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REPUBLIC OF INDONESIA

THE MEDAN AREA TRANSPORTATION STUDY

FINAL REPORT

ON

LONG TERM MASTER PLAN

NOVEMBER 1980

JAPAN INTERNATIONAL COOPERATION AGENCY

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PREFACE

It is a great pleasure for me to present this report entitled "The Final Report on Long-Term Master Plan, The Medan Area Transportation Study" to the Government of the Republic of Indonesia.

This report embodies the results of the field survey which was carried out in Medan City and its surrounding areas from September 10, 1979 to November 10, 1979 by a Japanese Survey Team sent by Japan International Cooperation Agency at the request of the Government of Indonesia to the Government of Japan.

The Survey Team, headed by Michio Inoue, had a series of consultations with officials concerned of the Government of the Republic of Indonesia and conducted extensively a field survey for master planning of urban transport system in Medan Area.

I hope this report will be useful as a reference for development of the said area.

I wish to express my deep appreciation to the officials concerned of the Government of the Republic of Indonesia for their close cooperation extended to the Survey Team.

November, 1980

Keisuke Arita

Keisuke Arita
President
Japan International Cooperation Agency

Words of Chief of the Supervisary Committee

It is a great pleasure for me to say a word upon the successful completion of the Medan Area Transport Study by the JICA Study Team.

In the course of preparing the final report we visited Jakarta five times together with the Study Team to submit several intermediate reports to explain the progress of the study and to present problems concerned in order to well discuss with the Steering Committee members of the Indonesian Government of this study.

In a general urban transport planning various urban activities concentrated and/or diversified in urban areas must be conveniently accessible by citizens of any parts of the city whose economic and social lives, which need divergent and sophisticated patterns and distribution of urban trips, depend largely on a well-planned urban transport system. In order appropriately to balance between the conflicting demands of different traffic movements a careful traffic management based on a comprehensive urban transport planning is strongly needed, which will be affected by the people of the city who live in the city and also determine the future character of the city.

We believe that the Master Plan proposed by the Study Team will surely fit to the future possible situation of the Medan Area and that the Master Plan will be an appropriate guideline for the future development of the Medan Area.

November, 1980

Y. Matsumoto

Prof. Dr. Yoshiji Matsumoto

Chairman

JICA Supervisory Committee

Words of the Study Team Leader

This report has been prepared in succession to the Final Report on Short-Term Improvements, Medan Area Transport Study which was submitted in July 1980.

In this report we tried to clarify the process to select the optimum plan out of several alternatives, making the optimum one into a master plan, accompanied by its financial analyses and its implementation program. In this presentation we have incorporated into the text the changes suggested by JICA Supervisory Committee members as well as we have well reflected the official comments made by the Steering Committee members of the Government of the Republic of Indonesia on this study. We attached to this report detailed supporting data of the master plan alternative of the second priority for readers' reference.

In this report on master planning on Medan Area Urban Transport System for Long-Term we pointed out various important projects which will require feasibility studies prior to their implementation.

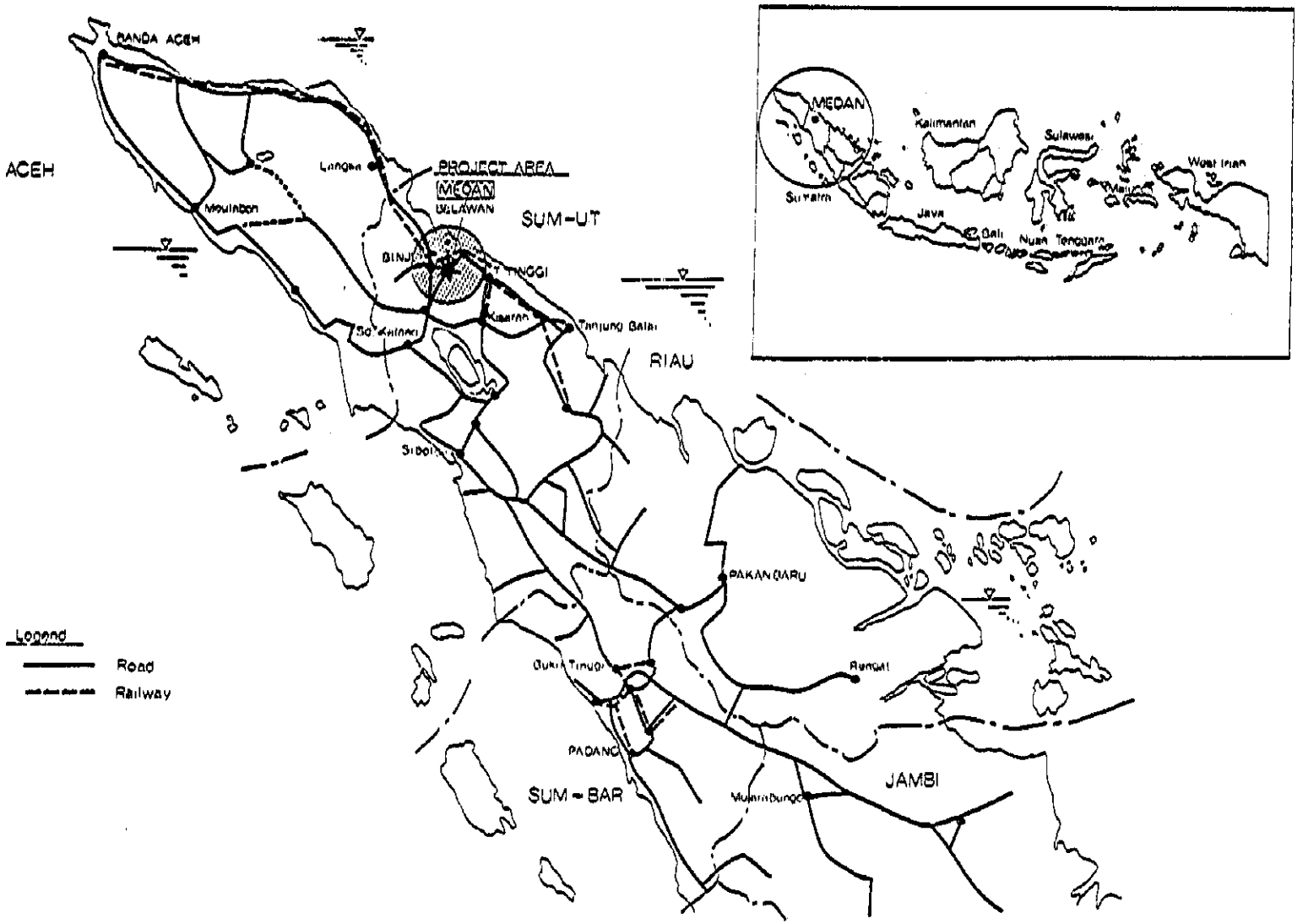
This study was carried out jointly by planners, economists and engineers of Pacific Consultants International and Japan Transportation Consultants Inc.

November, 1980

M. Inoue

Michio Inoue
Team Leader
Japanese Survey Team
on Medan Area Transport Study

PROJECT LOCATION MAP



SUMMARY

SUMMARY OF DRAFT FINAL REPORT ON LONG TERM MASTER PLAN MEDAN AREA TRANSPORTATION STUDY

1. Summarized Conclusions

1.1 Forewords

Upon the request made by the Government of Indonesia the Japanese Government conducted the Medan Area Transportation Study since September 1979. The study consists of the preparation of the short-term improvement plans aiming at the year 1985 and also the preparation of the long-term master plan of Medan Urban Transport System aiming at the year 2000 A.D. This report was prepared by the JICA Study Team as its final fruit of the long-term master planning, while the final report on the short-term improvements was separately submitted to the Government of Indonesia already in July 1980.

1.2 Conclusions

Conclusions made in the master planning of urban transport system for Medan City and her surrounding areas aiming at 2000 A.D. can be summarized as follows:

(1) Ranking of Medan City

Because Medan City is anticipated to grow up even in future as the core of legislation, administration, industry, economy and culture of North Sumatra, it is proposed to guide her land-use planning so as to realize 'the Central Business District Redevelopment Model', and consequently, it is necessary to consider the urban transport planning to cope with and promote such land-use plan.

(2) Basic Policy on Urban Transport Planning

The present urban transport system of Medan Area is proposed to be remodelled into such a type in which the public transport system performs as the backbone of the urban transport service.

(3) Specific Contents of Urban Transport System

If the consideration is extended on the problems of energy and urban environment and also to the estimated noticeable increase in vehicular traffic in future it is proposed to remodell the present road-centered urban transport system into an efficient and comprehensive transport system under the active participation of railway or other new effective mass transport mode.

Specific improvement strategies based on the afore-mentioned philosophy can be summarized as follows:

(a) In the long-distance transportation the railway is proposed to be developed as the backbone in both passenger and freight transportation in North Sumatra.

(b) In the urban transport in Medan city and her surrounding areas it is proposed to establish a transport system, an efficient combination of railway, buses including mini-buses and private vehicles, functioning respectively in their appropriate range of service distances.

(4) Basic Conclusions in Facilities Planning

(a) Formulation of an integrated Urban Transport System consisting of Road and Railway.

(i) Improvement of six radiating arterial roads and two ring roads and the establishment of tollway system of the area;

(ii) Separation of the railway freight train operation and freight-related facilities from the central district;

(iii) Continuous elevation of railway in the central district and grade separation of important road intersections of arterial roads, particularly on the intermediate ring road;

(iv) Common use of railway station plazas as the mutual access points between the railway system and the bus system;

(v) Establishment of several bus terminals dispersed widely in the city area to enable easy transferring between the inter-city service and the urban and the suburban services and to avoid the concentration of bus routes in the centeral district;

(vi) Establishment of truck terminals with the function of warehouses in the peripheral areas in order to avoid the direct entry of large trucks loaded with imported commodities into the central district and also to distribute commodities coveniently therefrom without disturbing the urban traffic.

(b) Additional Proposals to Each Mode of Transport

(i) Change of the railway passenger train operation from the diesel traction to the electric traction; at the appropriate time in the long-term;

(ii) To seek for the possibility of introduction of any new transport system;

(iii) Improvement of road intersections in order to use the road system more efficiently, and establishment of public parking spaces in the central district.

(5) Administrative Steps for Effective Implementation of Improvements of Existing Transport Facilities,

(a) Clarification of organization responsible for facility improvements in each mode of transport, and establishment of a system to share those improvement costs reasonably among the government agencies concerned;

(b) Establishment of social education for traffic affairs and regulations and accidents;

(c) Establishment of administrative steps to realize the low motorization in the private-vehicle traffic and the high dependence on the public transport system; and

(d) Establishment of specific administrative step to implement various improvement plans of transport facilities.

(6) Studies to be made in Future

The field survey and study conducted by the JICA Study Team are for the master planning of the urban transport system for the Medan Area and those proposed facility improvement plans are recommended to be furthered by respective feasibility studies before their actual implementations. Particularly those categories to be confirmed by conducting respective feasibility study.

- Electrification Project of Railway Passenger Transport in Medan Area;
- Tollway Project;
- Expansion or Relocation of Polonia Airport;
- Investigation for Effective Implementation of Urban Transport Master Plan;
- Area Coordinated Road Traffic Signaling Project;
- Possibility of Introduction of New Transport System;
- Urban Redevelopment Project around Medan Station;
- Bus Transport Improvement Project;
- Road Related Facility Projects;
- Truck Terminal Project accompanied by Relocation of Warehouses;
- Flood Control and Possibility of Waterway Transport

2. Planning Policies

The basic planning policies of transport planning for Medan Area for the year 2000 A.D. are summarised as follows:

(a) Securing of Urban Functions

Under the premise that Medan City be ranked as the central city of Sumatra Island in legislation, administration, culture and economy where various urban functions are maintained by facilitating urban traffic flows:

(b) Maintaining of Regional Environmental Conditions

Medan City is made as a safe and comfortable city to live in by preserving the urban environment of the whole city including housing environment through appropriate land-use planning;

(c) Securing of Public Spaces

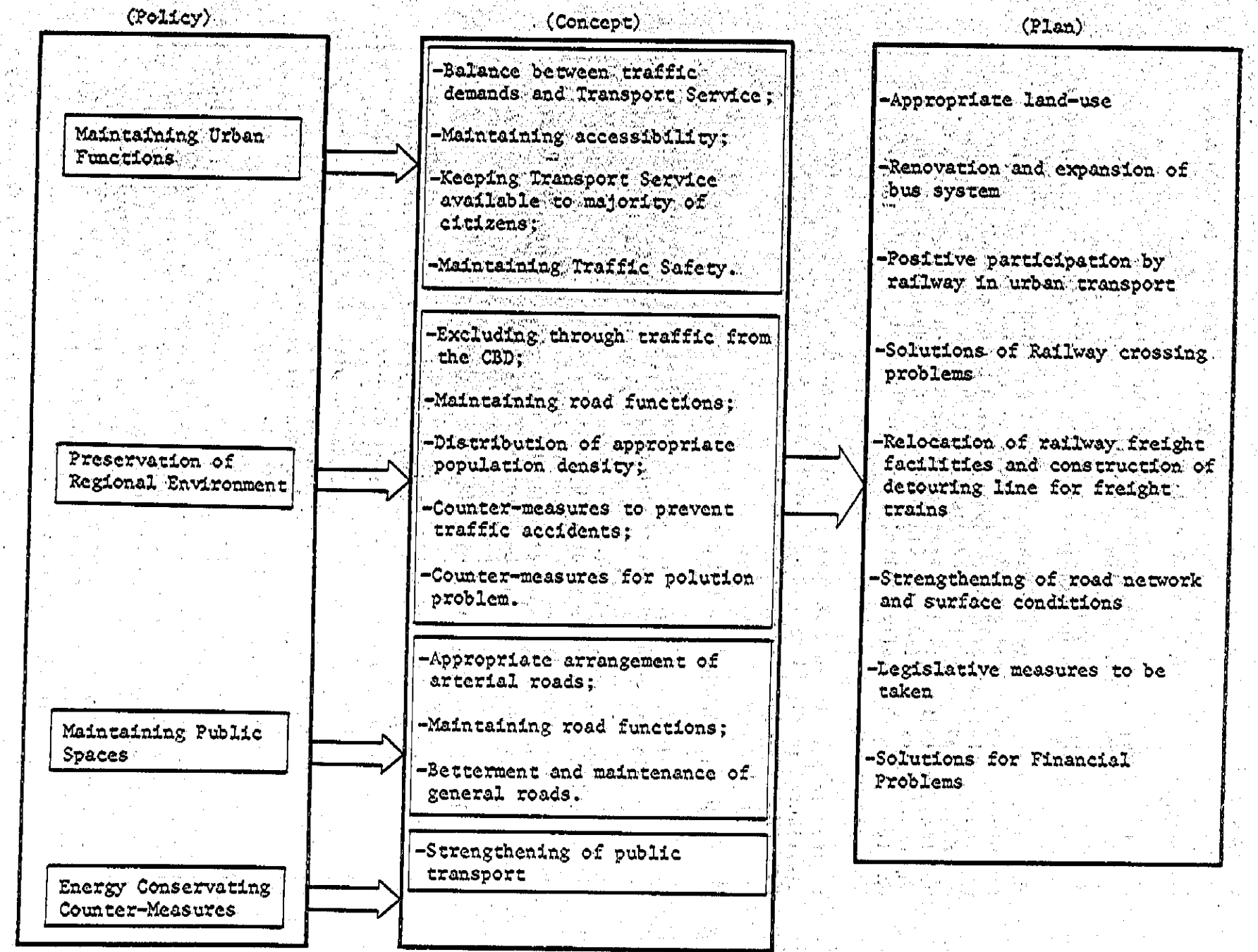
Public road spaces are maintained not only as facilities to handle the urban traffic flows but also as the spaces for the anticipated functions to hold public utilities and sanitary facilities to be needed in future:

(d) Energy Preservation Policy

The energy preservation problem, widely discussed presently throughout the world, is taken fully into account in selecting modes of transport for its future urban transport system.

The Table 1 is the summary of what was discussed briefly in the preceeding paragraphs.

Table I Summary of Planning Policies



3. Land-Use Plan

In the process of formulating the Master Plan of land-use in 2000 A.D. the followings are the major objectives;

(a) Understanding of the present and the future land-use plans of Medan City and its surrounding areas; and

(b) Formulation of necessary planning parameters.

This study is basically the urban transport planning and consequently, its own particular land-use planning was not carried out, but reviews were made on "Master Plan Kotamadya" prepared by Dinas Planologi Kotamadya Medan in 1974 and also findings made in "Medan Urban Development, Housing, Water Supply and Sanitation Project" which is under study by Engineering Science/Sinottech since 1979. This transport study was carried out substantially utilizing the findings of the latter in the land-use plan.

Further in establishing various planning parameters the population was distributed in two alternatives, namely "the Current Trend Model" and "The CBD Redevelopment Model" as follows:

(a) The Current Trend Model

This is the case when the central district of Medan City consisting of 4 kecamatans which is called as Internal Study Area in this study, is assumed to grow in population and nature continuously following the current growth trend, particularly without being controlled by policy-wise measure legislatively. Consequently, such a vision in 2000 A.D. is expected to hold a high night-population density with mingling of working places and residences in the Internal Study Area.

(b) The CBD Redevelopment Model

In this land-use model it is proposed to open the railway properties presently occupied by freight yard, locomotive depot and warehouses for the purpose of urban redevelopment by relocating freight facilities and simplifying the existing railway station, intending to decrease the night population density by flowing out to the peripheral area and to increase the day-population in the Internal Study Area by people commuting from outside of the central district.

In this study, viewing from the fact that Medan Area is expected to function as the central city of Sumatra in its legislation, administration, culture as well as in economy, the CBD Redevelopment Model in land-use pattern is considered favorable from the viewpoints of urban transport planning for the year 2000 A.D. as well as of genuine urban planning. Consequently, strengthening of urban transport network particularly improvement of those facilities for the benefits of commuters are essential for the future development of the Area.

The future population frames for those both land use models are shown by study area in the following table 2.

