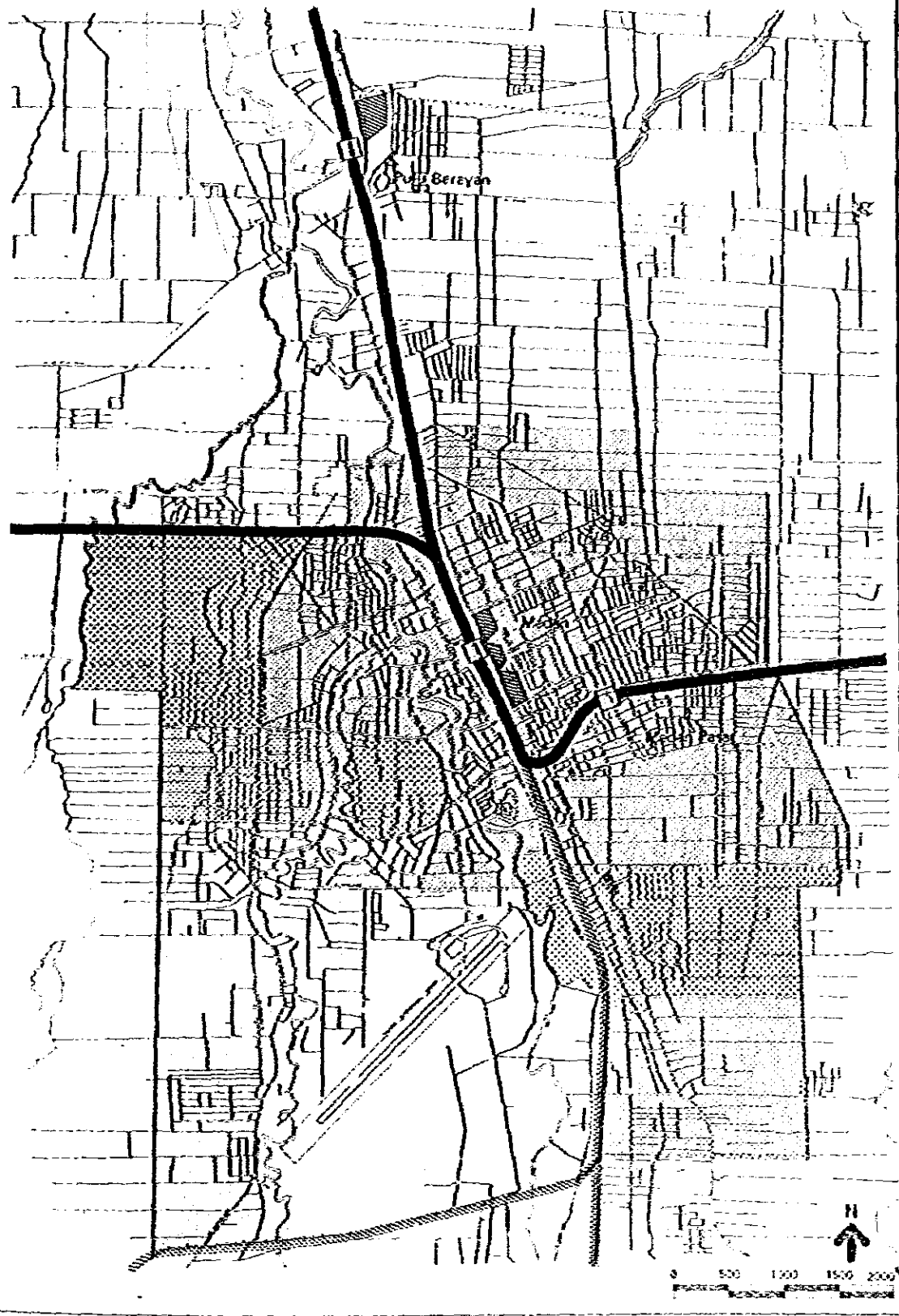


Fig. 3.3.2.1 Alternative Case 1

Medan Area Transportation Study

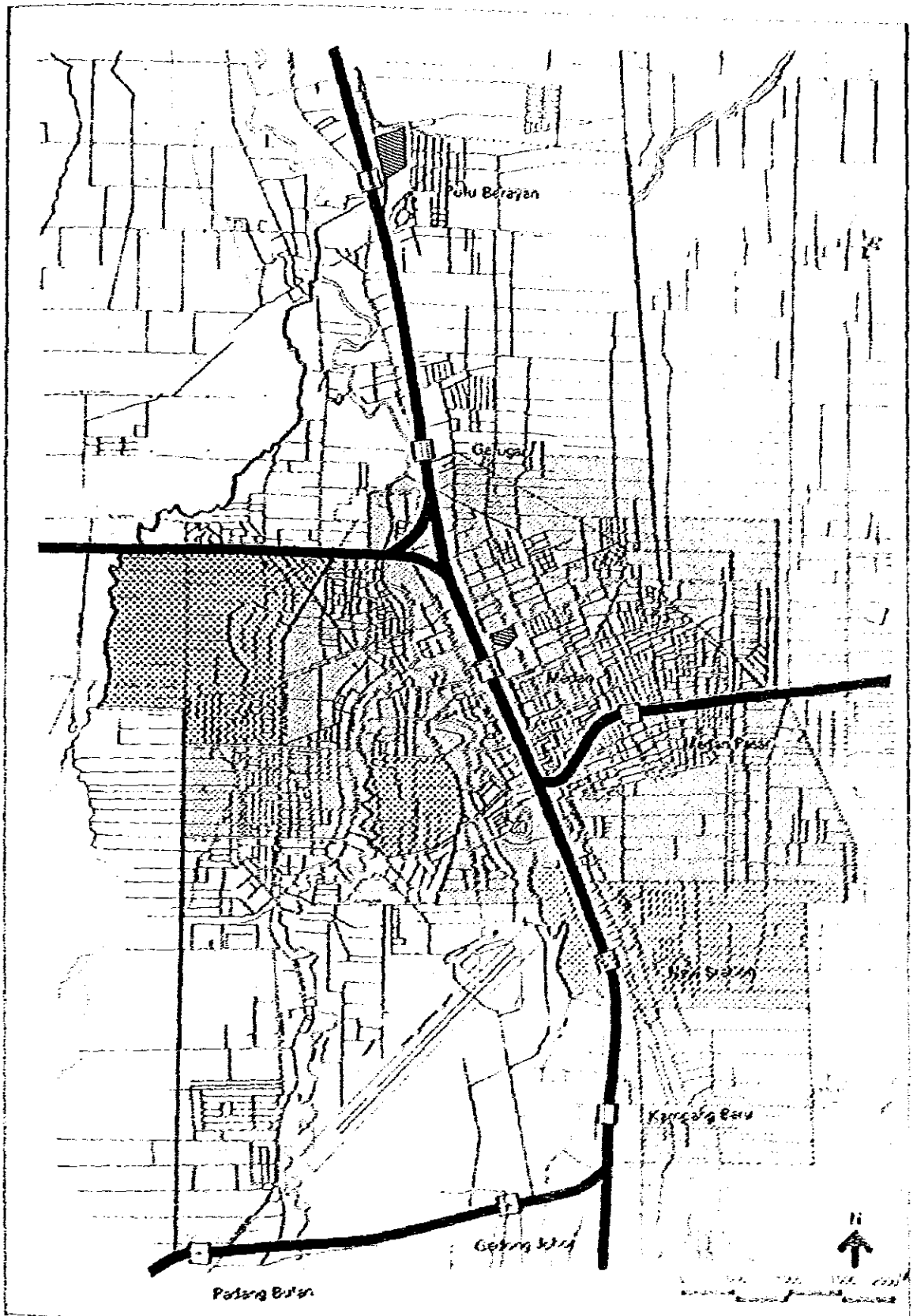


Fig. 3.3.2.2 Alternative Case 2

Medan Area Transportation Study

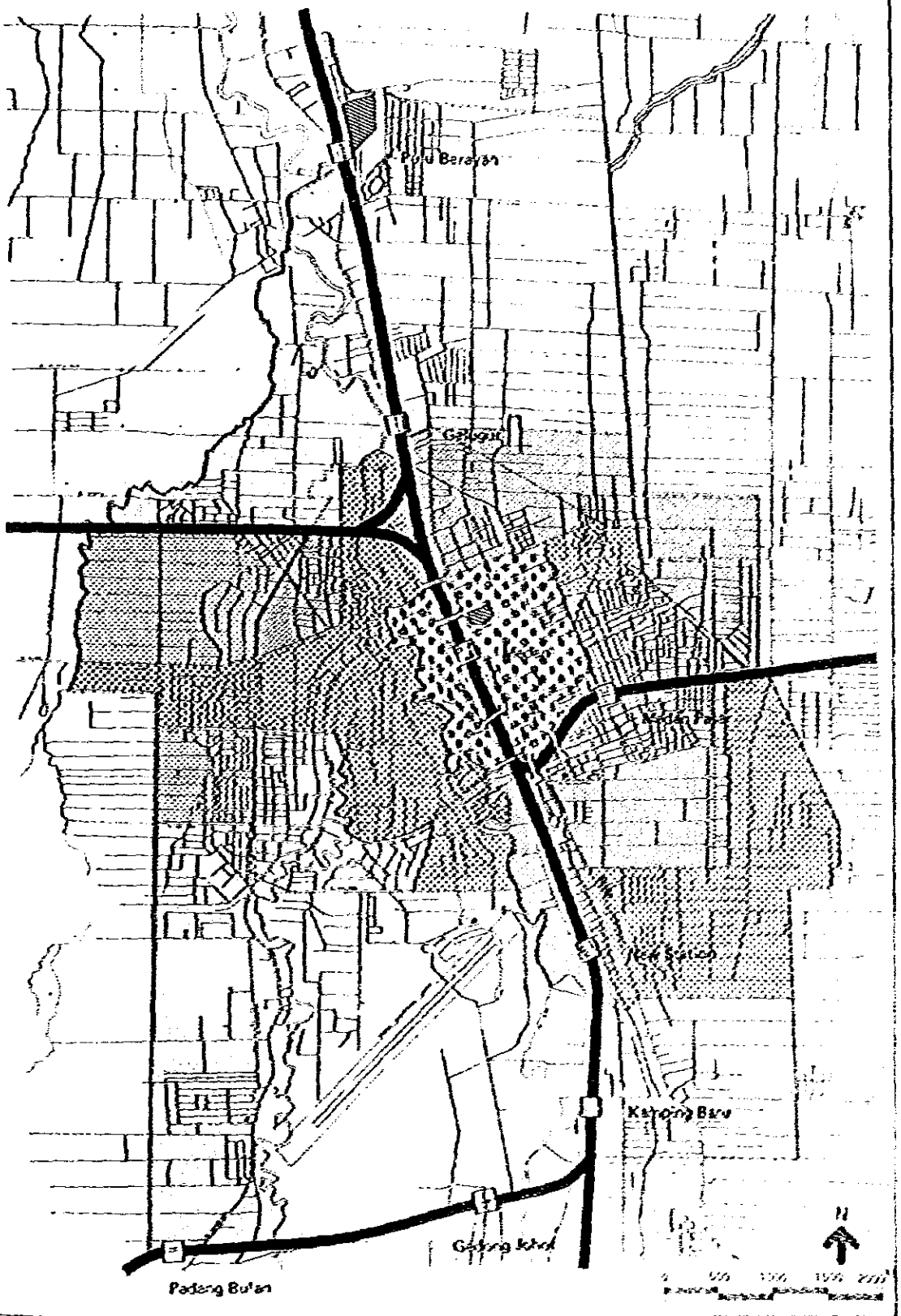


Fig. 3.3.2.3 Alternative Case 3

Medan Area Transportation Study

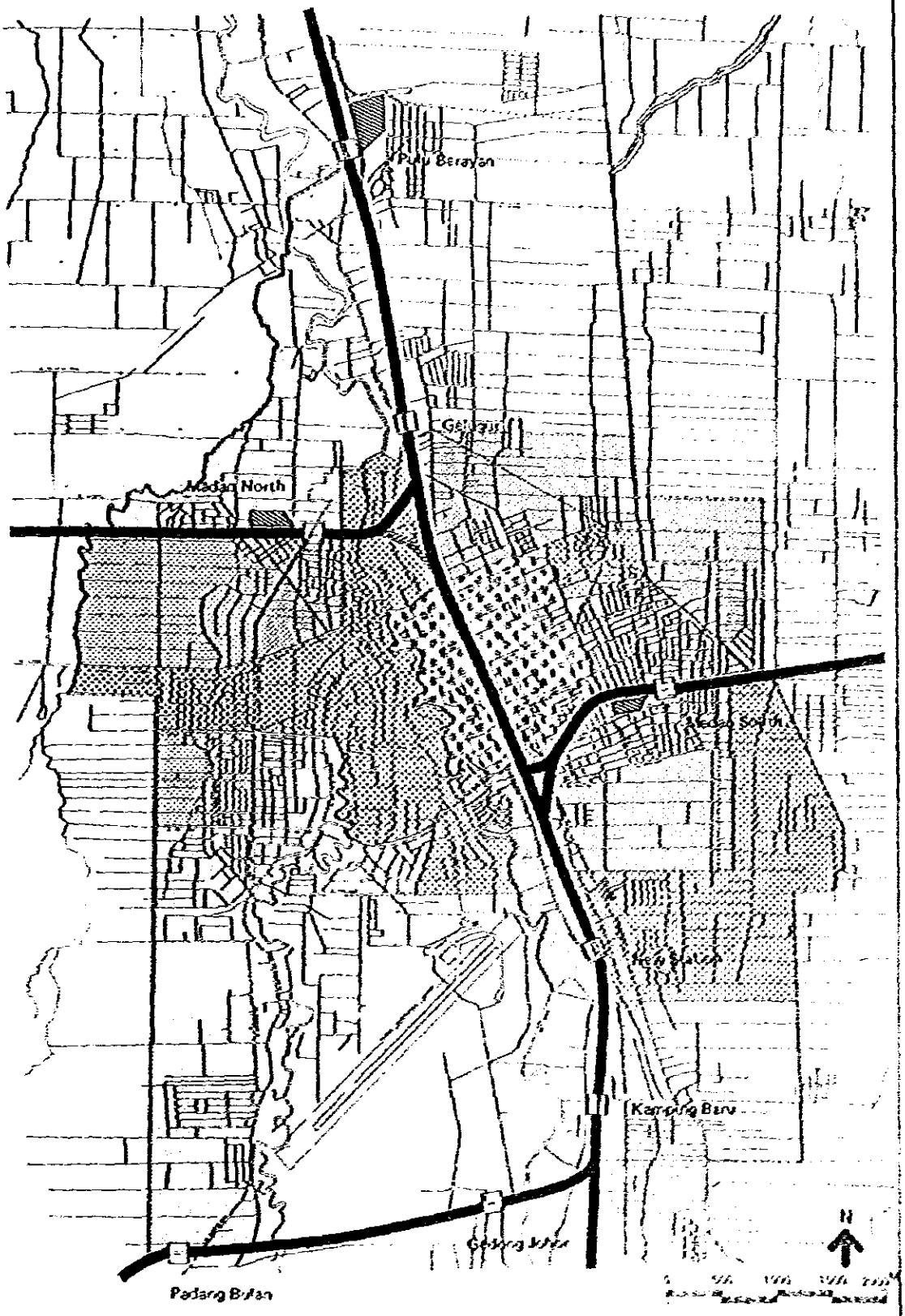


Fig. 3.3.2.4 Alternative Case 4

Medan Area Transportation Study

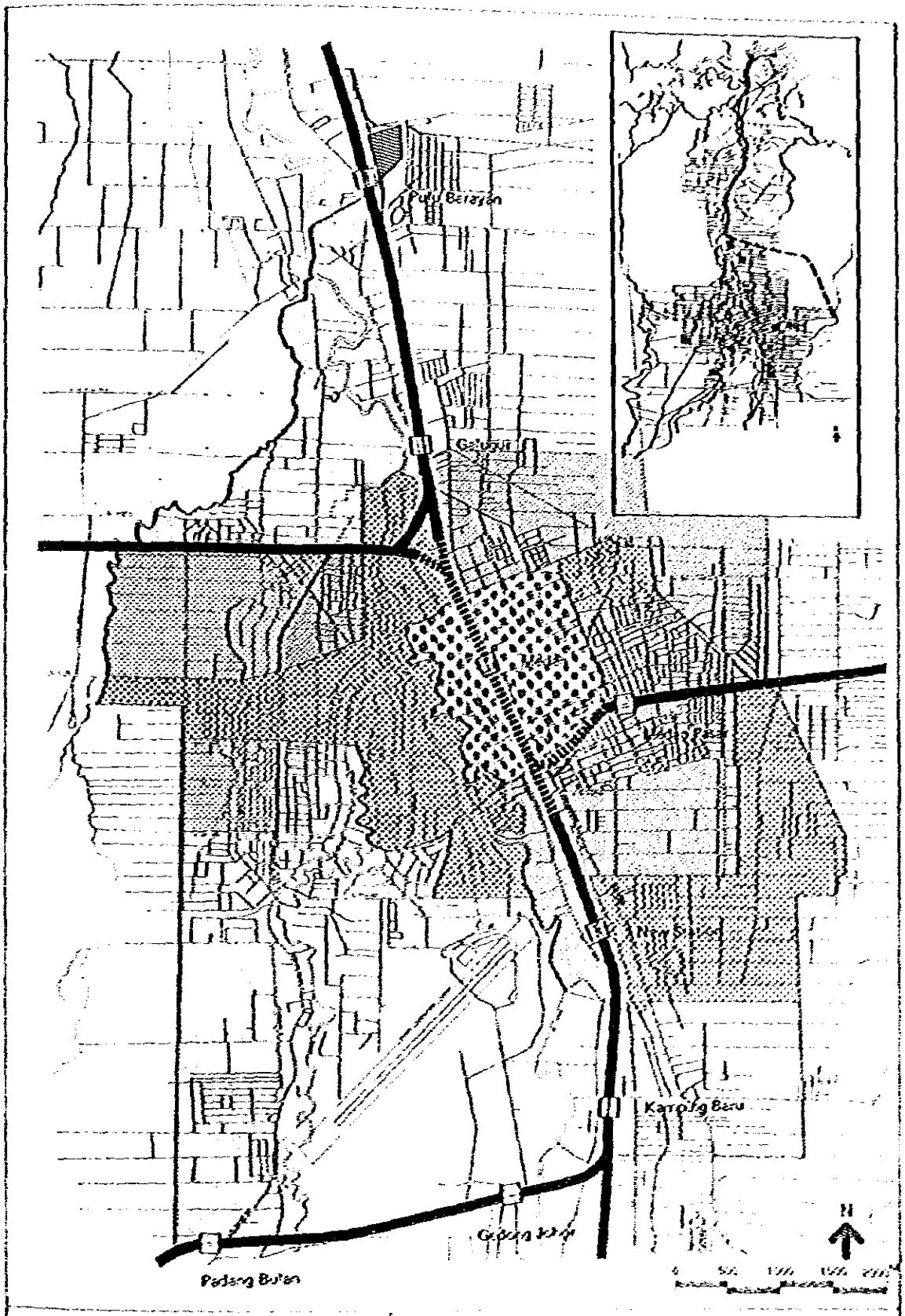


Fig. 3.3.25 Alternative Case 5

Medan Area Transportation Study

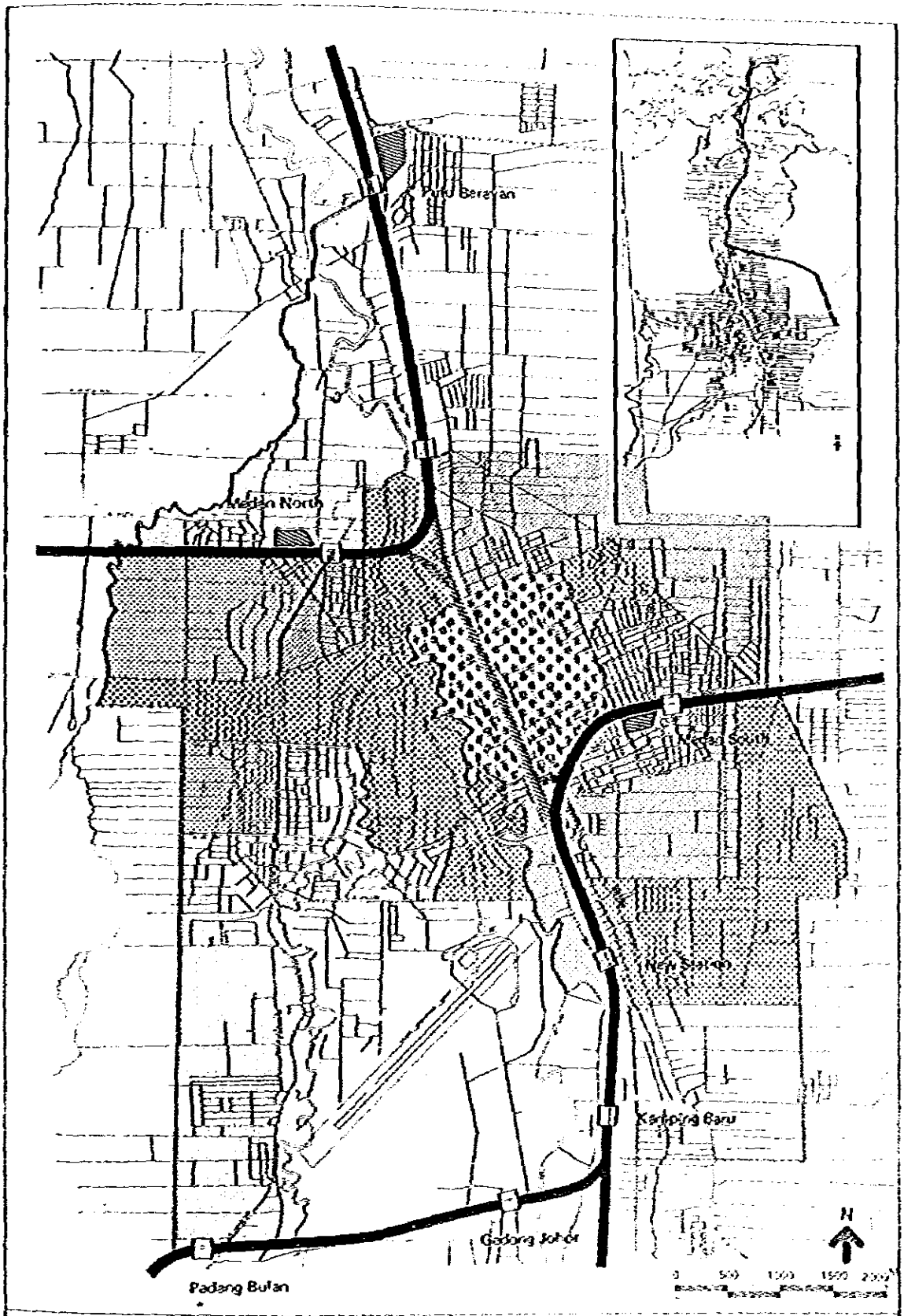


Fig. 3.3.2.6 Alternative Case 6

Medan Area Transportation Study

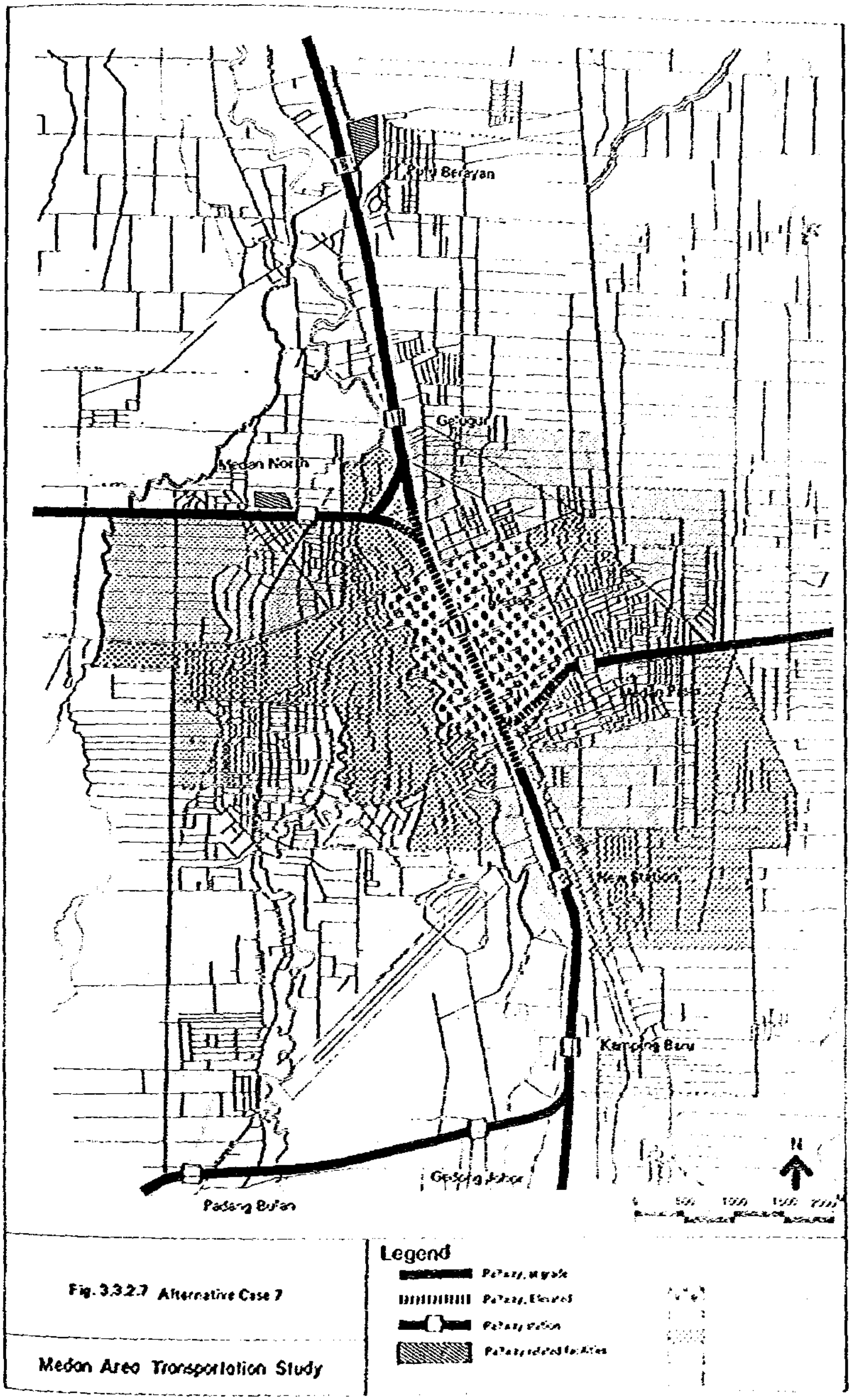


Fig. 3.3.2.7 Alternative Case 7

Medan Area Transportation Study

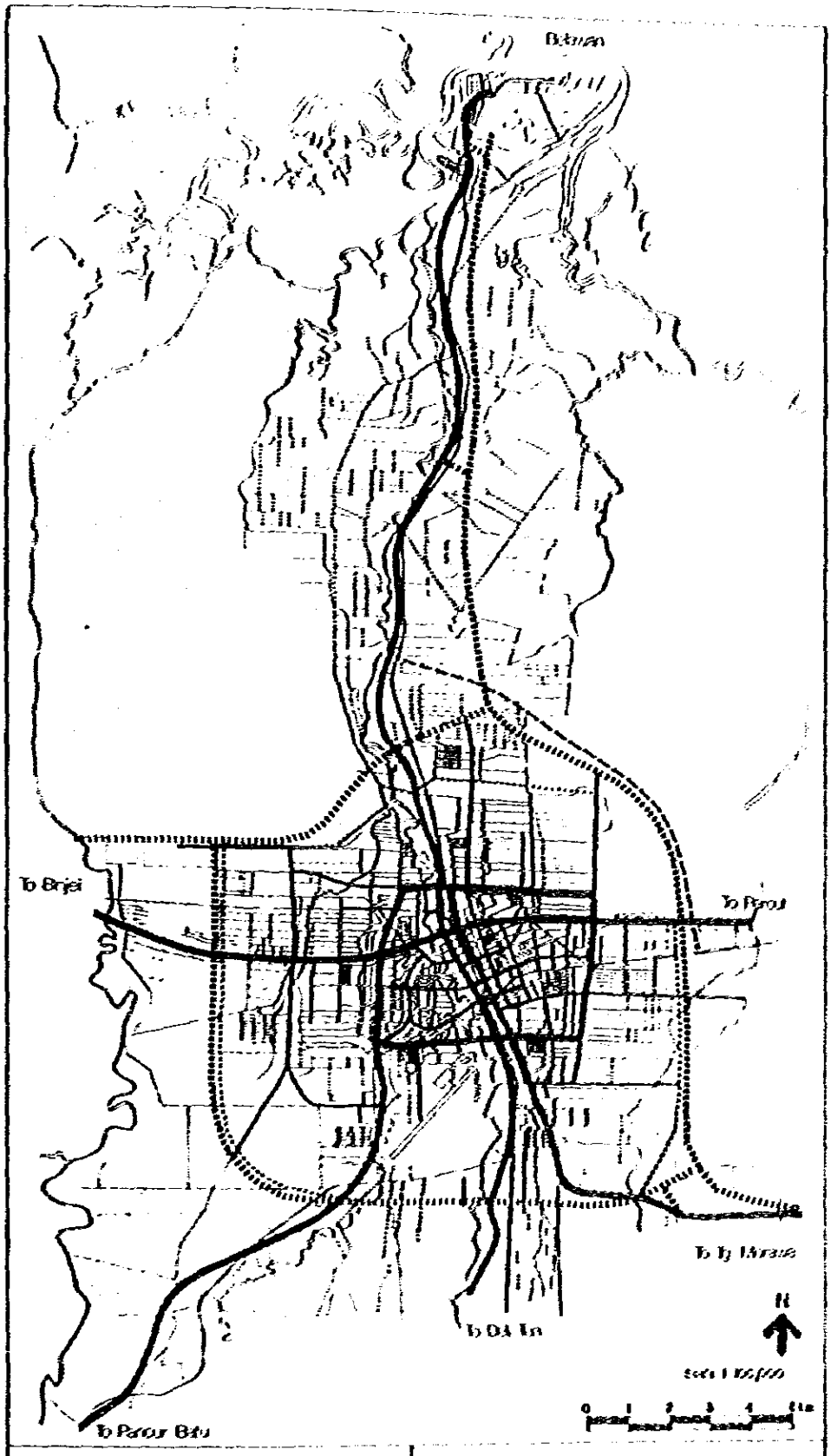


Fig. 3.3.3

Proposed Road Network in 2000 A.D.

Medan Area Transportation Study