Table 2 Planning Parameters by Study Area

(Unit: 1,000 persons)

Study Area	Planning Parameters	1978	1985	2000 A.D.	
				Current Trend Model	CBD Re-development Model
Core District (277 Ha)	Residential Pop.	50.8(183)	56.7(205)	75.9(274)	59.6(215)
	No. of Jobs	49.8	56.5	70.2	96.8
	Employed Pop.	14.1	15.7	22.7	18.0
	Excessive Flow-in Commuting Workers	35.9	40.8	47.5	78.8
	Students (studying place)	4.3	5.2	7.7	5.6
	Students (residing place)	3.5	4.7	6.5	4.9
	Excessive Flow-in Commuting Students	0.8	0.5	1.2	0.7
	Day-Time Pop.	87.3(315)	98.0(354)	124.6(450)	139.1(500)
Internal Study Area Outside Core District (4,863 Ha)	Residential Pop.	677.1(139)	779.4(160)	1,056.0(217)	911.1(187)
	Number of Jobs	176.7	313.5	480.1	453.5
	Employed Pop.	188.3	217.0	316.9	273.2
	Excessive Flow-in Commuting Workers	11.6	96.5	163.2	180.3
	Students (studying place)	51.4	68.7	103.0	85.0
	Students (residing place)	47.0	63.1	89.6	77.5
	Excessive Flow-in Commuting Students	4.4	5.6	13.4	7.5
	Day-Time Pop.	699.9(138)	881.5(181)	1,232.6(253)	1,098.9(226)
Intermediate Study Area (21,380 Ha)	Residential Pop.	526.2(19)	804.9(38)	1,163.8(54)	1,325.0(62)
	Number of Jobs	102.7	110.0	223.5	249.1
	Employed Pop.	117.1	194.6	328.4	37
	Excessive Flow-in Commuting Workers	14.4	84.6	104.9	6,127.7
	Students (studying place)	5.0	52.0	96.6	6.7
	Students (residing place)	8.4	54.3	105.0	118.7
	Excessive Flow-in Commuting Students	3.4	2.3	8.4	2.0
	Day-Time Pop.	508.4(30)	718.0(36)	1,050.5(49)	1,195.3(56)
Kot. Medan Total (26,520 Ha)	Residential Pop.	1,254.1(47)	1,641.0(62)	2,295.7(87)	2,295.7(87)
	Number of Jobs	329.2	480.0	773.8	799.4
	Employed Pop.	319.5	427.3	668.0	668.0
	Excessive Flow-in Commuting Workers	9.7	52.7	105.8	131.4
	Students (studying place)	60.7	125.9	207.3	207.3
	Students (residing place)	58.9	122.1	201.1	201.1
	Excessive Flow-in Commuting Students	1.8	3.8	6.2	6.2
	Day-Time Pop.	1,265.6(47)	1,697.5(64)	2,407.7(91)	2,433.3(92)

Notes: (1) Figures in blacket show population density (Unit: inhabitants/ha)

(2) Employed Population and Number of Jobs: Sector II and III only.

4. Comparison of Alternative Improvement Plans

Being based on the afore-mentioned planning concepts the alternatives of improvement plan of the existing transport facilitels are formulated in this study following three evaluating steps:

(First Step) The original classification of alternatives under the basic mutual relationship among the land-use pattern, the participation of railway in urban transport or not, mutual relativity between railway and roads particularly in the central district.

Seven alternatives were formulated and the Alternative No. 5 was selected as the optimum among them.

(Second Step) The classification based on the road motorization grades in the private-vehicle traffic. Alternative No. 5 was developed into Alternative 5-A (High motorrization) and Alternative 5-B (Low Motorization). Alternative 5-B was selected as the optimum among those two.

(Third Step) The classification from the viewpoint of railway operating conditions of three types, such as Case 5-B-1, Case 5-B-2, and Case 5-B-3 were formulated. Case 5-B-3 was selected as the optimum plan to be studied further in details. And Case 5-B-2-1 and Case 5-B-2-2 were developed from Case 5-B-2 for the final comparison with Case 5-B-3.

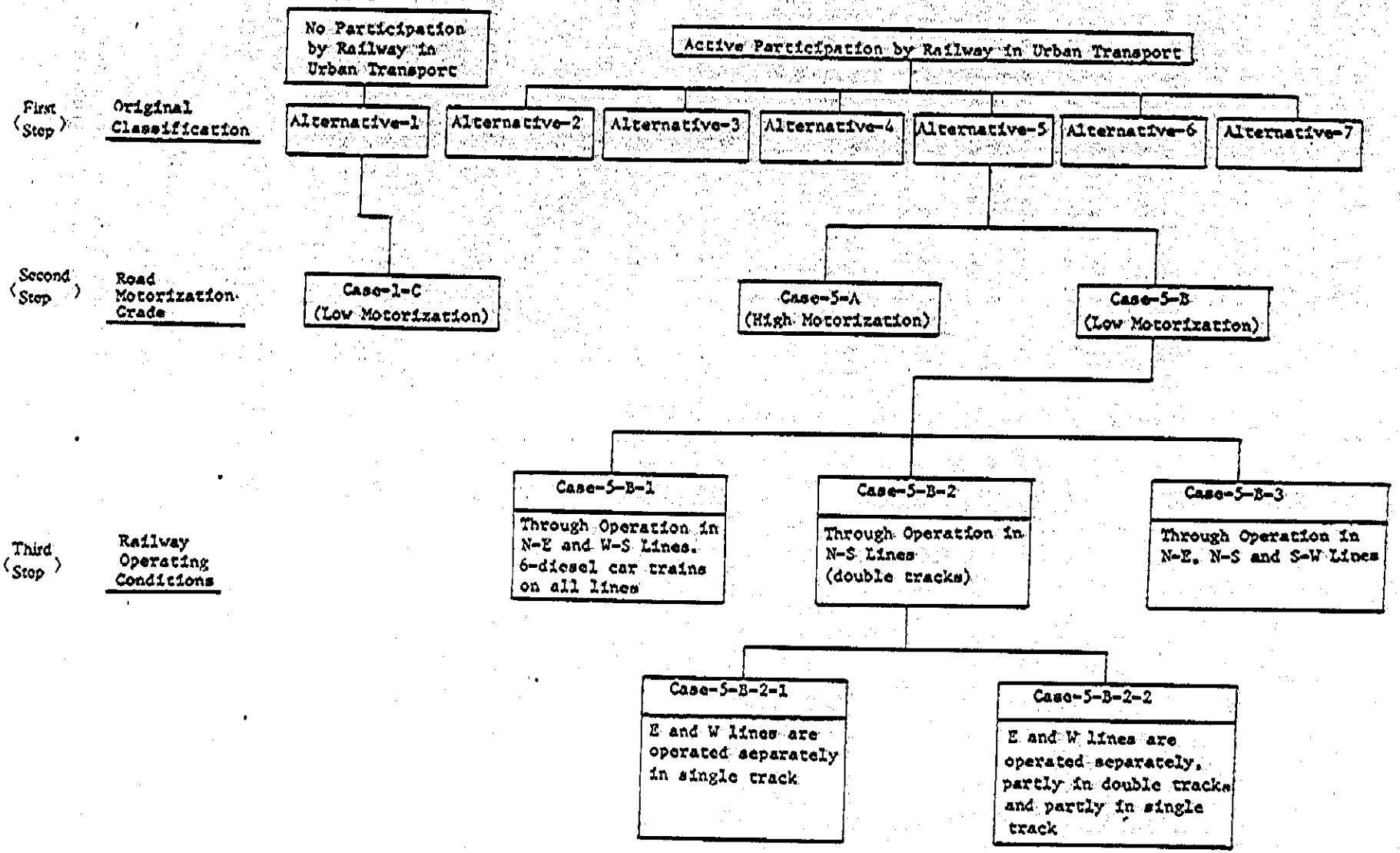
Fig. 1 shows the selecting process of optimum Plan out of various alternatives.

(1) Components of Evaluating Categories and Items of Alternatives in Urban Transport Planning

Following categories and items to evaluate improvement alternatives of the existing urban transport facilities are considered:

(Categories)	(Items)
a) Land-use pattern:	- Current Trend Model, or
	- CBD Redevelopment Model
b) Railway Participation in urban transport service:	
	- Railway does not participate at all, or
	- Railway participates actively.
c) Major Improvement Items in case of railway participation:	
	- Strengthening of service (Reopening of Pancur Batu Line and Batu Line);
	- Separation of freight handling facilities from passenger handling facilities:

Fig. 1 Selecting Process of Optimum Plan out of Alternatives



(i) Relocation of freight yard, warehouses, and locomotive depot from Medan Station to peripheral areas of the city;

(ii) Construction of a detouring line for freight trains of the Eastern line.

(iii) Remodelling of Medan Station into a central passenger station.

- Solutions for grade-crossing problems of railway line in the CBD.

(i) Mainlines in the CBD remain at grade with improved safety devices at crossings; or

(ii) Continuous elevation of mainlines in the CBD; or

(iii) Complete removal of mainline in the CBD accompanied by relocation of Medan Station for urban redevelopment of freed railway right-of-way.

d) Major Improvement Items of Road Network and Related Facilities:

- Strengthening of the urban road network by widening of existing arterial roads, intensifying traffic control signalling and construction of flyovers at important road intersections;

- Completion of the remaining portion of Outer Ring Road;

- Tollway operation of Outer Ring Road;

- Establishment of a bus-lane in each direction on arterial roads in peak hours during week days;

- Providing railway station plazas for convenient transferring between bus and railway;

- Construction and/or relocation of bus terminals;

- Establishment of truck terminals accompanied with warehouses.

e) Improvement Items of Road Transport System:

- Rationalization of bus operating organizations;
- Strengthening and adjustment of existing bus route network;
- Opening new circulating bus routes linking laterally the existing bus routes radiating from the center of the CBD;
- Strengthening of bus fleet, replacing Bemo and Daihatsu with mini-buses, and replacing becak with taxi;
- Strengthening bus motor pools and repair shops.

(2) First Step in Evaluation of Alternatives

In this evaluation of alternatives for the year 2000 A.D. a macromatic trend of alternatives was sought for by taking into consideration (a) Land-use pattern, (b) railway non-participation or participation in the urban transport service of Medan area, (c) major improvements in railway in case of its active participation, (d) major improvements in roads and (e) improverents of raod transport system. Seven alternatives concepts were formulated for comparison as shown in Table 3. Summary of Combinations of Evaluating Categories in Original Alternative Classification, Table 4 'Summary of Improvement Alternative Concepts in Original Evaluation' and Figs. 2 to 8 and the Comprehensive Road Network Proposed for 2000 A.D. as shown in Fig. 9.

The most important category in those alternatives is how to solve the grade-crossing problem of railway existing in the CBD because the existence of those crossings is posing one of the major causes of traffic jams presently taking place in the CBD, which is expected to become more serious in future because of the anticipated noticeable increase of urban trains as well as of road traffic, when the daily total closing time of each of those crossing will increase from the present 30 minutes up to several hours in 2000 A.D. unless any drastic measure is taken to solve the problem.

Alternative Case-5 was selected as the optimum solution out of those seven alternatives from such point of views.

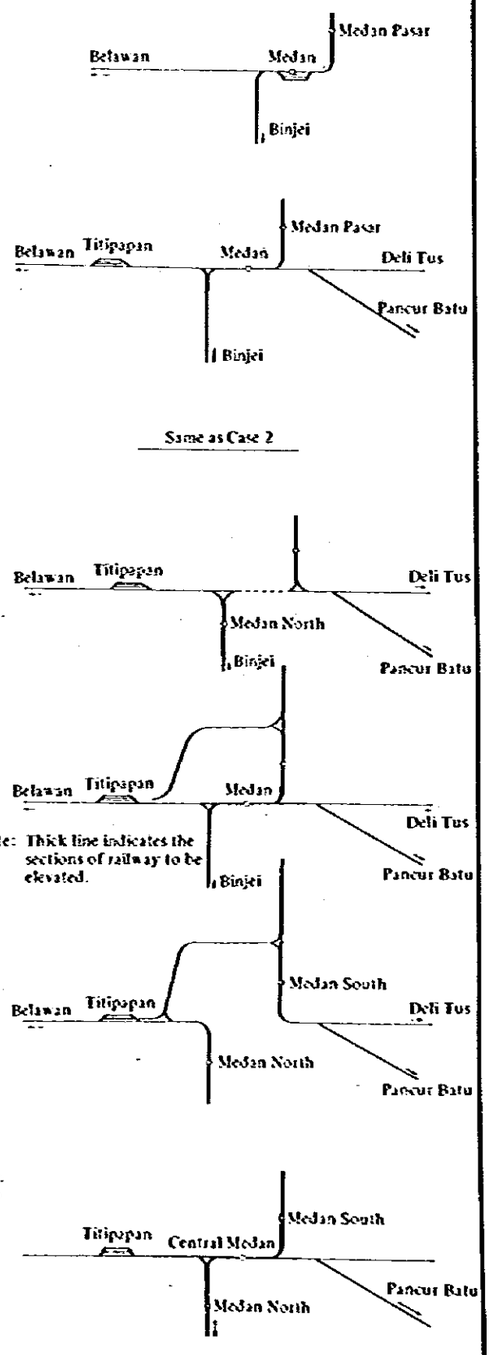
Table 3 Summary of Combinations of Evaluating Categories in the Original Alternative Classification

Land-Use Pattern	Participation by Railway in urban	Railway Lines in Central Business District		Reopening service on South Lines	Relocation of Medan Station	Relocation of Freight Yard, Loco. Shed, etc.	Sharing urban traffic demand by road network	Alternative Plan
Current Trend Model	No	Remain unchanged at grade	Passenger and freight trains are operated as at present.	No	No	No	Bears all urban traffic	Case 1
	Yes	Remain unchanged at grade	Passenger and freight trains are operated as at present.	Yes	No	Yes	Shares urban traffic with railway.	Case 2
CBD Re-development Model	Yes	Remain unchanged at grade	No passenger train is operated. Freight trains are operated only at night.	Yes	Yes	Yes	Shares urban traffic with railway.	Case 4
	Yes	Roads fly over railway.	Passenger and freight trains are operated as at present.	Yes	No	Yes	Shares urban traffic with railway.	Case 3
	Yes	Is elevated but the existing line still remains at grade	Passenger trains are operated on elevated line, freight trains are operated at grade only at night.	Yes	No	Yes	Shares urban traffic with railway	Case 7
	Yes	Is elevated. A detouring line for freight trains is built.	Passenger trains are operated on elevated line, freight trains detour the city.	Yes	No	Yes	Shares urban traffic with railway	Case 5
	Yes	Is removed completely.	No train is operated in the CBD, and freight trains detour the city.	Yes	Yes	Yes	Shares urban traffic with railway.	Case 6

Table 4 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 nuisance 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



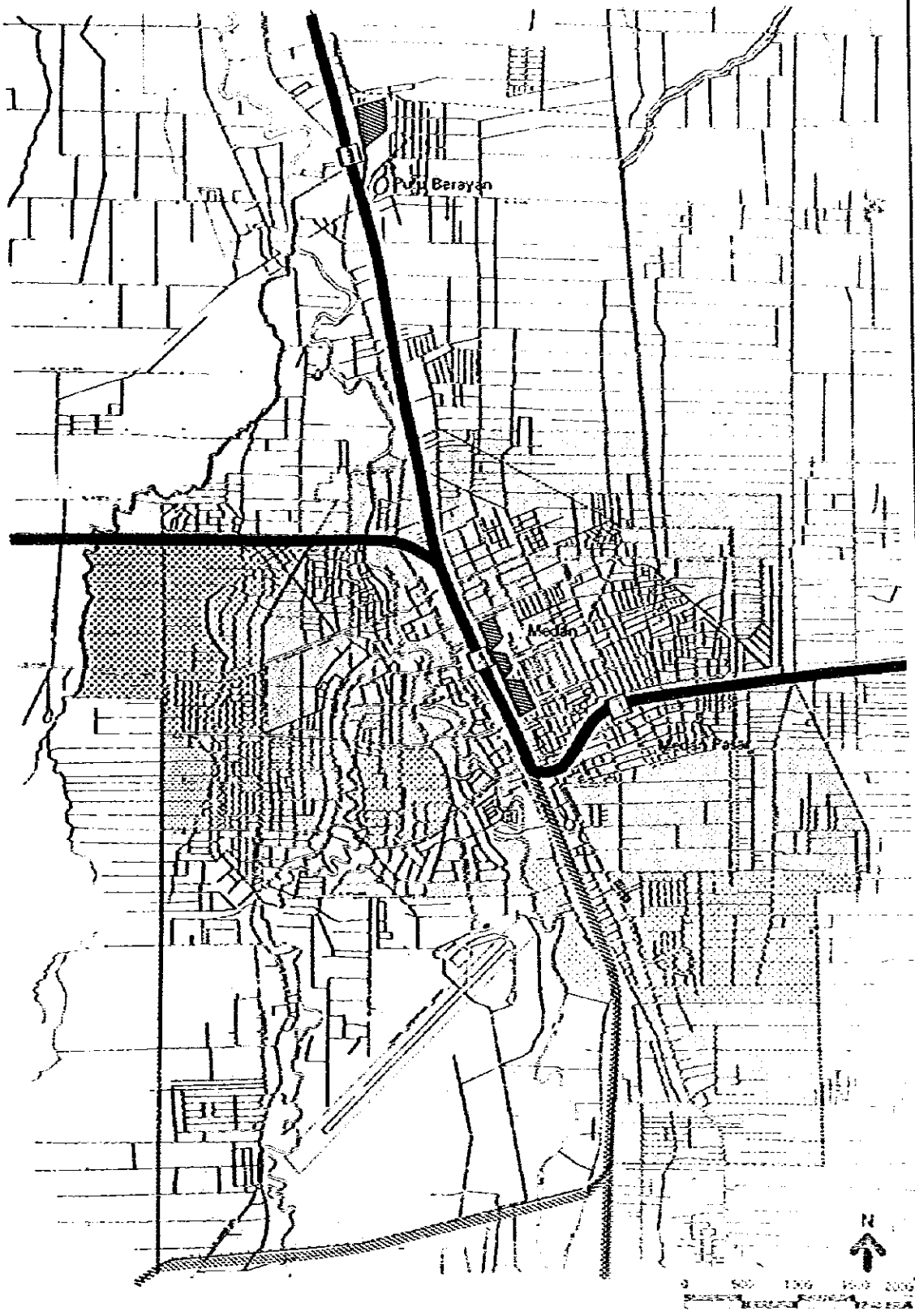


Fig. 2 Alternative Case 1

Medan Area Transportation Study

Railway, in grade

Railway, not in use

Railway Station

Railway related facilities

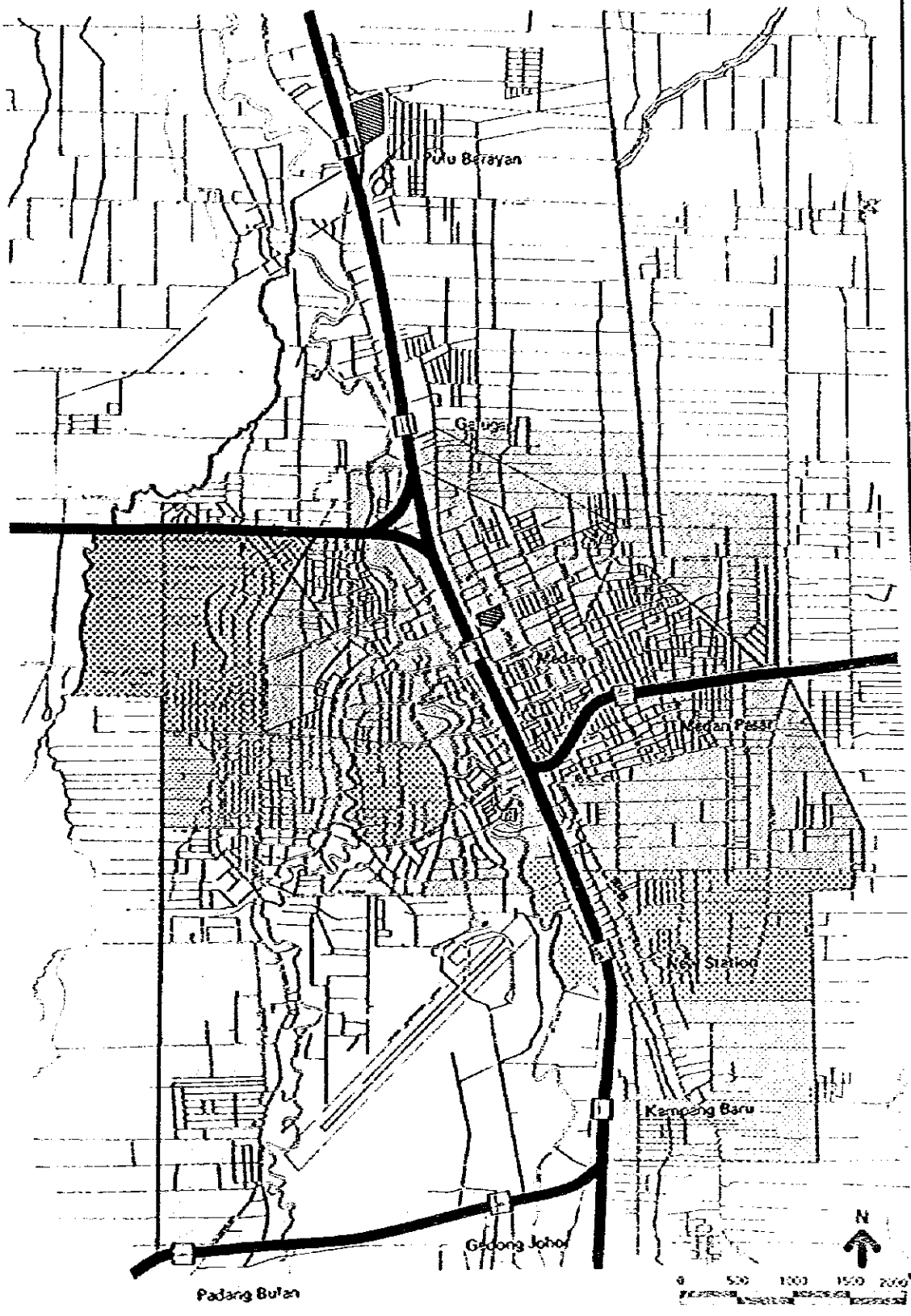


Fig. 3 Alternative Case 2

Medan Area Transportation Study

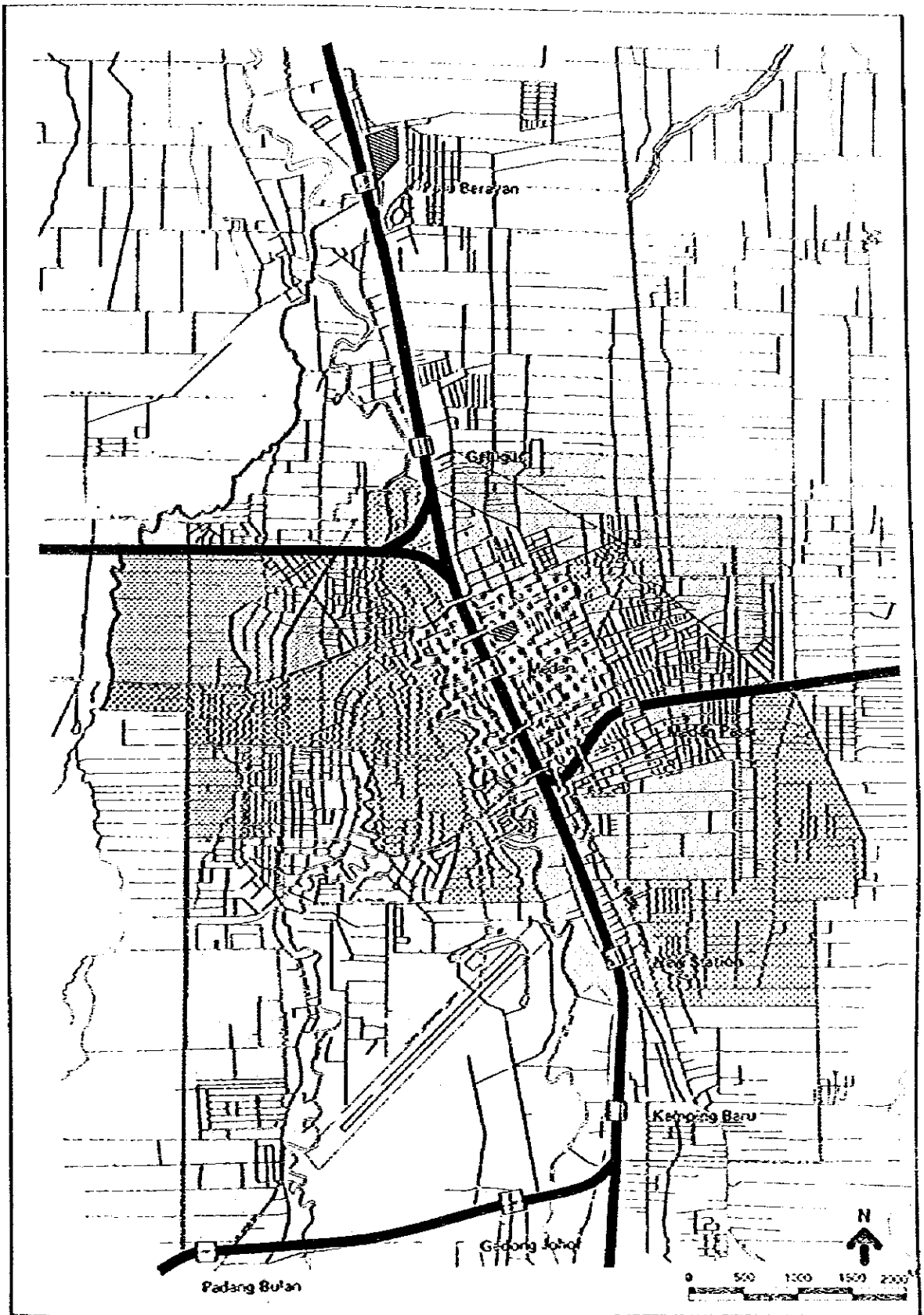


Fig. 4 Alternative Case 3

Medan Area Transportation Study

Railway, at grade
Railway station
Railway related facilities
Flyover of railway

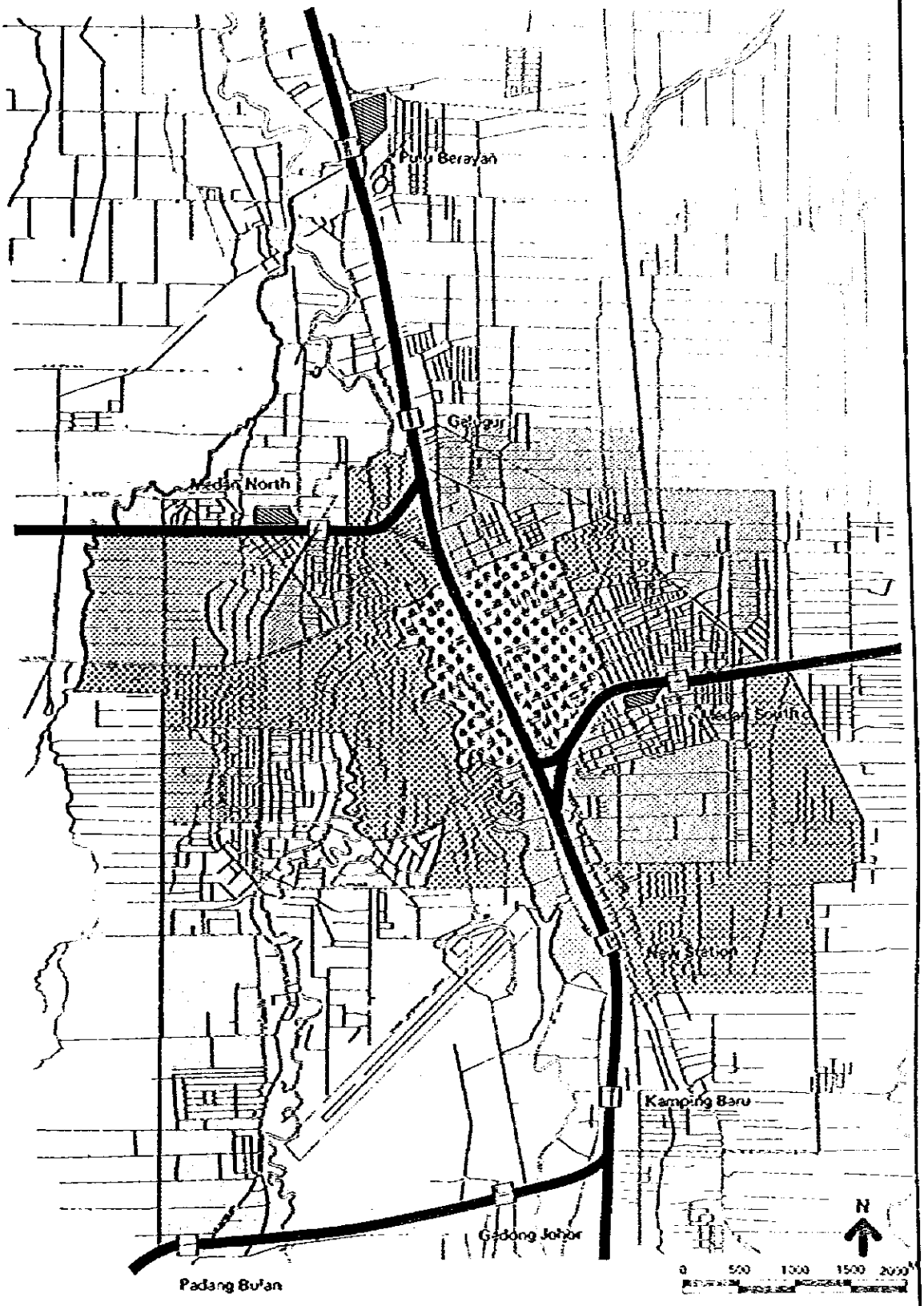


Fig. 5 Alternative Case 4

Medan Area Transportation Study

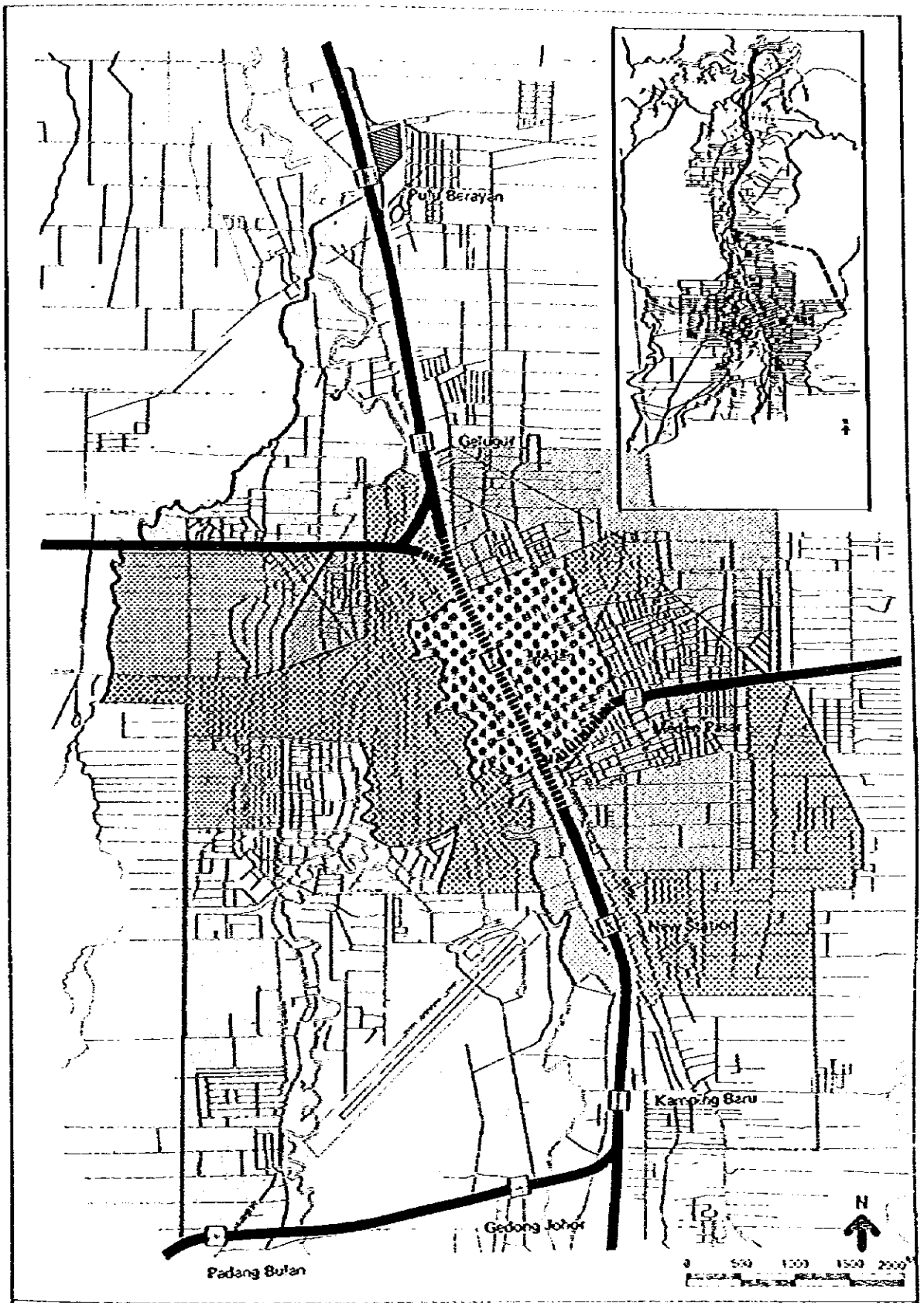


Fig. 6 Alternative Case 5

Medan Area Transportation Study

S-18

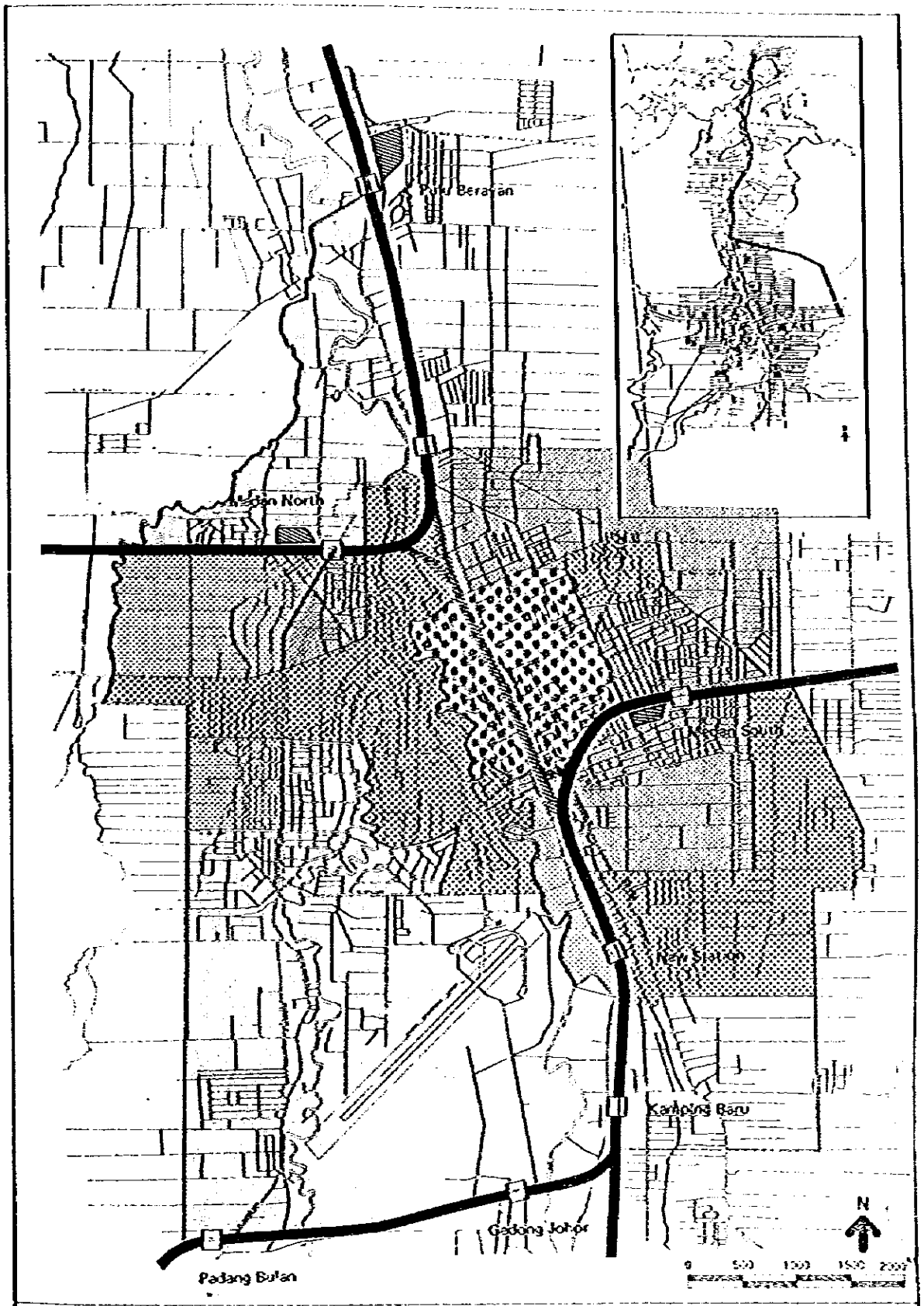


Fig. 7 Alternative Case 6

Medan Area Transportation Study

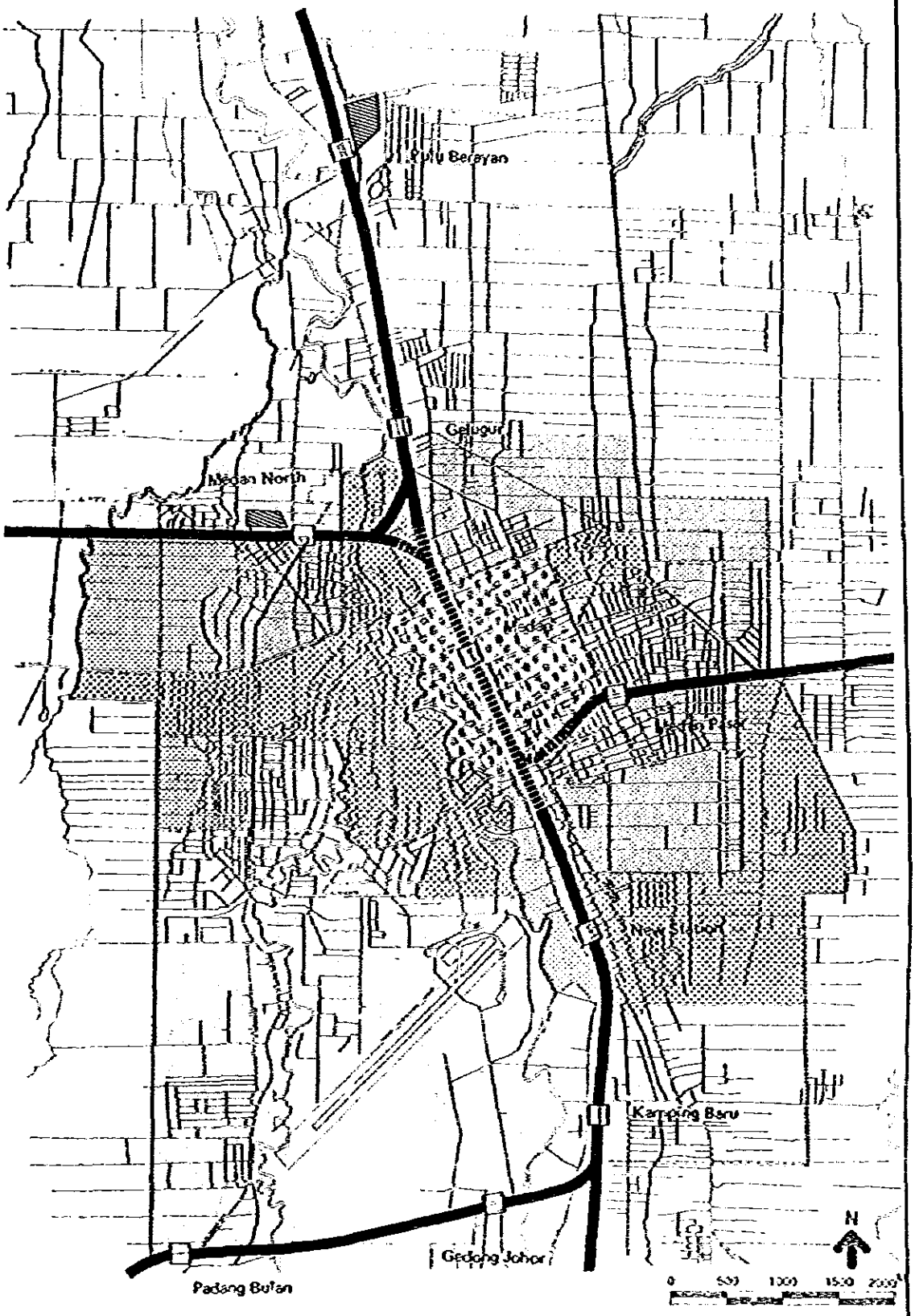


Fig-8 Alternative Case 7

Legend

Railway, at grade

Railway, Elevated

Railway station

Railway related facilities

Medan Area Transportation Study

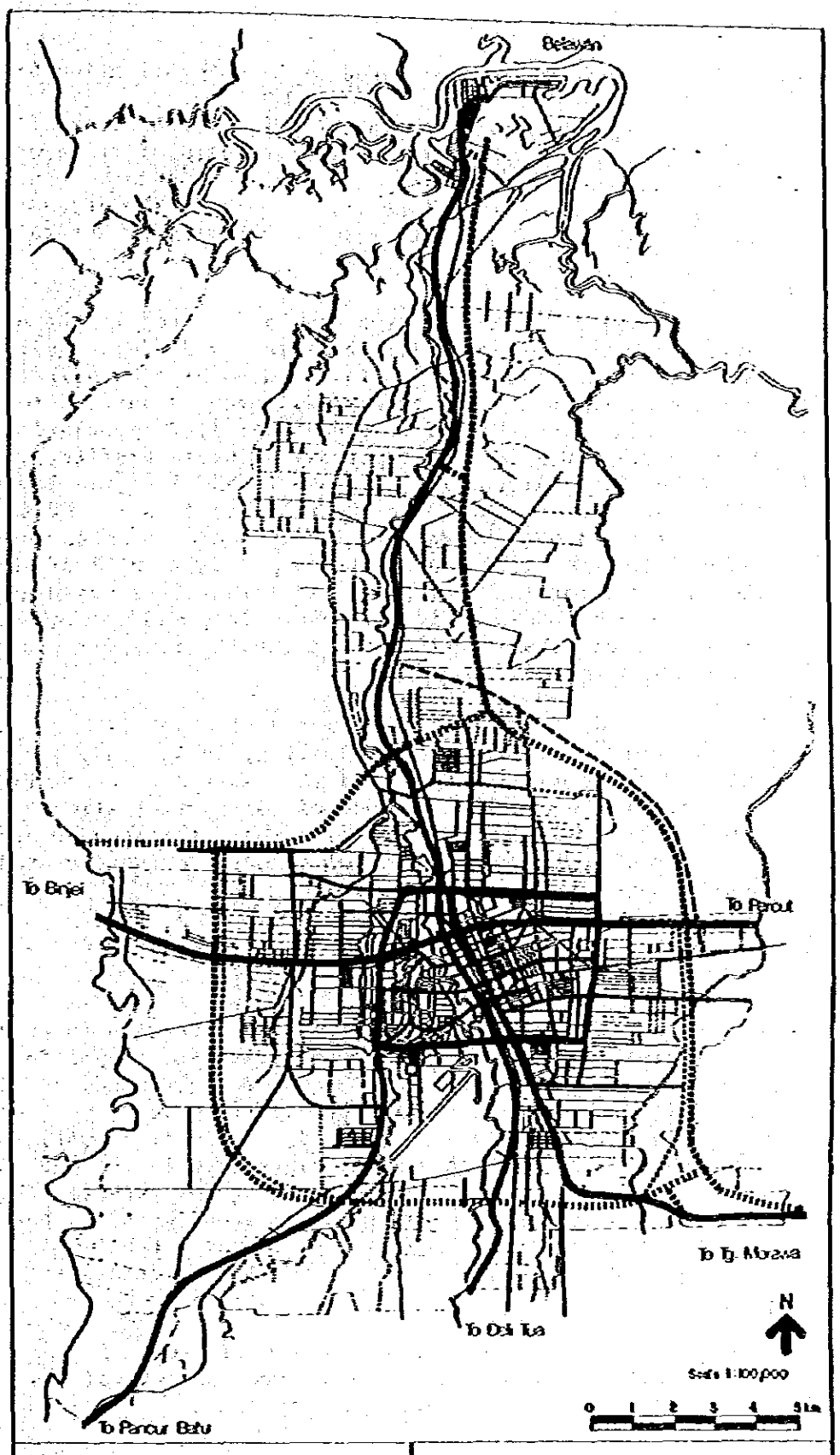


Fig. 9

Proposed Road Network (Long Term)

Medan Area Transportation Study

Legend

- Tollway
- Major Arterial Road
- Arterial Road
- Frontage Road
- Railway, detouring line

(3) Second Step in Evaluation based on Road Motorization Grades

High and low motorizations in the private-vehicle traffic present alternative cases of different numbers of trips per day per citizen due to the utilization of sedans to be controlled according to the national policy to enhance the dependence of urban traffic on the public transport system or not to be controlled at all.

In this evaluation Alternative Case-5 selected in the original evaluation was developed further into two different alternatives; namely, Alternative Case 5-A is based on high motorization, in which case the number of sedans will grow in natural tempo up to the sedan ownership of 66 sedans per 1,000 population, which induces 2,198.0 x 10^3 trips per day of urban traffic, while on the other hand Alternative Case 5-B is based on the low motorrization, in which the sedan ownership reaches to the same level as in Case 5-A but the daily trips by sedan is intentionally reduced down to 1,676.5 x 10^3 trips per day, 76.2% of the former, by enforcing appropriate administrative measures timely to be taken by Medan Municipal Government, and consequently the dependence of urban traffic on the public transport system is expected to enhance.

In this evaluation Alternative Case 1-C, which is a development from Case-1 in the original evaluation, is set only for comparison purpose as an alternative of the extreme case in which the road traffic is heaviest because of non-participation by railway in urban transport service and also there is taken no appropriate administrative measure to control on using private vehicle in the CBD at all under low motorization.

The detailed contents of high and low motorizations are compared in Table 5.

The establishment of a bus lane on each direction in peak hours on arterial roads in case of low motorization responding to the traffic demands aims at also to enhance the dependence of urban transport demand on the public transport system. Such establishment of bus lanes should be carried out simultaneously together with taxation on private vehicle registered in the CBD and their licensing restriction, entry-limit zoning for private vehicle, limiting the number of passengers per sedan entering the CBD, charging higher parking fee in the CBD and establishing public parking spaces, etc., which are described in details in later chapter.

From such points of veiw in this evaluation Case 5-B was selected as the optimum out of three alternatives because of its high dependence on the public transport system.

Table 5 Comparison of High and Low Motorizations

	Item	Low Motorization	High Motorization
a)	Estimated number of sedan ownership (units/1000 population)	66	66
b)	Total number of trips by sedans (trips x 10^3/day) *(1)	1,676.5	2,198.0
c)	Railway travel speed (k.p.h.) (10 minutes headway in peak hours)	40 - 45	40 - 45
d)	Bus travel speed (k.p.h.) (5 minutes headway in peak hours)	30 *(2)	25
e)	Vehicle travel speed on other lanes	0.8V *(3)	V
f)	Modal split curve	Apply the same curve.	

Note: *(1) Figures of trips do not include trips by sedans within zones.

*(2) Speed only on bus lane.

*(3) The reduced travel speed of vehicles on other lanes due to the establishment of a bus lane in each direction on arterial roads. V (k.p.h.) is the travel speed characteristic of the said street.

(4) Third Step in Evaluation based on Railway Operating Conditions

Alternative Case 5-B was further developed into three different alternatives according to the railway operating conditions as shown below:

- Which lines are to be operated with through trains and which lines should originate and terminate at Medan Station among four railway lines radiating from Medan Station;

- Two platforms system with four platform tracks or three platforms system with six platform tracks at Medan Station; and

- Efficient rolling stock utilization plan, etc.