Legend

3.3.4 Alternatives in Motorization

Generally, the road transport by private vehicles can be quantitatively controlled by the effective government policies to be taken timely. Specifically, such a control is attained by administrative measures as well as by appropriate improvement or construction of transport facilities, such as enforcing certain restriction on parking spaces in the CBD, establishing high parking fares in the CBD, providing a bus lane in each direction on arterial roads in peak hours, and others. As the future trend of motorization in Medan Area will vary by administrative measures to be taken by the municipal government in future, two alternatives are formulated in this section, one as the case in which private vehicles are freely used in peak hours without any administrative restrictive measure and the other as the case in which the commuters are encouraged to use the public transport system by the government policy under the premise that the role of the public transport system is emphasized in handling the future urban traffic demands in both cases. The former is the case of high motorization in the private-vehicle traffic and the latter is the case of low motorization by restricting the availability of parking spaces in the CBD, retarding the entry into the CBD in private vehicles and, on the other hand, increasing the transporting capacity of the public transport system particularly in peak hours.

Moreover, one more extreme alternative case for comparison is formulated for the comparison purpose under the premise that the railway does not participate in the urban transport service under low motorization.

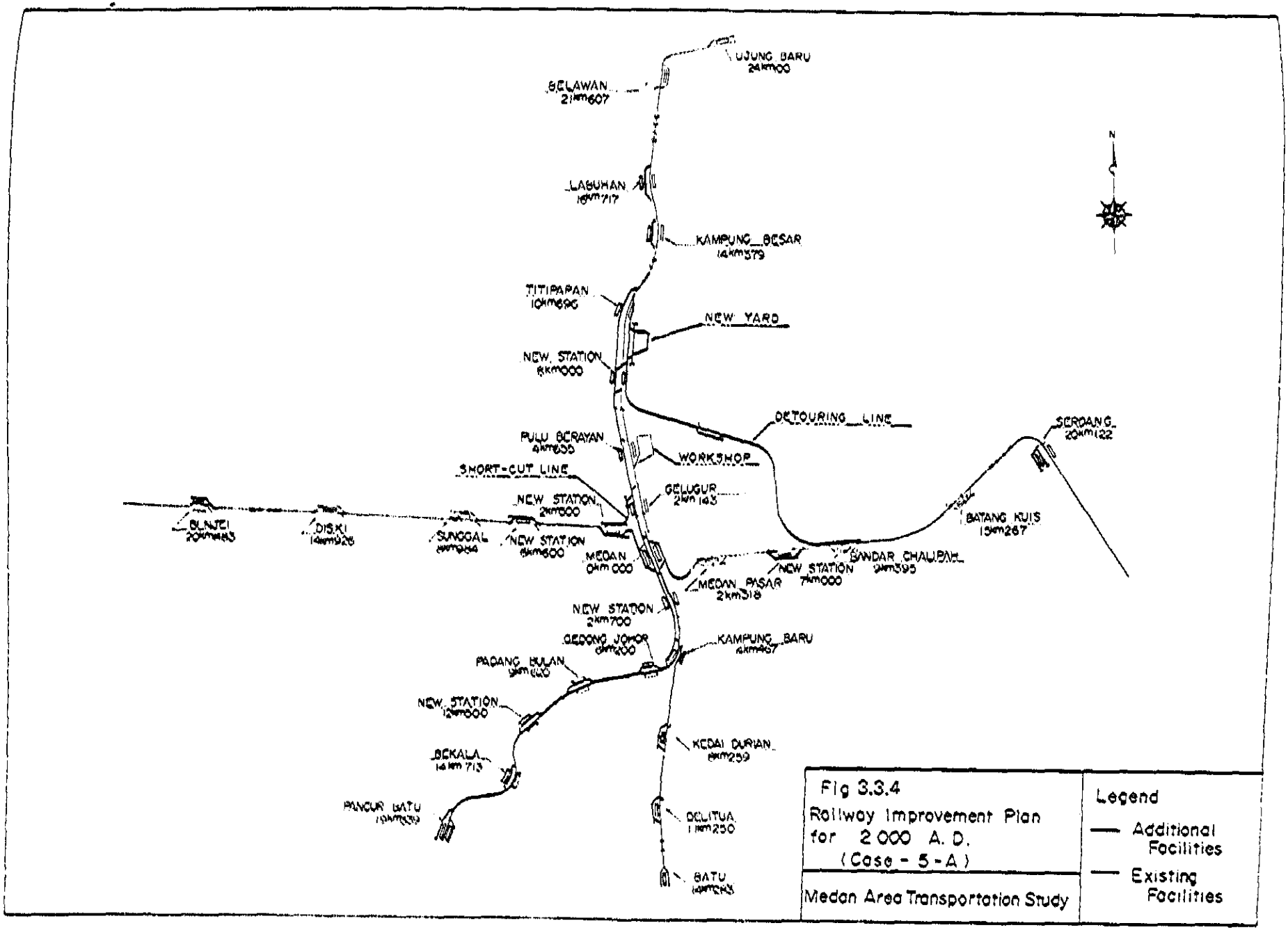
The Table 3.3.3 shows those alternatives based on motorization.

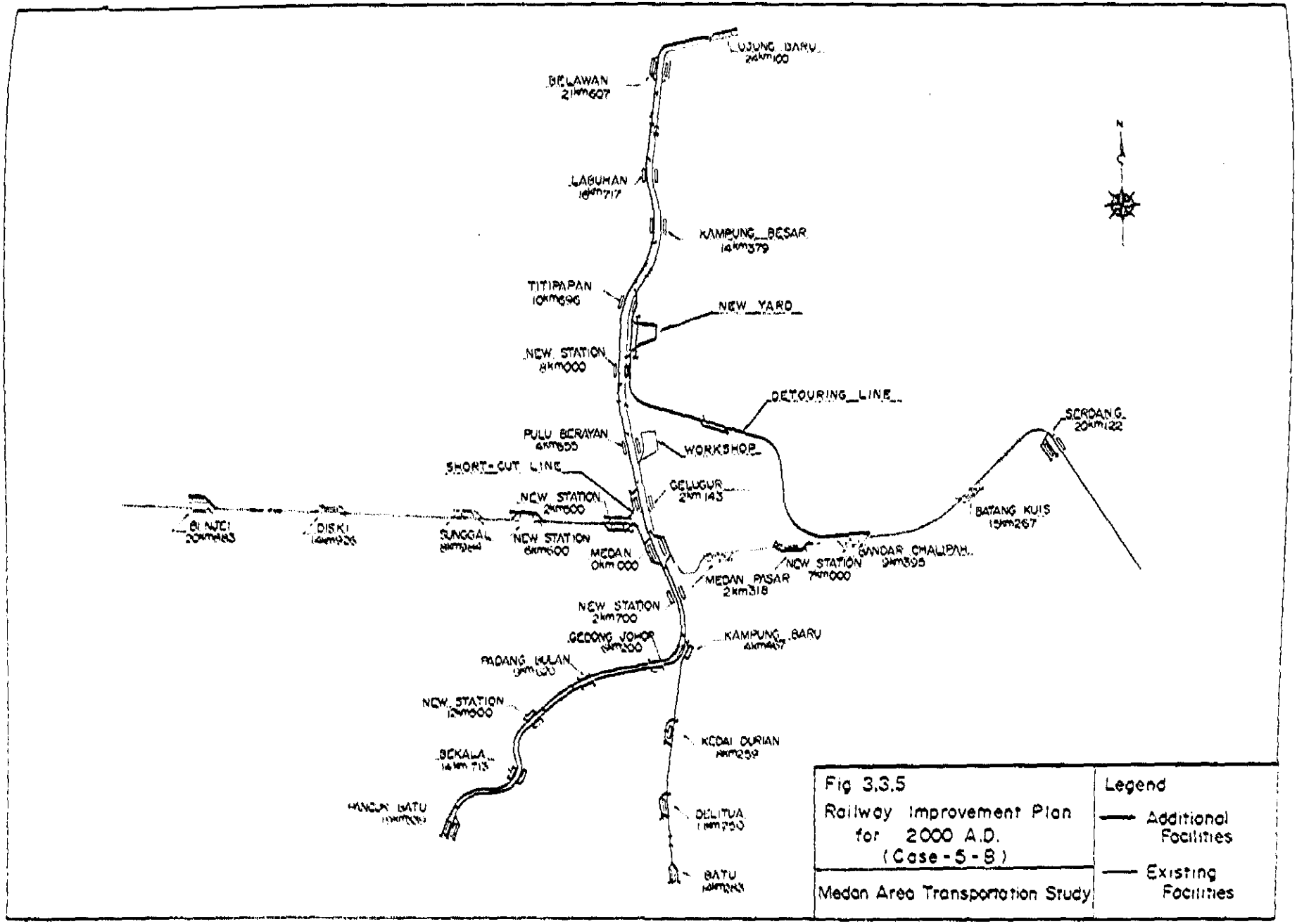
Table 3.3.3 Alternative Cases of Public Transport Planning

Road transport alternatives		Active Railway Participation in Urban Transport	
		Yes	No
	High Motorization	5-A	-
	Low Motorization	5-B	1-C

Note: High and Low Motorizations present the alternative cases of different numbers of trips per day/citizen due to the utilization of sedans to be controlled or not in the peak hours by the national policy although the numbers of sedan-ownership is same in the said cases.

Alternative Case 1-C in which the railway does not participate in the urban transport of Medan Area, is originally the Alternative-1 in the original classification shown in Fig. 3.3.1 in which seven alternatives are taken up according to the conceivable basic different relativity between the road system and the railway system in the Area. This alternative seems to be not necessary any more after the State Railway decided the policy to re-open the railway passenger service on the Northern Line after the fiscal year 1980/81 using diesel railcar trains although the


UJUNG BARU
24km000
BELAWAN
21km607
LABUHAN
16km717
KAMPUNG BESAR
14km379
TITIPAPAN
10km696
NEW YARD
NEW STATION
8km000
DETOURING LINE
SERDANG
20km122
PULU BERAYAN
4km600
WORKSHOP
SHORT-CUT LINE
NEW STATION
2km600
GELUGUR
2km143
BATANG KUIS
15km267
BLNJEI
20km443
DISKI
14km926
SUNGGAL
NEW STATION
6km600
MEDAN
0km000
SANDAR CHAUPAH
3km395
NEW STATION
7km000
MEDAN PASAR
2km318
NEW STATION
2km700
GEDONG JOHOR
0km400
KAMPUNG BARU
4km467
PADANG BULAN
NEW STATION
12km000
KEDAI DURIAN
8km259
BEKALA
14km713
PANCUR BATU
DELITUA
11km250
BATU
N
Fig 3.3.4
Railway Improvement Plan
for 2000 A.D.
(Case - 5 - A)
Medan Area Transportation Study
Legend
Additional Facilities
Existing Facilities


TUJUNG BARU
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NEW YARD
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SERDANG
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WORKSHOP
SHORT-CUT LINE
GELUGUR
NEW STATION
BINJEI
DISKI
SUNGGAL
NEW STATION
MEDAN
BATANG KUIS
GANDAR CHALIPAH
NEW STATION
MEDAN PASAR
NEW STATION
KAMPUNG BARU
GEDONG JOHOR
PADANG BULAN
NEW STATION
KEDAI DURIAN
BEKALA
HANCUR BATU
DELITUA
BATU
N
Fig 3.3.5
Railway Improvement Plan
for 2000 A.D.
(Case-5-B)
Medan Area Transportation Study
Legend
Additional Facilities
Existing Facilities

traffic demand is not sufficient enough to justify their operation in the Short-Term. But the Case 1-C still remains only for the comparison purpose as the extreme contrast case of the optimum case in order to confirm the approximate amount of necessary funds in the case of full bearing the urban transport burden only on the road system, which amount may be used as one of references to judge the appropriateness of the optimum case.

The case 1-C, which is an alternative that the railway does not participate in the urban transport, is intended to indicate how a tremendous amount of public investment is necessitated in road facilities, by which it is intended to evaluate the grade of active participation by railway in the urban transport to determine.

The comparison of the case 5-A and the case 5-B can be summarized from the viewpoints of transport conditions as follows:

Table 3.3.4 Comparison of Alternatives

	Low Motorization	High Motorization
Estimated numbers of sedan ownership	66 units/ 1,000 population	66 units/ 1,000 population
Numbers of trips *(3) by sedan	1,676.5 (trips x 10^3)	2,198.0 (trips x 10^3)
Railway travel speeds	40 - 45 k.p.h. (10 min. headway in peak hours)	40 - 45 k.p.h. (10 min. headway in peak hours)
Bus travel speeds	30 k.p.h. *(1) (5 min. headway in peak hours)	25 k.p.h. (5 min. headway in n
Vehicle travel speeds on other lanes	0.8V *(2)	V
Modal split curve	Same	Same

Notes: *(1) Only on bus lanes.

*(2) The reduced travel speed of vehicles on other lanes due to the establishment of a bus lane in each direction.

*(3) Figures do not include trips by sedan within zone.

V The travel speed characteristics of the said road.

3.3.5 Train Operating System Alternatives

The railway system is proposed to cope efficiently with the forecast urban transport demand in 2000 A.D. based on the forecast population distribution after taking into account the re-development of the CBD, various scheduled housing estate projects and the industrial estate projects. The railway system is designed to handle its share of urban transport through 28 railway stations in the Study Area where the railway system mutually functions with the bus system to transport passengers conveniently.

(1) Traffic Demand

The urban transport demand forecasts for the year 2000 in the Medan Area is as shown in Table 3.3.5 "O-D Table for Railway Passengers", which presents the number of passengers by line and of Medan Station. Fig. 3.3.6 shows the estimated number of railway passengers by line section, from which it is apparent that the passenger traffic is conspicuous in the line section between Kampung Besar Station and Kampung Baru Station in the north-south direction. Fig. 3.3.7 shows the railway passenger flows in Medan Area in the year 2000.

(2) Considerations on Over-all Problems

In order to cope with such estimated railway passenger demand in the Medan Area, the follow topics are considered below.

- Study of Electrification and Dieselization
- Mode Selection for Southern Lines

(a) Study of Electrification and Dieselization

i) Additional Investment Benefit Ratio

Currently, there is no electrified section in the Medan Area, and all the trains are pulled by diesel locomotives. Forecasts to the year 2000 show that the number of operating trains over every line will increase to well over 500 trains per day as is shown in Fig. 3.3.8.

Under such circumstances, it is necessary to review the justification of electrification from the standpoint of cost-savings. As one of the evaluation criteria, the additional investment benefit ratio, shown below, will be used.

$$\text{Additional investment benefit ratio} = \frac{\text{Annual cost for diesel operation} - \text{Annual cost for electric operation} + \text{Annual increased revenue through electrification}}{\text{Investments through electrification} - \text{Investment through dieselization}}$$

The additional investment benefit ratio for this project is obtained under the conditions shown hereunder.