Case 5-B was developed into Case 5-B-1 with the through operation between the north and east lines and between the west and south lines on double tracks respectively, Case 5-B-2 with the through operation between the north and south lines of double tracks and the east and the west lines of as single track or partly double-tracked on which trains orginate and terminate at Medan Station, and Case 5-B-3 with through operation between the north and the south lines of double tracks, between the north and the east lines, and between the south and the west lines.

Case 5-B-2 was further developed into two different alternatives according to the condition of the east and west lines whether they remain as single line or partly double tracked. Substantially the four alternatives were formulated such as Case 5-B-1, Case 5-B-2-1, Case 5-B-2-2 and Case 5-B-3. They are compared in details in Table 6.

From this table Case 5-B-3 is optimum from the economy of construction and train operation and the smallest number of estimated transferring passengers at Medan Station.

Item / Alternative	Schematic Track Plan	Train composition	Train Operation System	Total Length of Lines to be operated. (unit:km)	No. of Transfer Passengers at Medan Station (unit:10^3 persons/day)
Case-5-B-1	(Unit: 10^3 persons per day) Northern Line 24.1km 63.1 Western Line 20.9km 9km 85.1 Medan Eastern Line 9.4km 20.1km 4.5km 19.4km 14.7km Southern Line	Each train consists of 6 diesel rail-cars on all lines.	Through operation between Eastern & Northern Lines. Through operation between Western & Southern Lines.	Northern Line: 45.7 Southern Line: 48.6 Eastern Line : 29.5 Western Line : 29.9 Total :153.7	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-5-B-2 / Case-5-B-2-1	N 85.1 W 46.7 Medan 46.0 E 85.1 S	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-5-B-2 / Case-5-B-2-2	N 85.1 W 46.7 Medan 46.0 E 85.1 S	Each train consists of 6 cars on all lines.	Operation System: Same as Case-5-B-2-1 Partly Double Tracks in Eastern & Western Lines.	Same as Alternative-1 Total :153.7	Same as Case-5-B-2-1 Total :60.3
Case-5-B-3	N 46.0=38.4=84.4 W 46.7 Medan 46.0 E 46.7=38.4=85.1 S	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

5. Traffic Demands

5.1 Passenger Traffic Demands

Concerning urban passenger flows in Medan Area in 2000 A.D. the person-trip O-D table was formulated based on the land-use and the population frame, and the passenger traffic by modes of transport were calculated by multiplying the rate of modal split to the figures of person-trip O-D Table. (Refer to Fig. 10, Table 7 and 8) The passenger person-trips were of course calculated in both cases of high motorization as well as of low motorization.

(a) Total Person-Trips in 2000 A.D.

The total person-trips of Medan Area was calculated at 5,585,600 trip-ends per day.

(b) Modal Split (Refer to Fig. 10)

(i) Private Transport Person-Trips

The generated and attracted number of trip-ends by private transport in passenger flows are separated from other modes in the stage of calculation of generated and attracted traffic in trip-ends Model. This is because the possession of private vehicles means a kind of social status-symbol in this area which can be expected to continue even in 2000 A.D.

(ii) Public Transport Person-Trips

Trip-ends of other modes than private one are separated in the beginning and they are also splitted into bus and railway.

(iii) Taxi Person-Trips

The share of taxi in public trnasport is difficult to calculate by modal split curve, it is determined by assuming its rate of share.

(iv) Becak Person-Trips

It is basically assumed to take a policy to abolish Becak by the year 2000 A.D. in the city area, but it is considered that it will remain in the peripheral areas of the city. The volume of trip-ends by Becak is not possible to calculate numerically.

(v) Bemo and Daihatsu Person-Trips

The existing Bemo and Daihatsu are expected to remain in 1990 as of modes not competing with the bus system, but they are expected to be replaced completely by mini-buses of about 30 seats by the year 2000 A.D.

The person trip-ends by modes of transport in 2000 A.D. were calculated based on the concepts afore-mentioned as shown in Table 7 'Estimated Daily Traffic Demands by Mode of Transport in 2000 A.D. for Three Alternative Cases.'

Table 7 reveals the high dependence on the public transport system in the case of low motorization (Case 5-B) compared to the case of high motorization (Case 5-A). This is due to the fact that the urbanized area of Medan Area in 2000 A.D. is expected within the range of 5 to 7 km radius from the center of the central district for the population size of 2.3 millions, consequently the average trip distance does not grow noticeably from the current situation, and that the importance of railway and bus in the urban transport service is expected to be of such average trip distances as shown Fig. 11 'Estimated Trip Distribution in 2000 A.D.' in which the average trip distances are 13.0 km in railway, 8.0 km in bus and 11.0 km in sedan.

Fig. 10 Flow Chart of Modal Split by Binary Choice Method

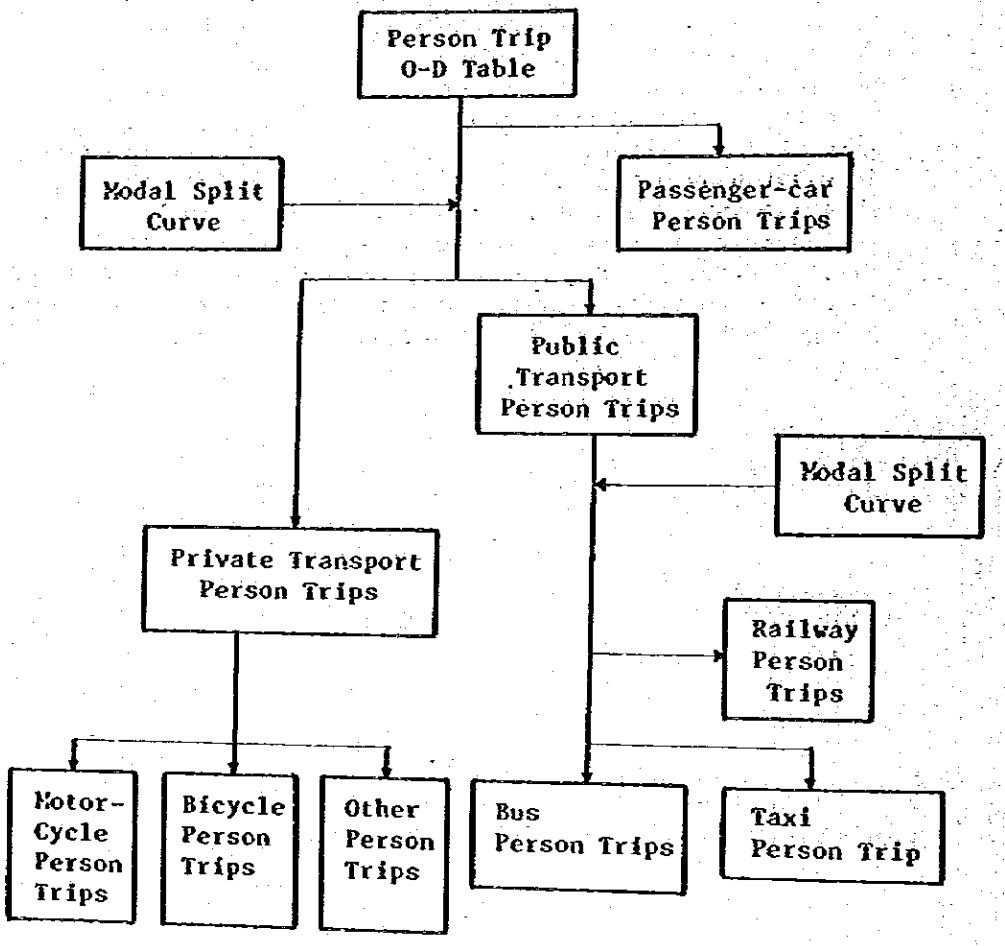


Table 7 Estimated Daily Traffic Demands by Mode of Transport in 2000 A.D. for Alternative Case