Electrification System

At present, the electrification system which is prevalent on a wide scale is of DC 1,500 V, AC 20,000 V or AC 25,000V. The merits and demerits of those systems are as shown in Table 3.3.6.

The Comparison between A.C. System and D.C. System on the Construction Costs

- As to the ground facilities including the substations, power transmission facilities and tramways, the AC system is

Table 3.3.5 Railway Passenger O-D Table (2000 A.D.) Medan Area

(Unit: 1,000 persons/day)

	Northern Line (For Ujung Baru Stn.)	Medan Station	Western Line (For Benjei Stn.)	Eastern Line (For Serdang Stn.)	Southern Line (For Pancur Batu Stn. & Batu Stn.)	Total
Northern Line	15.4	21.1	10.4	10.7	20.9	78.5
Medan Station		0	12.8	11.1	33.5	78.5
Western Line			6.5	8.5	15.0	53.2
Eastern Line				6.7	15.7	52.7
Southern Line					29.6	114.7
Total						377.6

Table 3.3.6 Comparison between DC and AC Electrification Merits and Demerits

Item	AC 25,000 V or 20,000 V	DC 1,500 V
Land Facilities		
Substation	Distance 30 ∿ 50 km; Converting facilities unnecessary	Distance 10 ∿ 20 km; Converting facilities necessitated
Trainways	Positive feeder line unnecessary Negative feeder line necessitated	Positive feeder line (thick feeder line) Necessitated
Signal facilities	AC with different frequencies for track circuit necessitated	AC commercial frequency available for track circuit
Communication facilities	Underground cable laying necessitated for preventing induction interference	No induction interference
Safety devices	Maintenance work is difficult because of high voltage	Maintenance work is easier because of low voltage
Rolling Stock		
Speed Control	Generator voltage can be adjusted freely through tap of the transformer. Speed control can be attained at will.	Generator voltage is controlled by series, parallel, etc., and is regulated by stages
Equipment	AC equipment is necessary, and is costly. In case of DC generator, AC. DC Converting facilities necessitated	AC. DC Converting facilities unnecessary
Actual results in in Indonesia	Not yet used in this country	Actually in use Jakarta Area

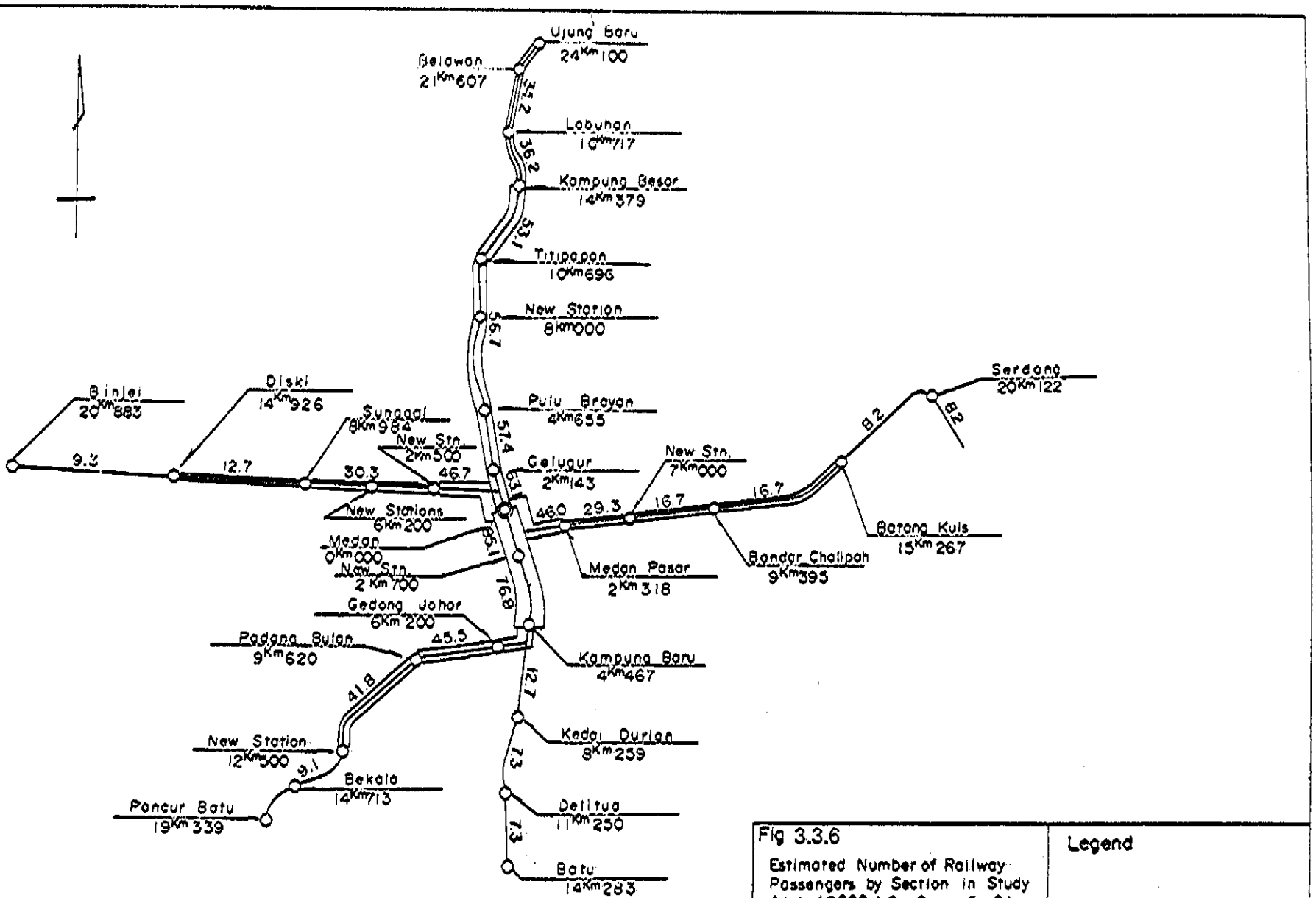


Fig 3.3.6
Estimated Number of Railway Passengers by Section in Study Area (2000 A.D. Case-5-8) Low Motorization

Medan Area Transportation Study

Legend

Unit: 10^3 Persons/day

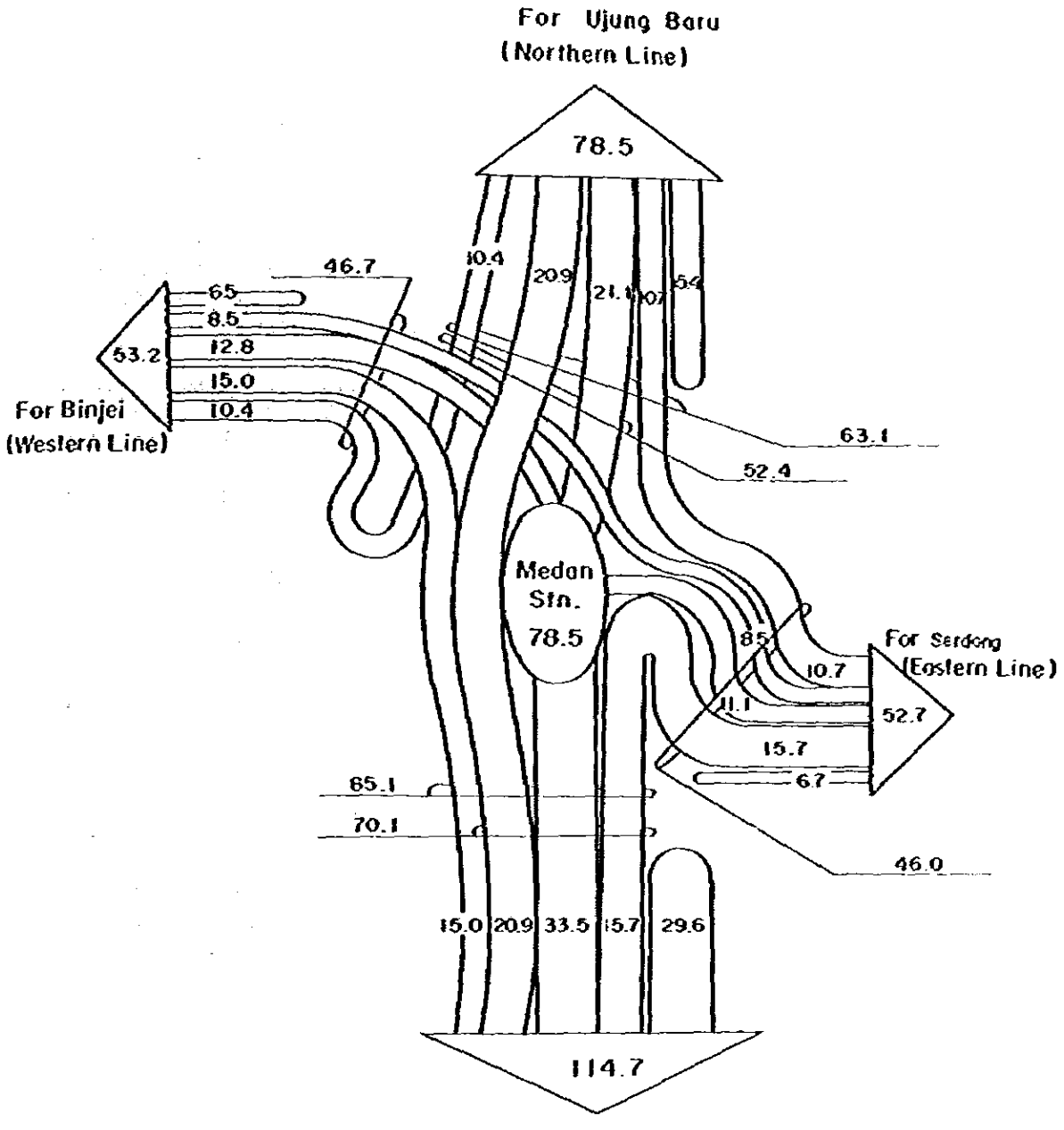


Fig 3.3.7 Estimated Railway Passenger Flows in Medan Area (2000 A.D.)	Legend Unit : 10^3 Person/day
Medan Area Transportation Study	

inexpensive when compared with that of DC. In the case of urban transportation where the route length is rather short, the difference in number of substations is accordingly small. These and other reasons will testify to the fact that the difference for ground facilities is comparatively small.

- As to rolling stock, the AC system is more expensive than the DC system. In the case of urban transportation, the number of rolling stock per route length is comparatively large, and the difference of rolling stock cost between the AC and DC systems is deemed important. In this project, it would, therefore, be reasonable to conclude the following:

- So long as the electrification project over the longer route length is not expected, and the project objective is meant for the urban transport route, the number of rolling stock for electrified sections would be greater. The DC system which will entail cheaper costs, therefore, would prove advantageous.

- Currently, there is no AC system in the Republic of Indonesia. Since a DC system of 1,500 V is now in use in Jakarta Area, the same system would have advantages over an AC system from the standpoint of standardization and rolling stock management.

Consequently the DC system of 1,500 Volts is recommended for this project.

Operation Planning

As to train routing, number of car consisting a train, passenger car accommodations, and train operation headway, the same principles would apply to both dieselization and electrification. Consequently, all the signal and safety equipment, civil structures, tracks and rolling stock bases related thereto would be of the same scope. The electric cars, however, have greater acceleration than that of diesel cars, and the scheduled speed would be greater; thus, the required number of rolling stock could be decreased by 5 per cent.

Motive Power Cost

As to the unit price of fuel oil, prices in Medan Area at the time of the current survey were adopted. As to the unit price of electric power, the unit price of electric power in Jakarta Area for the operation purpose of electric cars was likewise adopted.

Amount of Increased Revenue through Electrification

In the case of this project, the traveling distance of each passenger is comparatively short, and the merit of time curtailment brought about electrification would naturally be negligible. Consequently, the increased number of passengers and the resultant increase in revenue will be ignored.

Objective Period

In line with the forecasts to the year 2000, two cases are considered by way of comparison: one is the case where all the

objective sections are dieselized, and the other is the case where all are electrified.

ii) Estimated Results of Additional Investment Benefit Ratio

Based on the investment amount and the annual expenses relating to Case 5-B-3 mentioned hereunder, the additional investment benefit ratio is derived as follows:

Table 3.3.7 Benefit Ratio for Additional Investment

(Unit: 10⁶ Rp.)

Item	Motive Power	Electrification	Dieselization
Investment Amount	Electrified Facilities	31,700	
	Rolling Stock	26,860	41,500
	Total	(A) 58,560	(B) 41,500
	Difference	(A) - (B) 17,060	
Annual Expenses	Motive Power Expenses	692	529
	Maintenance Expenses	658	1,494
	Total	(A') 1,350	(B') 2,023
	Difference	(B') - (A') 673	

Additional Investment benefit ratio = $\frac{B' - A'}{A - B}$ = 0.039

As for the additional investment benefit ratio, a level of 0.1 (10%) or more is disireable. In the case of this project, the ratio is much smaller as mentioned above.

iii) The Choice between two Alternatives in This Project

The calculated result of the additional investment benefit ratio is an shown heretofore. Generally, in cases where electrification is effected, the efficient utilization of energy can be reasonably expected. In consideration of the worldwide energy crisis, the issue of the most efficient utilization of energy is of vital importance and affects the choice between the two alternatives (i.e., dieselization and electrification). A discussion of the relevant topics are reviewed below.

- Demand/supply of petroleum

The Republic of Indonesia produces petroleum in great abundance. However, due to worldwide supply and demand in the future, there is every possibility of increases in the price. Moreover, from the standpoint of the preservation of natural resources, it is most desirable that petroleum products be conserved to a considerable degree.

- Electric supply in the Medan Area

Hydro-electric power plants are now under development in Asahan Area and elsewhere, which will have an abundance of spare capacity. Consequently it is expected that an inexpensive supply of hydro-electric power will be available in the Medan Area in the future.

- Comparison between Dieselization and Electrification with reference to Motive Power Cost

The electric power expense for electrification in the above-mentioned additional investment benefit ratio was based upon the electric power cost per running kilometer for electric car operation in the Jakarta Area.

However, the fuel expense for dieselization is based upon the purchasing price by PJKA in the Medan Area.

Assuming that the motive power cost for dieselization would be 100, that for electrification would reach 130. However, in Japan, the electrification value would stand at about 60, which constitutes a remarkable difference from the figure cited above. The reasons for this difference are ascribable to the following:

  - The price of petroleum in Indonesia is exceedingly cheap.

  - The electric power cost for operating rolling stock in Jakarta area is rather high. The reason for this cost is attributable to the fact that the unit price of electric power is high and that slow operating sections of railway are prevalent in the city area, thereby causing greater electric power consumption per running kilometer. For electric car operation in the Medan Area, such reduced speed is not be conceivable, and hence, the electric power consumption per running kilometer would decrease when compared with the current situation in the Jakarta Area.

- Improvement in the Additional Investment Benefit Ratio

Reliable data regarding the future petroleum price and electric power cost in the Republic of Indonesia are not available at present. However, on the assumptions that the electric power cost remains as it is at present and that fuel cost increases 2.9 times above the current price level, the additional investment benefit ratio mentioned above would reach 10%.

There is a strong possibility that the petroleum price will become higher due to the worldwide situation between demand and supply. On the other hand, it is expected that the electric power cost will remain unchanged at a comparatively low level, due to the development of the hydro-electric power project in Sumatra. It is a general practice in Japan to apply to the Railway, when it is electrified, the power rate of large power-consumers of industries which is much lower than that of small power-consumer. A possibility may be studied of applying a special rate of power to the State Railway in this case so as to improve its financial aspect because of its role of public urban transport, when it is highly probable that the benefit rate of additional investment to electrify the railway in Medan Area would be much improved.

The Indonesian Government Authorities expressed their strong interest in the electrification issue in the Joint Meeting held in July 1980. In addition to the various conditions mentioned above, greater merits for the urban environment are expected as follows in cases where overall electrification is realized.

- Benefits on the part of passengers derived from the increase in train speed

- Improvement in riding comfort through the operation of smoother riding electric cars

- Solution of environmental issues through abating noise nuisance and eliminating exhaust gas

Consequently, the electrification of the railway in Medan Area is an appropriate policy as the final target of railway improvement in the long term.

(b) Mode Selection for Southern Lines

The train operation on two Southern Lines has been suspended since 1970, however, its right-of-way and railway facilities still remain intract although facilities have somewhat deteriorated. In view of re-opening these two lines for the passenger service to meet the future estimated passenger transport demand the selection of appropriate transport mode was studied from the point of view whether the existing railway is to be rehabilitated or some other new mode of transport is to be introduced instead:

- Light Rail Transit System

  The transporting capacity of this system is estimated at approximately 4,000 passengers per hour; and consequently, the system does not meet the required transport demand of the year 2000.

- Medium-Volume Transport System on Track

  Monorail is presently the representative of this category; however, it does not permit crossing with roads at-grade due to structural feature of its track. This fact required the

continuous elevation of its track over the entire length of those lines, even in the country-side, in order to cross country roads anywhere, which will result in an enormous construction cost. In addition, all passengers of those lines would have to change their trains at Medan Station despite the fact that the majority of them are the through passengers with their destinations on the Northern Line.

From such points of view, monorail is not appropriate on those lines.

- Railway using Existing Track

Quite a considerable portions of the remaining railway facilities of those lines could be used if they are appropriately rehabilitated; thereby, saving a large amount of the construction cost and making this mode feasible in contrast to the other modes already mentioned. In addition if through operations are intentionally planned the railway passengers destinated for other lines would be able to travel directly without changing trains at Medan Station. Furthermore, the rolling stock could be commonly and economically used by other lines due to the same gauge of track and the same track structure. Consequently, greater savings in the operating costs would be made than in other modes under the same traffic conditions.

(3) Estimated Daily Number of Trains

The estimated daily number of trains for urban transport by line section to meet the railway passenger transport demand of 2000 A.D. are calculated assuming that the minimum train headway of 15 minutes is maintained in operation and that alternatives of train composition are considered in order to optimize the transporting capacity of each line. The following two alternatives of train composition were considered:

Case 5-B-3 Six-car trains on the Northern and the Southern Lines, while eight-car trains on the Eastern and the Western lines.

Case 5-B-2-2 Six-car trains on all lines.

The daily numbers of trains including long distance passenger trains and freight trains are shown in Fig. 3.3.8.1 for Case-5-B-3 and in Fig. 3.3.8.2 for Case 5-B-2-2.

(4) Double Tracking

Presently all railway main lines in Medan Area are of single track, but some sections require double tracking in order to cope with the estimated train traffic of 2000 A.D. as shown in Fig. 3.3.8.1 and Fig. 3.3.8.2.

(5) Train Operating System

The train operating system as shown in Table 3.3.8 has been formulated based on the passenger flows in Medan Area as shown in Fig. 3.3.7. In Table 3.3.8 the total length of lines to be operated, the required numbers of rolling stock and also the number of passengers transferring at Medan Station daily are presented for every alternative and every case.

(6) Track Elevation and Yard Relocation, etc.

It is proposed to elevate the railway lines, including Medan Station, continuously within the CBD to eliminate road traffic jams now occurring at railway crossings located in the CBD. The railway elevation is proposed to be carried out under the following conditions:

- As the prerequisite condition of railway's continuous elevation, it is proposed to relocate (1) a locomotive shed, (2) a freight shunting yard, (3) a coach yard, (4) a freight station and warehouses presently located in the railway property of Medan Station to appropriate sites in the peripheral area of the city; namely, the former three facilities to the site south of Titipapan and the fourth (major portion) to the vicinity of an interchange of the Belawan-Medan-Tg. Morawa Highway and the remaining portion of that on the Binjei-Medan Bypass. On the other hand, a freight line of 17.3 km long detouring the eastern peripheral areas of the city and reaching Titipapan Yard is proposed to be built for freight train operation of the Eastern Line. In addition, a short-cut is proposed between the Western Line and the Northern Line of 2.4 km long at their junction point north of Medan Station for the freight trains of the Western Line to reach the Titipapan Yard. Titipapan Yard should have capacity as a junction shunting yard for four main lines and also be responsible for shunting assignment of Belawan Port yard, which is too narrow to expand.

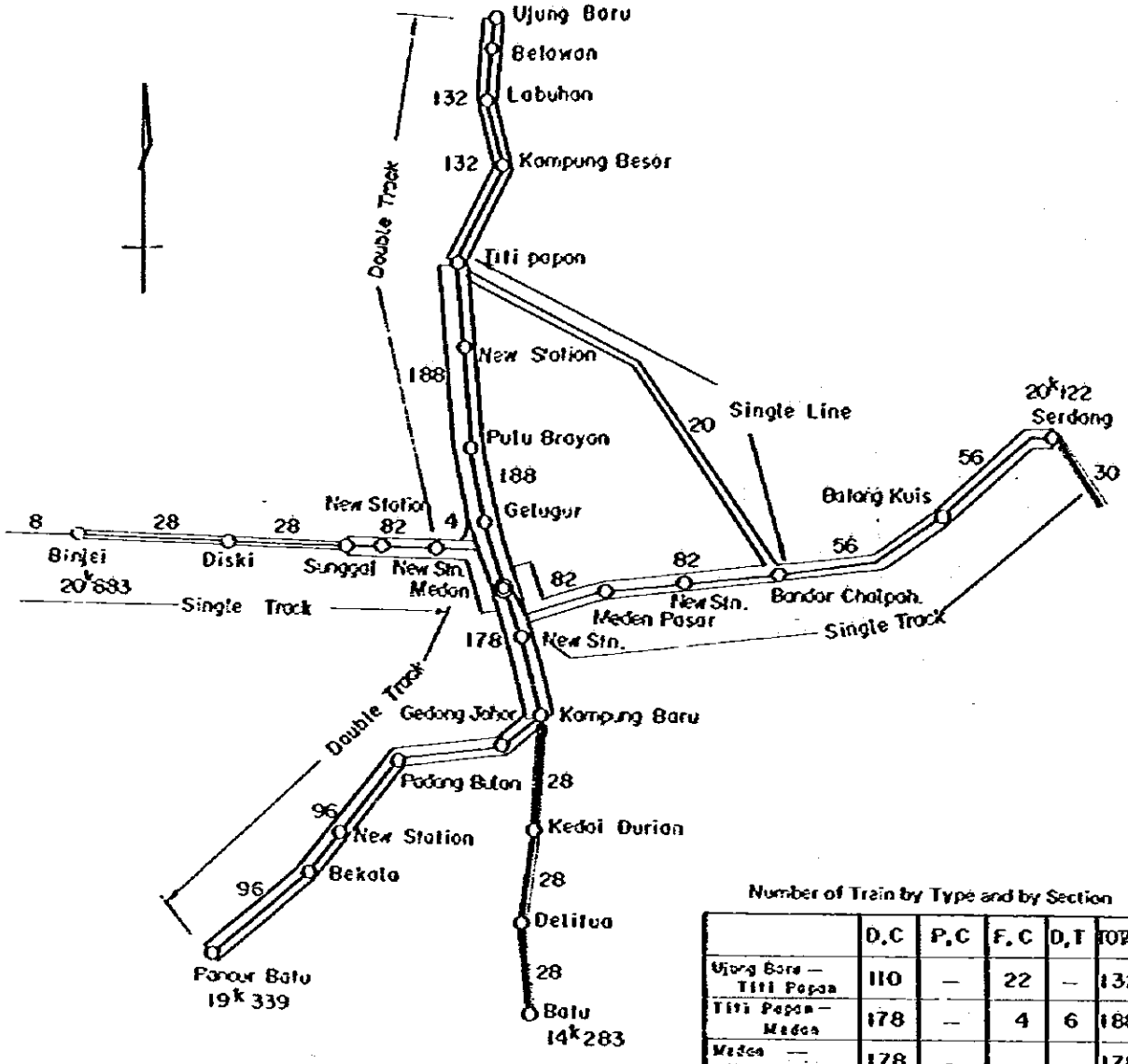
- The total length of railway elevation is proposed to be as short as practically possible to minimized its construction cost: The longer the embankment portion is, the shorter the structure portion will be. The anticipated length of railway, including Medan Station, to be elevated is approximately 2.9 km as is shown in Fig. 3.3.9.