(Unit: Trip Ends x 10^3/day)

		Case 1-C	Case 5-A	Case 5-B
Public	Railway	(0)	230.0 (4.1)	377.6 (6.9)
	Bus	2,166.9 (38.8)	936.0 (16.8)	1,789.3 (31.9)
	Taxi Cab	230.1 (4.1)	324.4 (5.8)	230.0 (4.1)
	Sub total	2,396.9 (42.9)	1,490.4 (26.7)	2,396.9 (42.9)
Private	Sedan	1,676.5 (30.0)	2,198.0 (39.4)	1,676.5 (30.0)
	Motorcycle	1,110.0 (19.9)	1,392.5 (24.9)	1,110.0 (19.9)
	Bicycle	402.2 (7.2)	504.7 (9.0)	402.2 (7.2)
	Sub Total	3,188.7 (57.0)	4,095.2 (73.3)	3,188.7 (57.0)
Grand Total		5,585.6 (100.0)	5,585.6 (100.0)	5,585.6 (100.0)

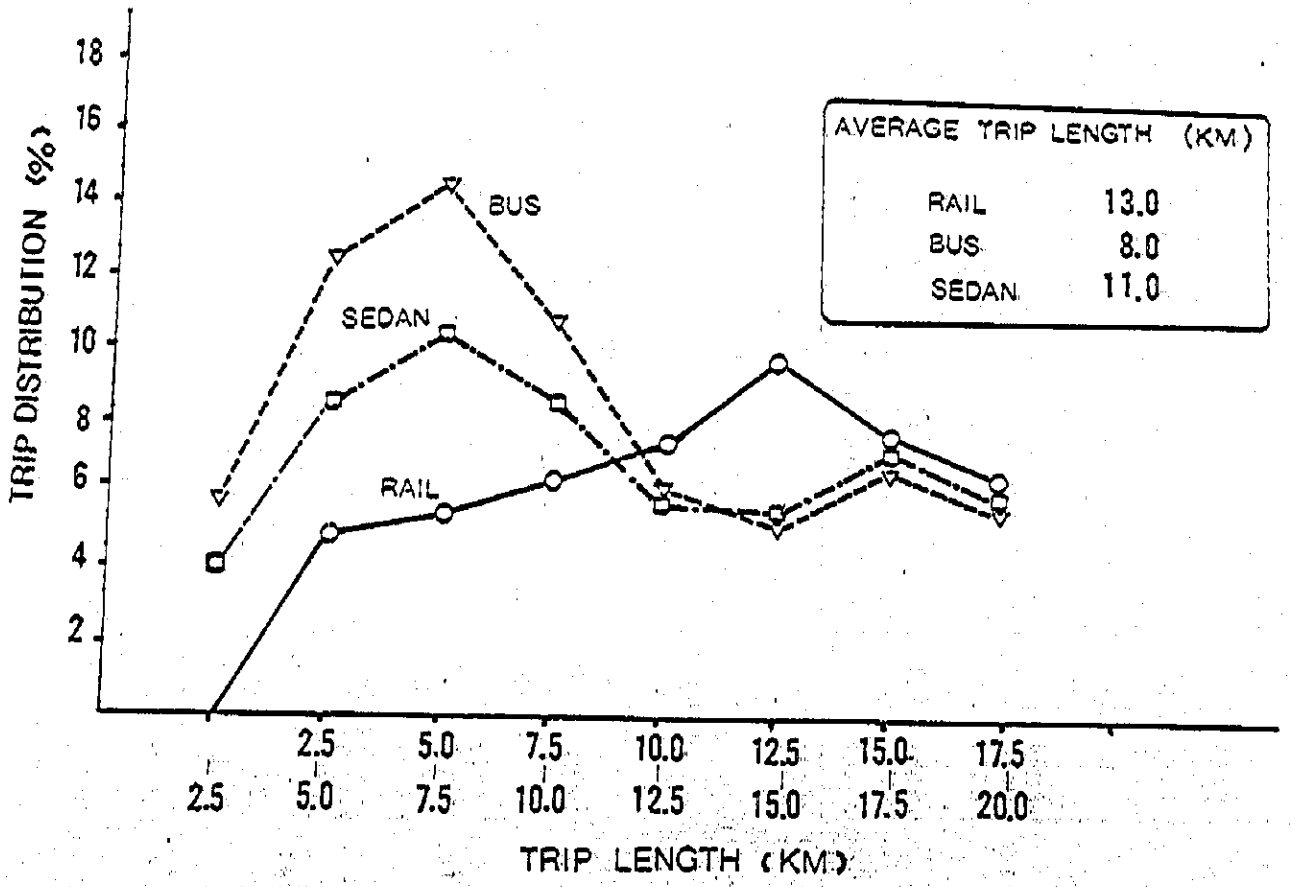
Table 8 Estimated Traffic Demands in Peak hour by Mode of Transport in 2000 A.D. for Alternative Case

(Unit Trip Ends x 10^3/peak hour)

		Case 1-C	Case 5-A	Case 5-B
Public	Railway	(0)	64.1 (9.6)	95.8 (14.3)
	Bus	342.6 (51.1)	141.6 (21.1)	246.8 (36.8)
	Taxi Cab	22.1 (3.2)	34.1 (5.1)	22.1 (3.2)
	Sub Total	364.7 (54.3)	239.8 (35.8)	364.7 (54.3)
Private	Sedan	160.7 (24.0)	231.1 (34.5)	160.7 (24.0)
	Motorcycle	106.4 (15.9)	146.4 (21.8)	106.4 (15.9)
	Bicycle	38.5 (5.8)	53.0 (7.9)	38.5 (5.8)
	Sub Total	305.6 (45.7)	430.5 (64.2)	305.6 (45.7)
Grand Total		670.3 (100.0)	670.3 (100.0)	670.3 (100.0)

Note: (1) In both tables the internal trips within zones are excluded.
(2) Figures in bracket are expressed in percentage.

Fig. 11 Estimated Trip Distribution in 2000 A.D. Medan Area



5.2 Freight Traffic Demands

The concepts, on which the figuring out of freight traffic demands in 2000 A.D. is based, are as follows:

(a) The railway freight traffic demands were based on the figures used in the improvement plans formulated in 'North Sumatra Transportation Study' and no analysis was made on this respect.

(b) The freight traffic to be shared by the road system was classified into such two parts as those concerned to Port of Belawan and the rest.

The estimated truck traffic thus classified are tabulated in Table 9.

Table 9 Estimated Truck Traffic in Medan Area

(Unit: truck unit)

Classification	1978	1985	2000
To/from Port of Belawan	4,142	8,900	24,000
Others	61,228	97,000	218,000
TOTAL	65,430	106,000	243,000

6. Evaluation

As alternatives were formulated in three steps as mentioned in Chapter 4, consequently the evaluation on them are made in three steps as follows:

6.1 Evaluation of the First Step

Evaluations made in the first step are based, on various factors of basic relationship between the railway system and the road system, in which it was emphasized from the viewpoint of how the urban transport in Medan Area should be in the long-term:

(a) From the viewpoint of Land-Use Pattern

The Current Trend Model and the CBD Redevelopment Model were compared, and the latter model was found preferable because it is expected in the land-use plan of Medan Area in 2000 A.D. that the latter enables the improvement of the existing urban environmental conditions by means of clear separation of land by their single uses instead of combined uses.

(b) Railway Participation in Urban Transport Service

From the viewpoint of strengthening of the existing public transport system and also from the population size of the area in future, it is essential to fully utilize the existing railway facilities in order to handle the estimated future urban traffic efficiently. Such an utilization of existing railway facilities is also evaluated in the second step of evaluation based on road motorization grades.

(c) Continuous Elevation of Railway in the CBD

In the case that the railway participates actively in the urban transport service it is expected that the train frequency in all lines in Medan Area will heavily increase besides the increase of road traffic in the area, and the problem of how to handle both modes of such a large traffic at grade in the CBD will become the core problem in the urban transport planning. The measure to solve this problem can be effectively attained by the continuous elevation of railway in the CBD, by which the railway can eliminate railway accidents at crossings, save maintenance and operating costs of crossings and increase the financial value of spaces under the elevated tracks by utilizing for railway station, concessions and vehicle parking, etc., and also the citizens can be benefitted tremendously by eliminating traffic jams to be caused at crossings, by saving vehicle operating costs as well as time costs, thus, making easy access between both sides of the railway will benefit both the railway and the city; consequently, the implementation of railway elevation in the CBD

should be strongly promoted because this improvement is expected to bring about the largest benefits to the Medan Area as a whole.

(d) Financial Point of View on Construction Costs

The cost comparison of the core problem, the railway elevation in the CBD, reveals that there exists not a large difference between the cost of construciton of railway elevation and that of road flyovers at six locations instead of railway elevation. (Refer to Table 10)

(e) Road Improvement Point of View

From the road improvement point of view the decisive evaluation cannot be made in the original evaluation of alternatives but it shall be made from the financial point of view of construction costs, and results in the same evaluation of item (d).

(f) Other Viewpoints

Concerning other viewpoints of evaluation are also presented in Table 11: 'Evaluation Matrix of Improvement Alternatives'

From the results of evaluation in the Original Classification the Alternative-5 is considered as the most favorable one out of seven original alternatives.

6.2 Evaluation of the Second Step

In this stage of evaluation the Alternative 5 in the original classification is further developed into two different alternatives of the cases, of high motorization and low motorization. In addition to those two alternatives, an additional alternative of non-participation of railway in the urban transport is added only for the comparison purpose. Those three alternatives are evaluated by the following evaluating categories and items:

(Categories)	(Items)
(1) Economic Analyses	(i) Construction Cost;
	(ii) Costs of rolling stock and bus units;
	(iii) Maintenance and Operating Costs;
	(iv) Number of necessary rolling stock;
	(v) Number of necessary bus units;
	(vi) Benefits due to saving in passenger-hours;
	(vii) Cost-Benefit Ratio.

Table 10 Summary of Railway Improvement Costs of Seven Improvement Alternatives

Unit: Rp x 10^6

	Quantity	Case 2	Case 3	Case 4	Case 5	Case 6	Case 7
		Railway Crossings at Grade	Railway Crossings at Grade	Railway Crossings in CBD Opened During Day-Times	Railway Track Elevated Detouring Line for Freight Trains Constructed	Railway Track removed from CBD Detouring Line for Freight Trains Constructed	Railway Track Elevated
Relocation of Freight Yard, Freight Terminals, Locomotive Depot, Diesel Car Depot, and Coach Yard	-	20,150	20,150	20,150	20,150	20,150	20,150
Rehabilitation of Southern Lines for Reopening the Passenger Services	29.2 km	10,400	10,400	10,400	10,400	10,400	10,400
Construction of Medan South Sta.	-	-	-	3,710	-	3,710	3,710
Construction of Medan North Sta.	-	-	-	3,710	-	3,710	3,710
Railway Elevation in the CBD.	2.9 km	-	19,460 *	-	23,190	-	23,190
Construction of Additional Small Stations for Passenger Services	4 stations	1,330	1,330	1,330	1,330	1,330	1,330
Improvement of Medan Sta.	-	1,690	1,690	-	-	-	-
Construction of Detouring Line for Freight Trains	17.3 km	-	-	-	18,200	18,200	-
Short-Cut Track Construction between Binejei and Belawan Lines	2.4 km	2,200	2,200	2,200	2,200	2,200	2,200
Short-Cut Track Construction between Pancur Batu Line and T. Tinggi Line	0.8 km	-	-	1,870	-	1,870	-
Total		35,770	55,230	43,370	75,470	61,570	64,690

Note: * The Cost of Road Flyovers

In this original cost comparison table following costs are excluded:

(a) Rolling stocks; (b) Improvement of Pulu-Berayan; (c) Railway Employee Housing; (d) Double tracking

(e) Railway Electrification; (f) Construction of station plaza

Table 11 Evaluation Matrix of Improvement Alternatives of Urban Transport Plan for Medan Area in 2000 A.D.

	Case 1	Case 2	Case 3	Case 4	Case 5	Case 6	Case 7
1. Redevelopment of the CBD	D	C	C	C	B	A	B
2. Effects on Road Facilities	D	A	A	C	A	C	A
3. Effects on Road Traffic Closing Time at Railway Crossings	C	D	A	B	A	A	B
4. Accessibility to the CBD by Railway Passengers	A	A	A	D	A	D	A
5. Safety Grade of Railway Crossings	C	D	A	B	A	A	B
6. Effects on Train Operation	C	C	A	D	A	B	A
7. Improvement Cost of Railway Facilities	A	B	C	B	D	D	D
8. Effects of Freight Train Operation to Urbanized Areas	D	D	D	D	A	A	D
9. Saving Energy	C	B	B	C	B	B	C
10. Utilization of railway property from the municipal points of view	D	D	D	D	B	A	C
11. Maintenance Cost of Railway Crossings	C	D	A	B	A	A	B
12. Utilization of space under elevated railway	D	D	D	D	A	–	A

Note: Characters used in indicating the grades of evaluating means from the viewpoint of urban transport planning are as follows :
A : Excellent
B : Fair
C : Poor
D : Bad

(2) Social Analyses

(i) Share of public transport;

(ii) Quantity of energy consumption;

(iii) Quantity of exhaust gas; and

(iv) Number of traffic accidents.

Table 12-A shows the summary of evaluations by those categories and items, and Table 12-B shows the same evaluations in terms of index under the premise that the values of Case 1-C are assumed as 100.

(a) Costs of Improvements and Procurements (Refer to Table 12-A)

In the total costs of improvements of transport facilities and procurement costs of rolling stock and bus units much differences cannot be found among those alternatives. But in the costs of maintenance and operating Case 5-A shows the lowest value due to the fact that the cost of private vehicles is excluded although the cost of buses is included.

(b) Necessary Number of Rolling Stock and Bus Units (Refer to Table 12-A)

The numbers of units of necessary rolling stock and buses are proportional to their procurement costs and the number of rolling stock is the largest in the Case of 5-B, and the number of bus units is largest in Case 1-C.

(c) Benefits and Cost-Benefit Ratio (Refer to Table 12-A)

In the total amount of benefits due to the savings in time cost and operating cost Case 5-B shows the largest amount; consequently Case 5-B shows the best B/C ratio.

(d) Quantity of Energy Consumption

In this evaluation on the quantity of energy consumption Case 5-A shows the largest quantity, and both Case 5-B and Case 1-C are less than Case 5-A and are almost in the same level.

(e) Traffic Accidents

The comparison is made based on the average number of death casualties per vehicle-km in Japan, and consequently, Case 5-A, which is highest in vehicle-kms, shows the highest traffic accidents and the rest two alternatives are less than Case 5-A and are in the same level.

(g) From Urban Transport Planning Viewpoints

From the urban transport planning points of view it can be safely say that it will not be appropriate to depend only the private-vehicle transportation in Medan Area in 2000 A.D. because of her estimated population size of 2.3 millions and the participation by the railway is considered essential by which the development of urbanized areas can be

promoted.

The followings are the integrated evaluation of those three alternatives:

Case 1-C

In this case it is assumed as an extreme case of non-participation of railway in the urban transport service to find out the side that has more merits, the railway or the bus system. Because of the fact that the estimated urbanized area of Medan City and its surroundings in 2000 A.D. is not large enough to receive full benefits of railway participation in the urban transport service as much as appreciated on large cities in foreign countries of similar size of population which was receiving sufficient benefits therefrom. There exists not a large difference in their economic analyses as well as in their social analyses between this case and other cases of railway participation but it is self-evident that the cases of railway participation are better than the case depending only on the bus system.

Case 5-B

This is the case that has more merits when compared to other two alternatives because the private-vehicle traffic is administratively controlled intentionally for the purpose to enhance the dependence upon the public transport system, aiming at more efficient utilization of the public transport system once investment is made thereon.

Case 5-A

This is the case which is originally to be compared to Case 5-B. In this case the private-vehicle traffic is rested on the natural growth trend without being controlled administratively. Although this case is of course favorable than the Case 1-C, the merits of controlling on the private-vehicle traffic is evident enough compared with the case without such control; consequently, the Case 5-A is inferior to the Case 5-B.

From the comprehensive evaluation of those alternatives Case 5-B, in which the public transport system is under the active participation of railway, can be regarded as the optimum alternative for Medan Area.

In the following Case 5 is further studied from the railway operating conditions.

Table 12-A Summary of Cost Comparison of Alternatives in Second Step Evaluation

			Unit	Case 1-C	Case 5-B	Case 5-A
Costs	Construction Cost		Rp. x 10^9	531.1	492.4	567.2
	Rolling Stocks and buses		Rp. x 10^9	171.4	192.1	103.5
	Sub Total		Rp. x 10^9	702.5	684.5	670.7
	Annual Maintenance & Operating Cost in 2000 A.D.		Rp. x 10^9	20.1	20.0	13.9
	Additional Number of Railway Coaches in 2000 A.D.		Unit	0	158	100
	Number of Buses in 2000 A.D.		Bus units	3,558	2,725	1,467
Benefits	Annual Time Saving Benefit in 2000 A.D.		Rp. x 10^9	219.5	284.5	280.0
	Annual Running Cost Benefit in 2000 A.D.		Rp. x 10^9	225.4	247.1	245.4
	Sub Total / Year		Rp. x 10^9	444.9	531.6	525.4
	B/C Ratio			4.66	4.80	4.46
Social Costs	Energy Consumption		Kℓ/Day	1,411	1,373	1,673
	Exhaust Gass	CO	Ton/Day	35.2	34.9	38.2
		NOx	Ton/Day	18.0	17.5	20.4
	Traffic Accidents		Person/Year	322	322	439

Notes: (1) In the category of annual maintenance and operating cost in 2000 A.D. costs of sedans are not included.

(2) Energy consumption and traffic accidents are calculated based on the estimated vehicle-kms, and figures due to the existence of crossings are not included.

Table 12-B Summary of Cost Comparison of Alternative in Second Step Evaluation (Exprised in Indice)

			Unit	Case 1-C	Case 5-B	Case 5-A
Cost	Construction Cost			100	93	107
	Rolling Stocks and and buses			100	112	60
	Sub Total			100	97	95
	Annual Maintenance & Operating Cost in 2000 A.D.			100	100	69
	Number of Railway Cars in 2000 A.D.			–	–	–
	Number of Buses in 2000 A.D.			100	77	41
Benefits	Annual Time Saving Benefit in 2000 A.D.			100	130	128
	Annual Running Cost Benefit in 2000 A.D.			100	110	109
	Sub Total			100	119	118
	B/C Ratio			100	103	96
Social Cost	Energy Consumption			100	97	119
	Exhaust Gass	CO		100	99	109
		NOx		100	97	113
	Traffic Accidents			100	100	136

6.3 Evaluation by Railway Operating Conditions

(1) Electric Operation or Diesel Operation

In the railway operation using the existing railway lines the contents of operation is different between the electric and diesel railcar-train operations. In selecting either of them should be studied taking into account the following factors:

(i) The general trend of railway operation in Indonesia;

(ii) Passenger transport demands and economy of operation;

(iii) Other conditions.

(a) General Trend of Railway Operation in Indonesia

Viewing on the general trend of railway operation in Indonesia the trend of railway electrification has begun to be observed responding to the respective local demands as seen, for instance, in the example of Jakarta Area.

(b) Passenger Transport Demands and Economy of Operation

Generally, the railway urban transport is commenced and continued with the diesel railcar-train operation while the urban passenger demands are still in moderate volume, and the optimum time of railway electrification is determined by the balance between the amount of investment to be made additionally and the difference in the costs of operation and maintenance in both types of operation.

In such evaluations the estimation of additional investment necessary for railway electrification is not difficult but in the calculation of operating cost involves such a portion which rests on the future aspect of local power situation including the power cost that cannot be estimated accurately at present. Consequently, a referencial study is made here, being based on the current power cost in Jakarta Area, from which study it is revealed that the electrification of railway in Medan Area in 2000 A.D. based on the estimated railway urban passenger demands is not fully justified economically due to the required operational frequencies are not large enough which fact induces the power consumption per coach-km remains still at comparatively high. If the railway passenger demands in Medan Area grows comparatively higher than expected in the estimation there is a possibility of lowering the power cost per coach-km to justify the electrification economically.

The following table shows the calculated rate of profitability of additional investment necessary for the railway

electrification.

Table 13 Calculation of Rate of Profitability of Additional Investment to Electify Railway Operation

(Unit: Rp x 10^6)

	Item	Electric Operation	Diesel Operation
Additional Investment	Power facilities	31,700	-
	Rolling stock	26,860	41,500
	Sub Total	(A) 58,560	(B) 41,500
	Difference (A) - (B)	17,060	
Annual Expenditure	Power cost	692	529
	Maintenance cost	658	1,494
	Sub Total	(A') 1,350	(B') 2,023
	Difference (B')-(A')	673	

The rate of profitability to electrify railway = $\frac{(B')-(A')}{(A)-(B)}$

= 0.039

The results of this calcuation means that the electrification of railway in Medan Area is not negative but not satisfactory justification. Considering the possible changes of oil situation in future the evaluation in such a way based on the current power and oil costs is considered not sufficient enough to judge this problem at present. Consequently, it is proposed to select Case 5-B-3 as the optimum urban transport master plan as the results of evaluations based on railway operating conditions.

(2) Comparative Scheme for Train Operation Planning

As a train operation system forecast for the year 2000 A.D. for transporting railway passengers, which is scheduled in Case 5-B (Fig. 12), four plans were formulated to be studied as shown in Table 6.

The merits and demerits of those plans are mentioned in Table 14.

From the comprehensive evaluating standpoint, Cases 5-B-3 and 5-B-2-2 are advantageous as reviewed above. When these two are compared, Case 5-B-3, with comparatively limited

traffic capacities over the East and the West lines, curtails various costs comprising track elevation and rolling stock by a large margin as against Case 5-B-2-2. From the standpoint of railway revenues and expenditures, Case 5-B-3 is recommendable as optimal. But Case 5-B-2-2 has the flexibility in track capacities over the East and the West lines with advantageous conditions of train operation, this plan is likewise worthwhile of consideration.

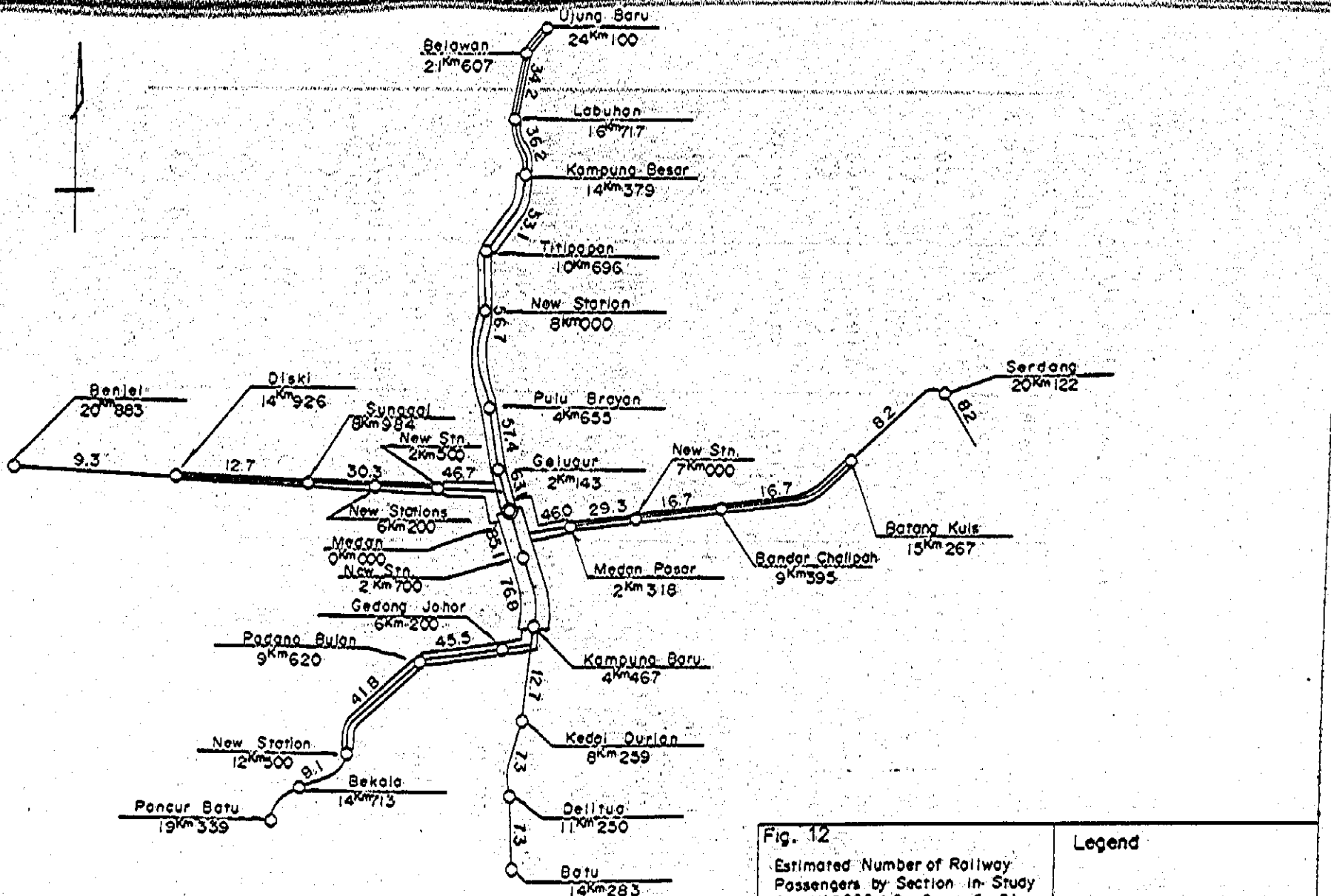


Fig. 12
Estimated Number of Railway Passengers by Section in Study Area (2000 A.D. Case-5-8) Low-Motorization

Medan Area Transportation Study

Legend

Unit: 10^3 Persons/day

Table 14 Superiority Comparison of Alternatives

Item \ Alternatives		Case-5-B-1	Case-5-B-2		Case-5-B-3
			Case-5B2-1	Case-5-B-2-2	
Main Line Track Length to be Operated (Kms)		153.7 ○	135.3 ◎	153.7 ○	135.3 ◎
Required No. of Diesel Railcars(Cars)		198 ○	200 △	192 ○	166 ◎
Diesel Railcar Running Kms (Car-Kms/day)		52.100 △	48.500 ○	48.700 ○	48.200 ○
Medan Stn.	No.of Transfer Passengers/day (x1000Person)	55.5 ○	60.3 △	60.3 △	26.1 ◎
Medan Stn.	No. of Platforms	2 ○	2 ○	3 △	2 ○
Train Headway on Eastern & Western Lines (Minute)		8~11 ◎	18-22 △	15 ◎	18~22 △
Investment Cost		○	○	△	○
Effect on the other Lines in case of Traffic Accidents		Effect on Other Lines ○	No Problem ◎	No Problem ◎	Effect on Other Lines ○
Transporting Capacity		◎	△	◎	△
Integrated Evaluation		○	△	◎	◎

◎ Suprior
○ Medium
△ Inferior

7. Proposed Master Plan of Medan Area Urban Transport System

The improvement alternative Case 5-B-3 selected as the optimum master plan of Medan Area Urban Tranport System is herewith described in details as follows:

7.1 Railway

(1) Railway Urban Traffic Demand

An improvement plan of railway facilities is worked out based on the estimated railway when traffic demand in the long-term under low motorization (Case 5-B). The estimated number of passengers for the year 2000 A.D. is 377.6×10^3 per day and the traffic growth in the period from 1980 to 2000 is assumed as shown in Fig. 13. The required numbers of rolling stock for the urban railway transport service are calculated in four stages as shown in Fig. 13. The appropriate time for electrification of railway would be in or after 1998.

(2) Improvement of Main Lines and Stations

The proposed imporvements of relevant main-lines and yards and terminals are as follows (Refer to Fig. 14):

i) The track elevation covering over a distance of 2.9 km in the CBD including Medan Station with two platforms and four platform tracks in the period between 1996 and 2000.

ii) The relocaction of a freight-car yard, a coach yard, a diesel railcar yard, and a diesel locomotive depot from the present Medan Station to Titipapan on the North Line in the period between 1986 and 1990, which are expanded as a freight shunting yard and various respective rolling stock bases in the period between 1996 and 2000. The diesel railcar base has to be remodelled into an electric railcar base later when the railway of Medan Area is electrified.

iii) The rehabilitation of main lines of a total length of 29.2 km and affiliated intermediate and terminal stations of Pancur-Batu Line and Batu Line in the period between 1986 and 1990. The former of which is double tracked in the period between 1996 and 2000.

iv) The construction of a detouring line of 17.3 km long for freight trains of the East Line, linking Bandar Chalipah Station on the East Line with Titipapan Yard to be constructed on the North Line in the period between 1986 and 1990, and a short-cut of 2.4 km long between the West Line and the North Line in the period between 1991 and 1995.

(3) Strengthening of Existing Track Structures

Since the existing main-line tracks in Medan Area are not strong enough for the estimated total annual passing tonnage by line-section. Their track structures are proposed to be strengthened between 1986 and 1995 mainly by replacing the existing rails by 40-kg rails on the West Line and Batu Line and also 50-kg rails on the East Line, the North Line and Pancur Batu Line.

(4) Installation of Automatic Blocking Signals

In order to handle the enormous estimated number of urban trains safely every day on each line it is proposed to install automatic blocking signals on each line in Medan Area instead of blocking track sections by telephone which is presently used.

(5) Procurement of New Rolling Stock

It is proposed to strengthen the railway urban transport service by using diesel railcars from 12 units already commenced in the short-term gradually up to 150 units step by step in 1984, 1987 and 1993 as shown in Fig. 13. If the diesel railcars are replaced by the electric railcars around in 1998 due to the railway electrification, the estimated railway electric railcars necessary for the whole electric traction in the Medan Area will be 158 units as shown in Fig. 13.

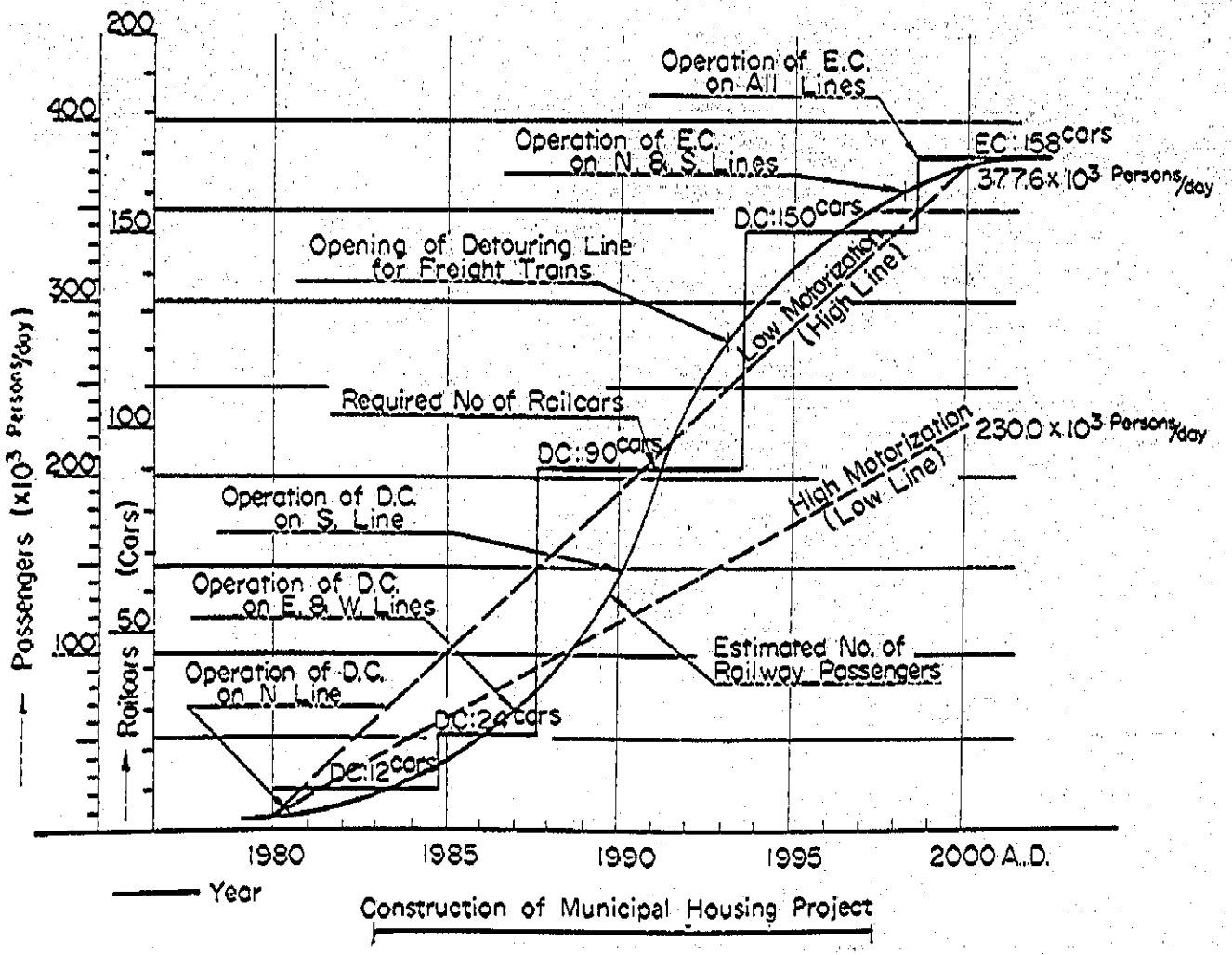
(6) Total Cost of Railway Facility Improvement and Rolling Stock Procurement

The total amount of improvement costs of railway facilities and procurement costs of rolling stock will be expected to reach 230.7 billion Rupiah, of which 73.9 % being foreign currency portion and 26.1 % the local currency portion. Their breakdowns in three five-year periods in the long term are tabulated in Table 16. All costs are evaluated with the price level of January 1980.

(7) Strengthening of Pulu Berayan Railway Workshop

It is proposed to strengthen the existing Pulu Berayan Railway Workshop to perform overhaulings and heavy repairs of diesel railcars to cope with the estimated increase of diesel railcars to be assigned to Medan Area in the period 1976 - 1990. When the railways in Medan Area are electrified all facilities in the workshop for overhaulings and heavy repairs of diesel railcars have to be remodelled into those which can overhaul and repair electric passenger cars, maybe in the period 1996 - 2000 A.D.

Fig. 13 Estimated Number of Railway Passengers and Required Number of Railcars in Medan Area

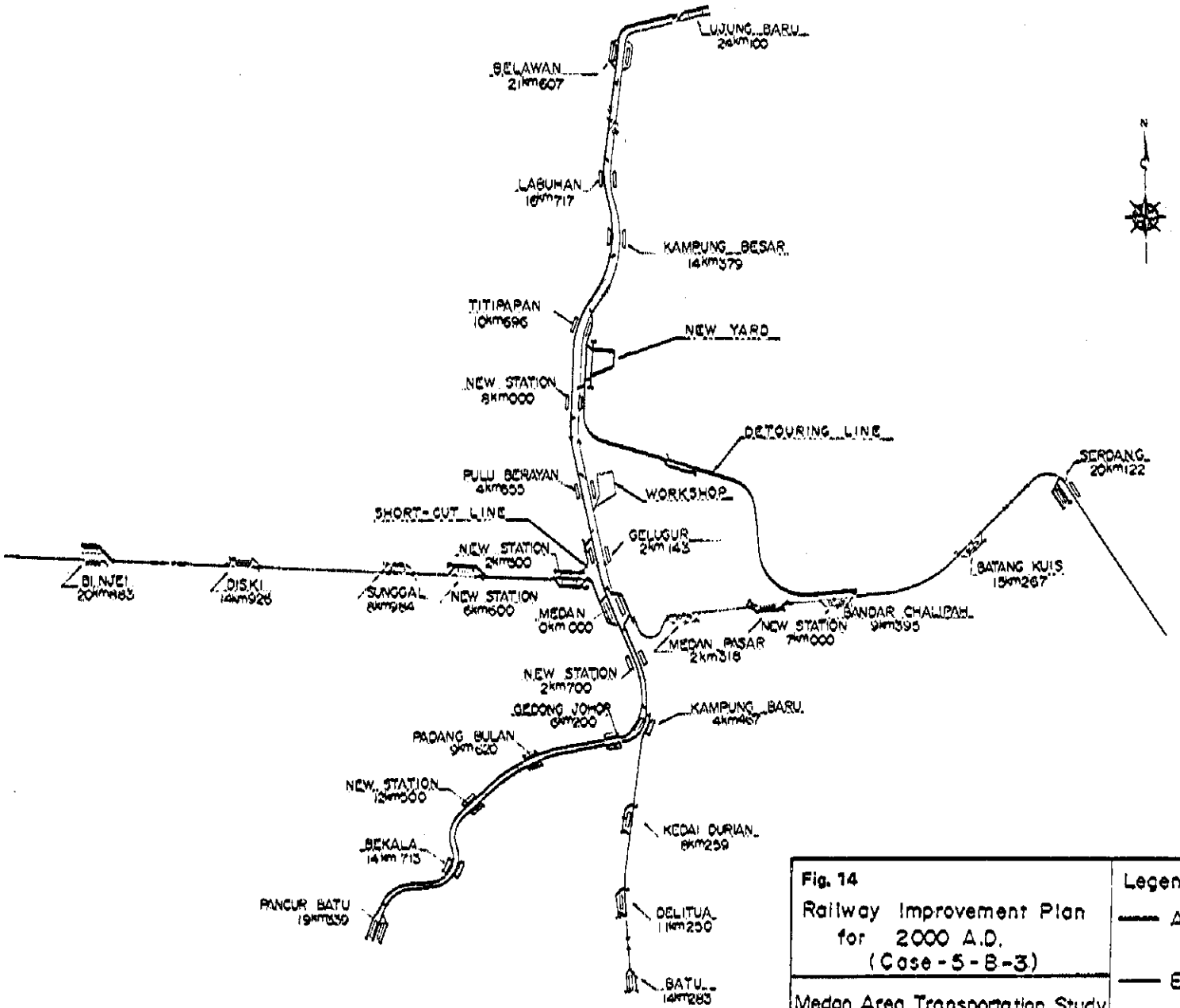


Remarks:

(1) Estimated Number of Boarding Passengers
Considerable increase in the upward tendency thereof is expected, starting from the initial stage of low pace towards high tempo in the intermediate period, when the Housing Complex Construction Program is to be in full pace of progress. The relevant curve, therefore, is steep in gradient in the intermediate term.