- Two alternative cases for the layout of Medan Station after the railway is elevated are shown in Fig. 3.3.10; namely, they are Case 5-B-3 in which both the Eastern Line and the Western Line are of single track and Case 5-B-2-2 in which those two lines are double tracks; the Northern Line as well as the Southern Line are double tracks in both cases.

- Four new stations are proposed to be built in the project area and any railway station which has not been in use for many years have to be rehabilitated or improved to handle railway urban passengers. The total number of such stations handling urban passengers in the study area is expected to be twenty eight.

(7) New Rolling Stock Bases

Before the railway elevation in the CBD is realized (1) a locomotive depot, (2) a coach yard, and (3) a diesel railcar depot are proposed to be relocated from Medan Station to Titipapan where a composite rolling stock bases including that of freight cars are to be constructed side by side with a freight shunting yard. Some residential facilities for railway employees of those facilities are proposed to be established in the vicinity of Titipapan. Appropriate land large enough for those facilities is proposed in the long-Term land use plan of the city. The outline of Titipapan Yard and affiliated rolling stock bases are shown in Fig. 3.3.11.



Number of Train by Type and by Section

	D.C	P.C	F.C	D.T	TOTAL
Ujung Baru — Titi Papan	110	—	22	—	132
Titi Papan — Medan	178	—	4	6	188
Medan — Kampung Baru	178	—	—	—	178
Kampung Baru — Pasar Batu	96	—	—	—	96
Kampung Baru — Batu	28	—	—	—	28
Medan — Bandar Chalpah	72	10	—	—	82
Bandar Chalpah — Serdang	26	10	20	—	56
Serdang —	—	10	20	—	30
Medan — Sunggal	74	4	4	—	82
Sunggal — Binjai	20	4	4	—	28
Binjai —	—	4	4	—	8

DC : Diesel railcar trains
PC : Long distance Passenger trains
FC : Freight Car
DT : Train Without Passenger

Conditions

a) Ride efficiency : 130%
b) Peck ratio : 20%(15 hours)

Fig. 3.3.8.1
Estimated Daily Number of Trains in Study Area
(2000 A.D. Case-5-B-3)

Medan Area Transportation Study

Legend

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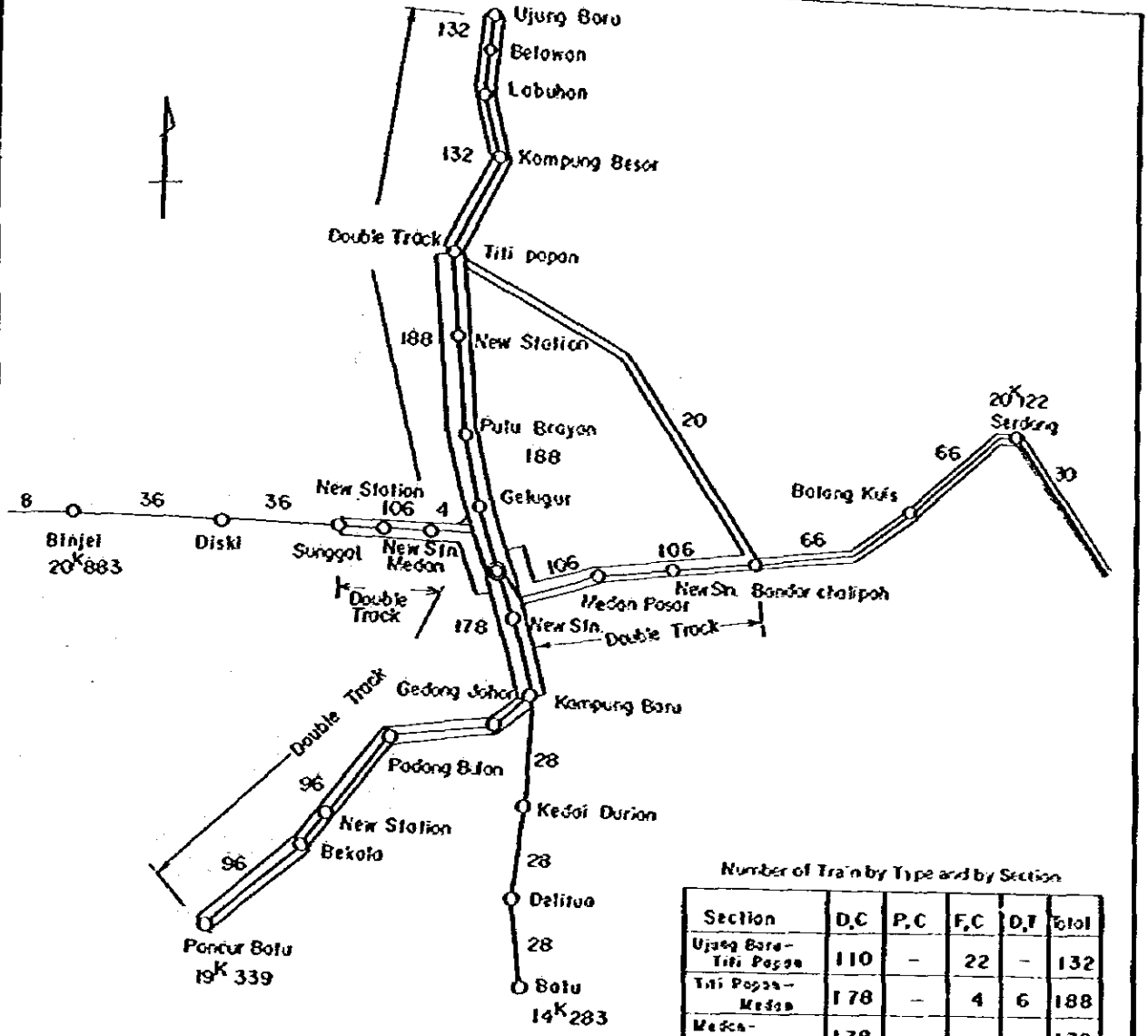
No. of Trains



Number of Trains by Type and by Section

Section	D,C	P,C	F,C	D,T	Total
Ujung Baru – Titi Papan	110	–	22	–	132
Titi Papan – Medan	178	–	4	6	188
Medan – Kampung Baru	178	–	–	–	178
Kampung Baru – Pancur Batu	96	–	–	–	96
Kampung Baru – Batu	28	–	–	–	28
Medan – Bandar Khalipah	96	10	–	–	106
Bandar Khalipah – Serdang	36	10	20	–	66
Serdang –	–	10	20	–	30
Medan – Sunggal	98	4	4	–	106
Sunggal – Binjai	28	4	4	–	36
Binjai –	–	4	4	–	8

D,C : Diesel railcar trains
P,C : Long distance Passenger trains
F,C : Freight trains
D,T : Trains Without Passenger

Fig 3.3.8.2
Estimated Daily Number of Trains in Study Area
(2000 A.D. Case-5-B-2-2)

Medan Area Transportation Study

Legend

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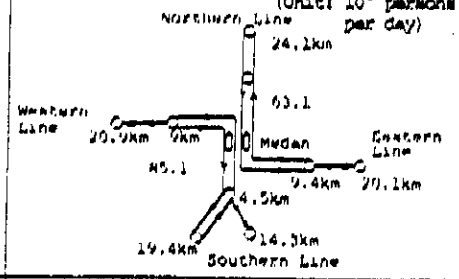
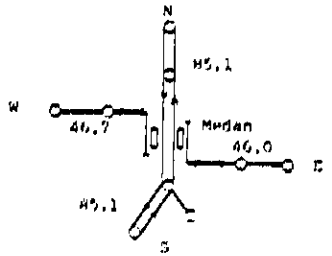
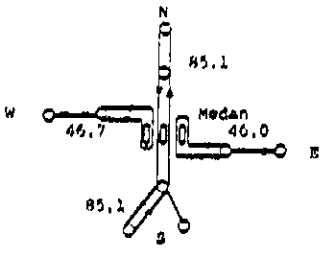
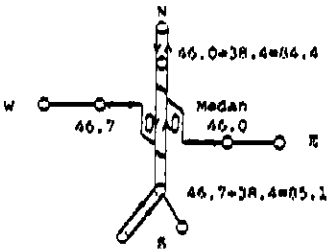
No. of Trains

Table 3.3.6 Train Operation System in Medan Area (2000 A.D.)

Alternative \ Item	Schematic Track Plan	Train composition	Train Operation System	Total Length of Lines to be operated.	No. of Transfer Passengers at Medan Station
Case-S-B-1	(Unit: 10^3 persons per day) 	Each train consists of 6 diesel rail-cars on all lines.	Through operation between Eastern & Northern Lines. Through operation between Western & Southern Lines.	(unit:km) Northern Line: 45.7 Southern Line: 48.6 Eastern Line : 29.5 Western Line : 29.9 Total :153.7	(unit:10^3 persons/day) Northern L.-Western L. :20.9 Eastern L. -Western L. : 8.5 Eastern L. -Southern L.:15.7 Western L. -Northern L.:10.4 Total :55.5
Case-S-B-2 / Case-S-B-2-1		Each train consists of 6 cars on Southern & Northern Line and 8 cars on Eastern & Western Lines.	Through operation between Southern & Northern Lines. Separate operation on Each Eastern & Western Lines.	Northern Line: 45.7 Southern Line: 48.6 Eastern Line : 20.1 Western Line : 20.9 Total :135.3	Nothern L. -Eastern L. :10.7 Eastern L. -Southern L.:15.7 Southern L.-Western L. :15.0 Western L. -Nothern L. :10.4 Eastern L. -Western L. : 8.5 Total :60.3
Case-S-B-2-2		Each train consists of 6 cars on all lines.	Operation System: Same as Case-S-B-2-1 Partly Double Tracks in Eastern & Western Lines.	Same as Alternative-1 Total :153.7	Same as Case-S-B-2-1 Total :60.3
Case-S-B-3		Each train consists of 6 cars on Southern & Northern Line and 8 cars on Eastern & Western Lines.	Decrease of train interval and transfer passengers because of dissolution of pendulum operation. Train Operation System is as follows. a. Through operation between Eastern and Northern Lines. b. Through operation between Western and Southern Lines. c. Through operation between Southern and Northern lines	Same as Alternative-2 -Case-1 Total :135.3	Nothern L. -Western L.:10.4 Southern L.-Eastern L.:15.7 Total :26.1