(2) Required Number of Diesel Railcars
The intersection points of the curve with the required diesel railcar number and that of the estimated number of passengers show the case when the car occupancy reaches 130 percent during the peak hours. Accordingly the plan has been worked out to increase the number of diesel railcars when the car occupancy exceeds 180%.

Notes: D.C.: Diesel Railcars
E.C.: Electric Railcars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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
GELUGUR
2km143
NEW STATION
2km500
BATANG KUIS
15km267
BLNJEI
20km185
DISKI
14km926
SUNGGAL
8km914
NEW STATION
6km600
MEDAN
0km000
SANDAR CHALIPAH
9km395
NEW STATION
7km000
MEDAN PASAR
2km318
NEW STATION
2km700
GEDONG JOMOR
6km200
KAMPUNG BARU
4km467
PADANG BULAN
9km020
NEW STATION
12km500
KEDAI DURIAN
8km259
BEKALA
14km713
PANCUR BATU
19km859
DELITUA
11km250
BATU
14km293
N
Fig. 14
Railway Improvement Plan for 2000 A.D. (Case-5-B-3)
Medan Area Transportation Study
Legend
Additional Facilities
Existing Facilities

Table 15 Estimated Annual Passing Tonnage in 2000 A.D. and Proposed Track Structures

Section		Estimated Annual Passing Tonnage		Weight of Rail (kg/m)		
		($\times 10^3$ Ton)	($\times 10^3$ Ton Single Track)	U.I.C. Recommendation	J.N.R. Recommendation	Recommendation
Northern Line	Belawan-Titipapan	21,800	10,900	46-50	50	50-
	Titipapan-Medan	25,500	12,750	50-60		
Southern Line	Medan-Kampung Baru	23,400	11,700			
	Kampung Baru-Pancur Batu	12,600	6,300	46-50	40	40-
	Kampung Baru-Batu	3,700	3,700			
Eastern Line	Medan-Bandar Chalipah	14,500	7,250			50-
	Bandar Chalipah-Serdang	13,200	13,200	50-60	50	
	Serdang-	8,600	8,600	46-50	40	
Western Line	Medan-Sunggal	15,100	7,550			
	Sunggal-Binjei	5,600	5,600			
	Binjei-	2,100	2,100			40-
Detouring Line	Titipapan-Bandar Chalipah	6,700	6,700			50-

Note: U.I.C.: Union International Chemin de Fer
J.N.R.: Japanese National Railways

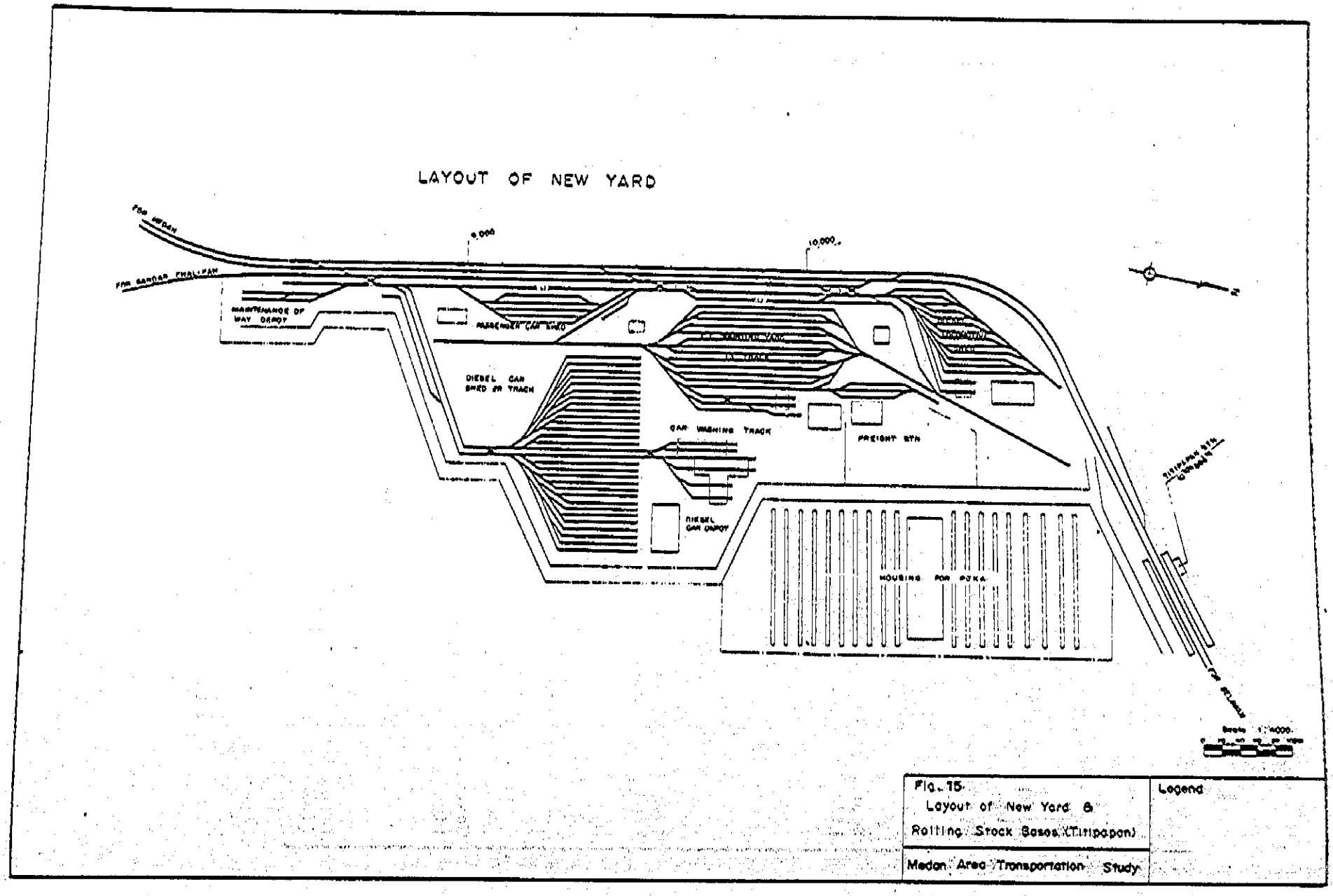


Fig. 15 Layout of New Yard & Rolling Stock Bases (Tanjung Pasir)	Legend
Medan Area Transportation Study	

Table 16 Summary of Railway Improvement Costs in Medan Area (Case-5-B-3)

Unit: 10^9 Rp.

Item	1986 - 1990			1991 - 1995			1996 - 2000			Total		
	Frgn. Curcy.	Local Curcy.	Total	Frgn. Curcy.	Local Curcy.	Total	Frgn. Curcy.	Local Curcy.	Total	Frgn. Curcy.	Local Curcy.	All Total
1) Medan Sta	1.5	0.6	2.1	6.8	3.1	9.9	9.1	4.2	13.3	17.4	7.9	25.3
2) East. Line	0.2	0.1	0.3	2.8	1.3	4.1	3.2	1.4	4.6	6.2	2.8	9.0
3) West. Line	2.9	1.3	4.2	0.5	0.2	0.7	3.4	1.5	4.9	6.8	3.0	9.8
4) South. Line	7.2	3.2	10.4	-	-	-	15.6	7.0	22.6	22.8	10.2	33.0
5) North. Line	3.8	1.8	5.6	9.3	4.1	13.4	10.6	4.8	15.4	23.7	10.7	34.4
6) New Rolling Stock Base	6.5	2.9	9.4	5.4	2.4	7.8	4.3	1.9	6.2	16.2	7.2	23.4
7) Detour. Line	-	2.0	2.0	12.6	3.6	16.2	-	-	-	12.6	5.6	18.2
8) Short-cut Line	-	-	-	1.5	0.7	2.2	-	-	-	1.5	0.7	2.2
9) Pulu Brayan Workshop	0.4	0.3	0.7	0.3	0.1	0.4	0.1	-	0.1	0.8	0.4	1.2
10) Housing for PJKA Staff	-	-	-	-	0.8	0.8	1.2	10.8	12.0	1.2	11.6	12.8
Sub-total	22.5	12.2	34.7	39.2	16.3	55.5	47.5	31.6	79.1	109.2	60.1	169.3
11) D.C. (Diesel Railcar)	8.5	-	8.5	14.8	-	14.8	11.2	-	11.2	34.5	-	34.5
12) E.C. (Electric Railcar)	-	-	-	-	-	-	26.9	-	26.9	26.9	-	26.9
Sub-total	8.5	-	8.5	14.8	-	14.8	38.1	-	38.1	61.4	-	61.4
Total	31.0	12.2	43.2	54.0	16.3	70.3	85.6	31.6	117.2	170.6	60.1	230.7
Main Construction	1 platform N.L. and W.L.: Track reinforced Rehabilitation of of S.L. New rolling stock base Detour Line D.C. Repair facilities			Elevation of Medan Stn. W.L.: Track reinforced New rolling stock base Detour Line Short-cut Line			Elevation of Medan Stn. S.L. and N.L.: Track doubling All Line: Electrification New rolling stock base Housing E.C. Repairing facilities			-		

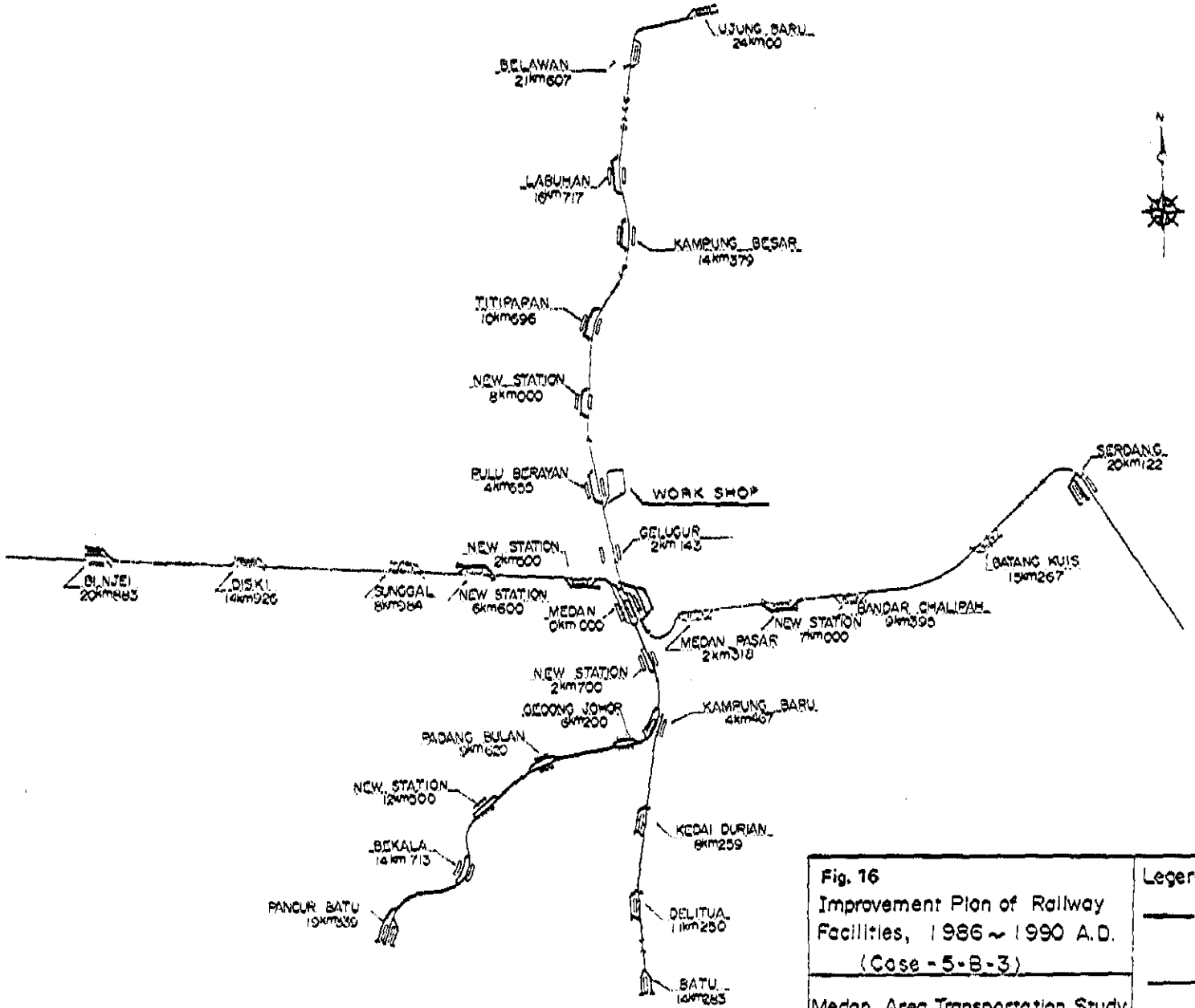


Fig. 16
Improvement Plan of Railway Facilities, 1986 ~ 1990 A.D.
(Case - 5 - B - 3)