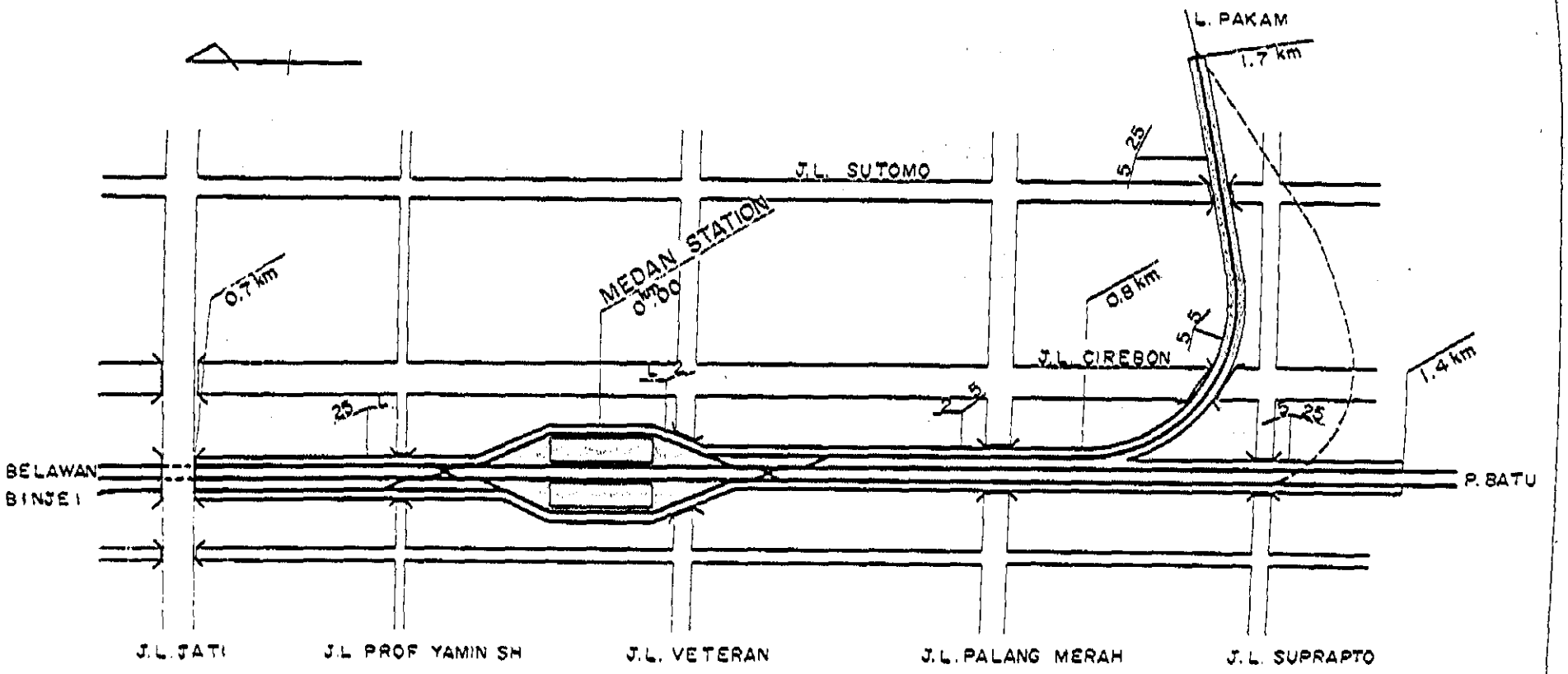


Fig 3.3.9
Schematic Plan of Elevated Track Section, Medan City (2000 A.D.)

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Elevated Track

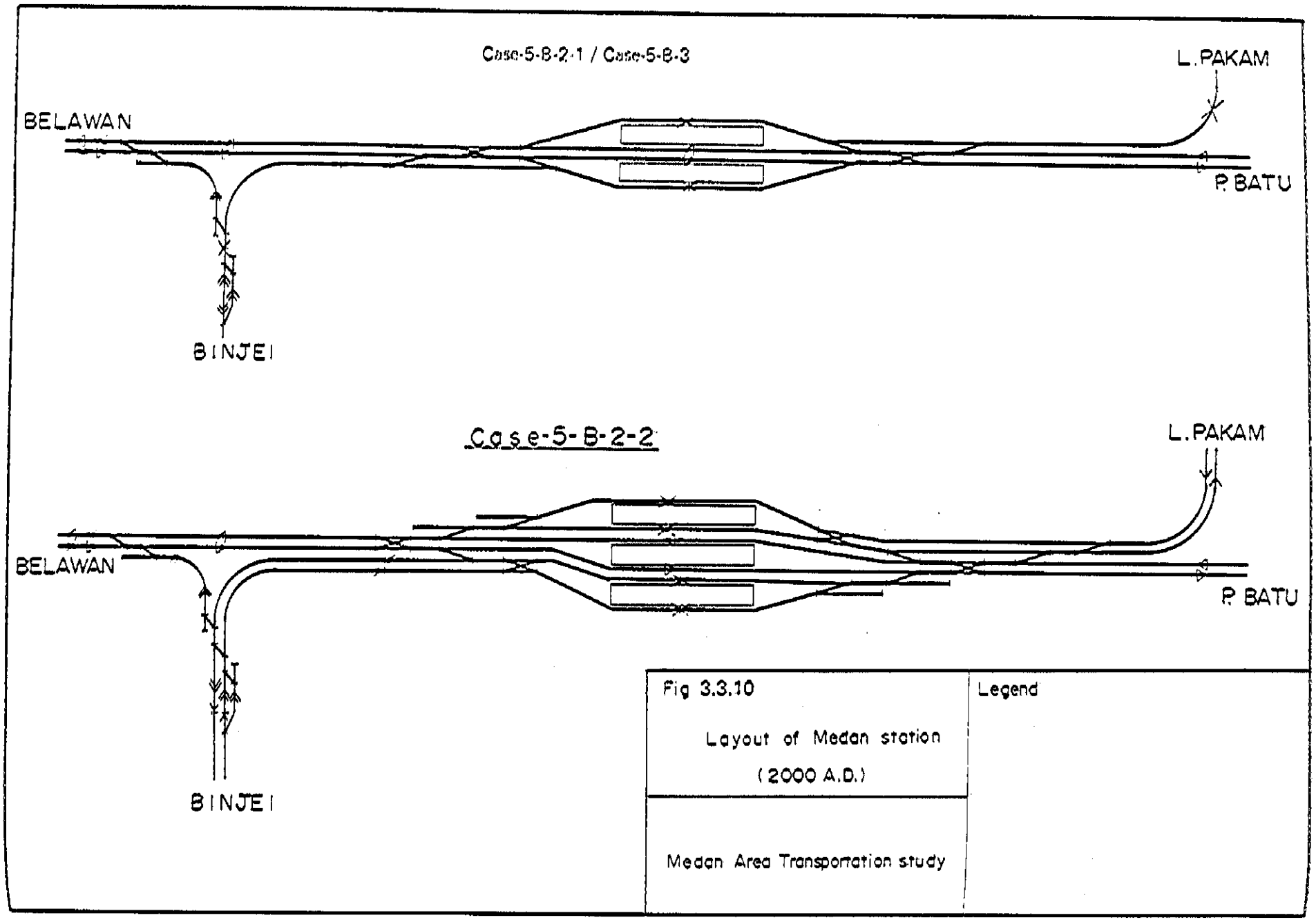

Fig 3.3.10

Layout of Medan station

(2000 A.D.)

Medan Area Transportation study

Legend

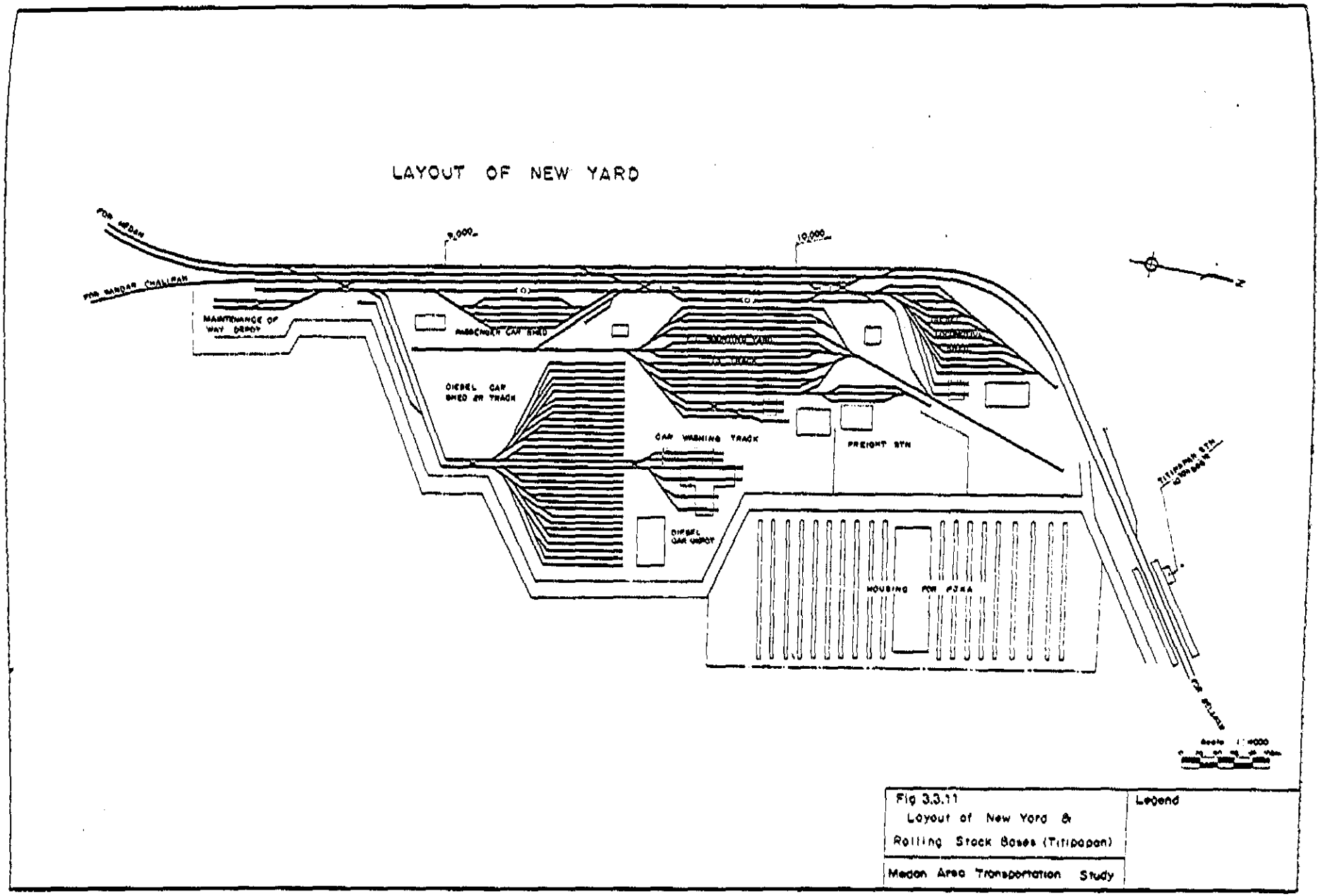

Fig 3.3.11 Layout of New Yard & Rolling Stock Bases (Tj.Tiram)	Legend
Medan Area Transportation Study	