Medan Area Transportation Study

Legend
- Additional Facilities
- Existing Facilities

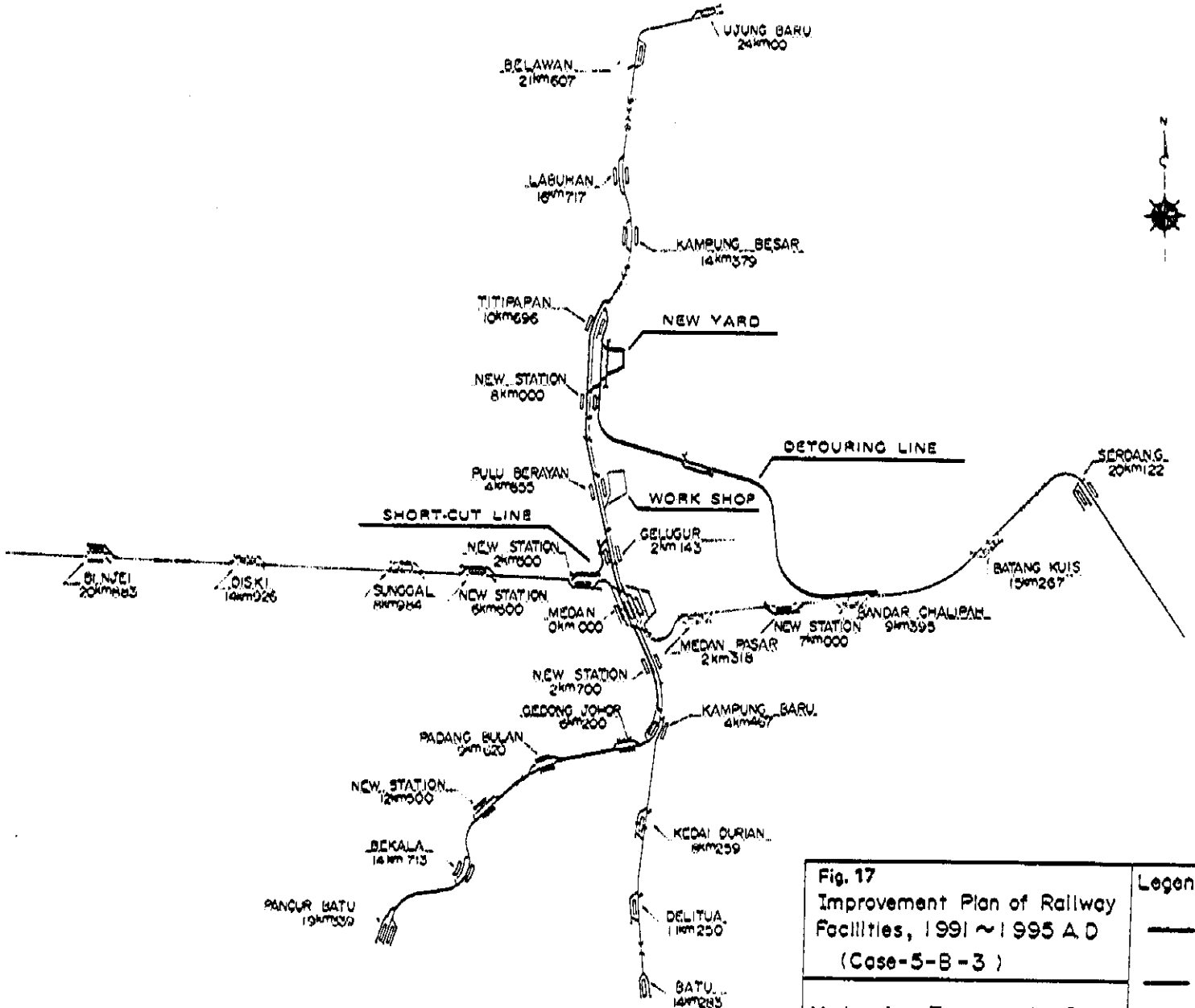
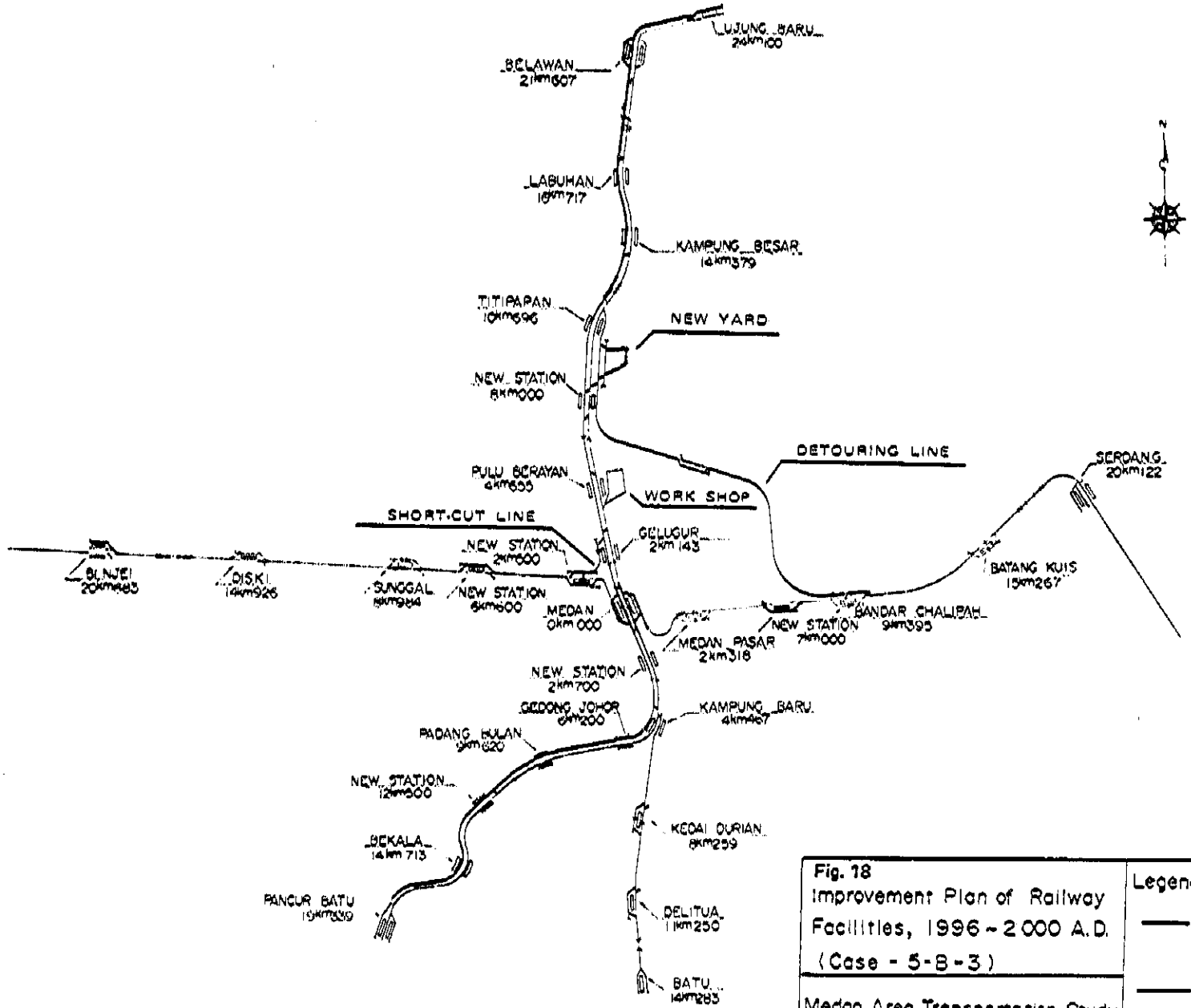


Fig. 17
Improvement Plan of Railway Facilities, 1991 ~ 1995 A.D
(Case-5-B-3)

Medan Area Transportation Study

Legend
- Additional Facilities
- Existing Facilites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TITIPAPAN
10km696
NEW YARD
NEW STATION
8km000
DETOURING LINE
SERDANG
20km122
PULU BERAYAN
4km655
WORK SHOP
SHORT-CUT LINE
GELUGUR
2km143
NEW STATION
2km600
BATANG KUIS
15km267
BINJEI
20km483
DISKI
14km926
SUNGGAL
NEW STATION
6km600
MEDAN
0km000
BANDAR CHALIPAH
9km393
NEW STATION
7km000
MEDAN PASAR
2km318
NEW STATION
2km700
GEDONG JOHOR
6km200
KAMPUNG BARU
4km467
PADANG BULAN
3km620
NEW STATION
12km500
KEDAI DURIAN
8km259
BEKALA
14km713
PANCUR BATU
19km520
DELITUA
11km250
BATU
14km283
N
Fig. 18
Improvement Plan of Railway Facilities, 1996 - 2000 A.D.
(Case - 5-8-3)
Medan Area Transportation Study
Legend
Additional Facilities
Existing Facilities

7.2 Road Facilites

(1) The concept of road network of Medan Area in 2000 A.D. is set up as shown functionally in Fig. 19, which is formed with six arterial roads radiating from the center of the CBD, Outer and Inter-mediate Ring Roads and Belawan-Medan-T. Morawa Tollway basically which are supplemented by arterial roads in each zone.

The standard cross-sections of arterial roads by type are presented in Fig. 20.

For the purpose to utilize the afore-mentioned basic road network efficiently depends much upon how to treat intersections between arterial roads but the Intermediate Ring Road functions as a very important route viewing from the utilization of road network. The efficient handling of the urban road traffic depends much upon the efficient utilization of Intermediate Ring Road, which needs the grade separation of Intermediate Ring Road at eight intersections with other arterial roads and six other intersections as proposed in Fig. 21.

(2) Tollway

The tollway system in Medan Area is proposed as shown in Fig. 22, which consists of Belawan-Medan-T. Morawa Tollway that is scheduled to be opened for traffic within the Pelita III, and Binjei Bypass and Outer Ring Road, which also constitute the core of inter-city road network in Medan Area to reach various cities in North Sumatra.

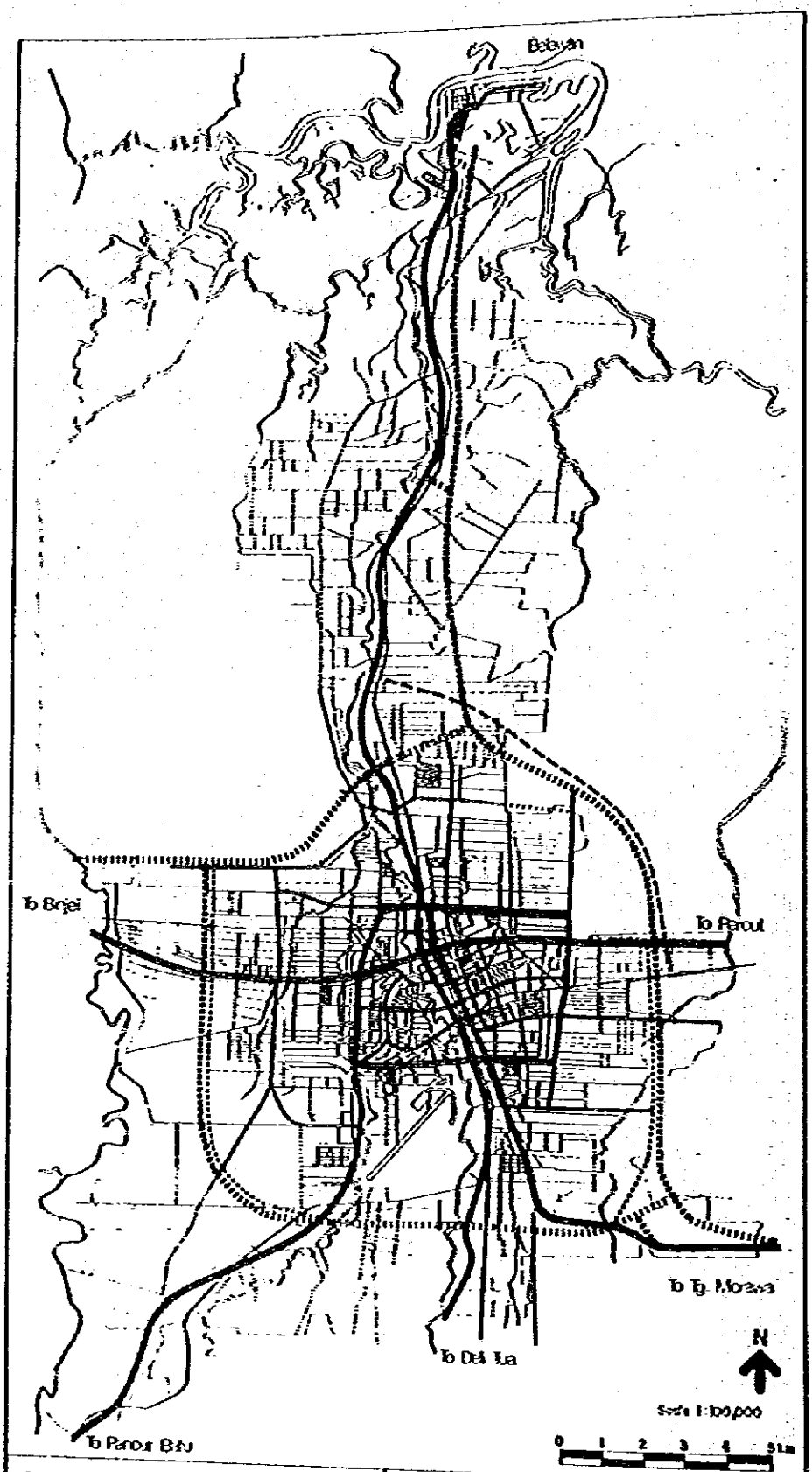


Fig. 19

Proposed Road Network in 2000 A.D.

Medan Area Transportation Study

Legend

- Tollway
- Major Arterial Road
- Arterial Road
- Frontage Road
- Railway, detouring line

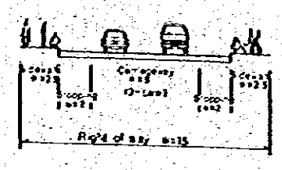
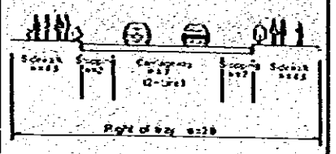
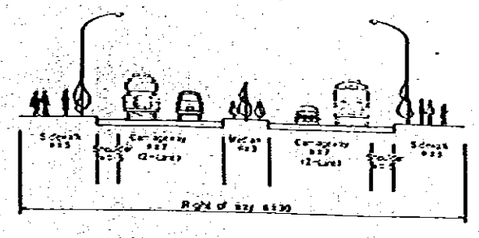
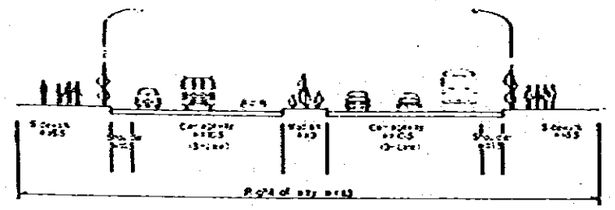
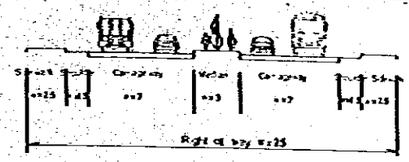
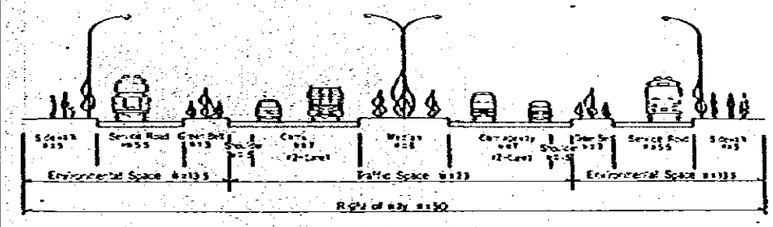
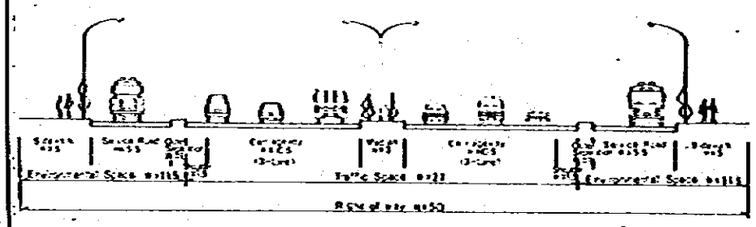
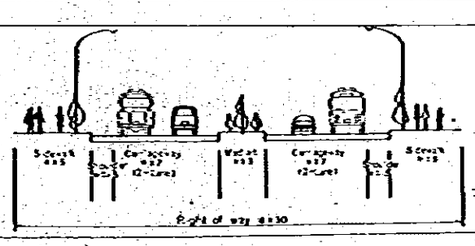
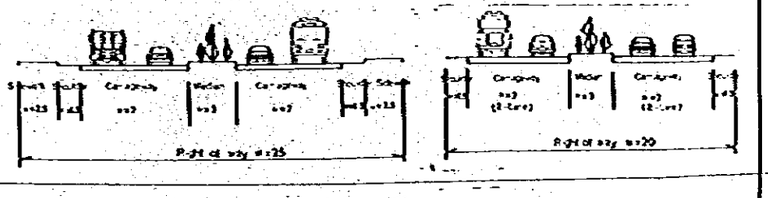
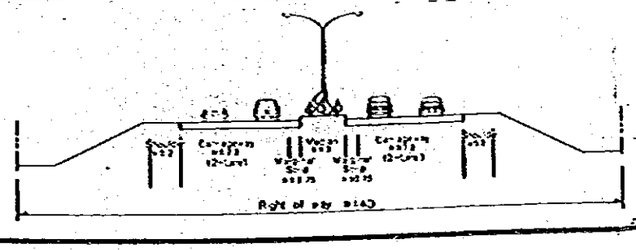
		2 Lanes	4 Lanes	6 Lanes
Supplementary Arterial Roads				
Arterial Roads	A & B-AREA			
	C-AREA			
Major Arterial Roads	A-AREA			
	B-AREA			
	C/D-AREA			
Tollway				

Fig. 20
Proposed Standard Cross Sections of Arterial Roads for the Recommended Road Network in 1000 A.D.

Medan Area Transportation Study

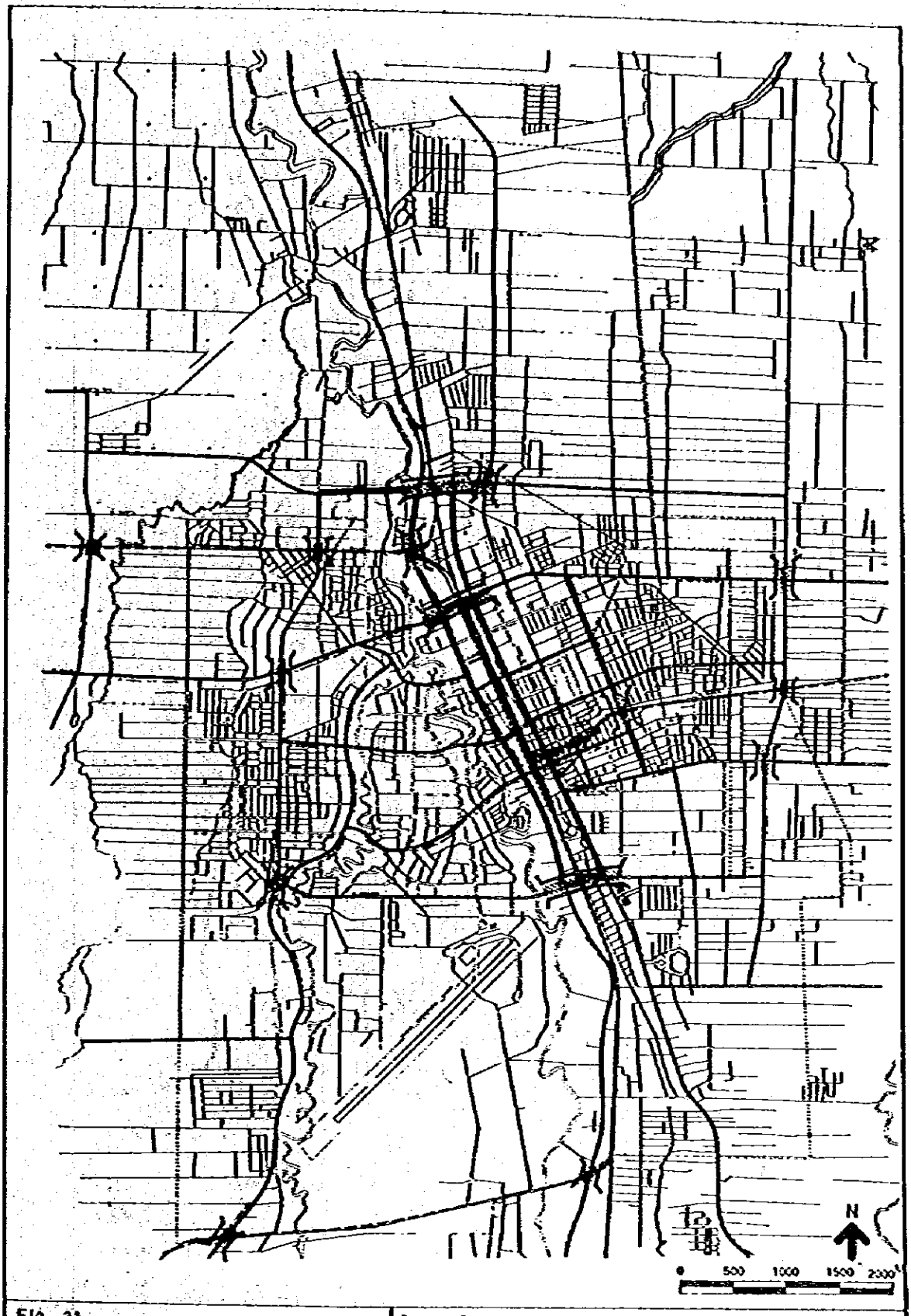


Fig. 21

Future Arterial Road Network in the Internal Study Area (Long Term)
Case – S – B

Medan Area Transportation Study

Legend

- 6 – lane
- 4 – lane
- Railway at grade
- Railway elevated
- Grade Seperation Structure

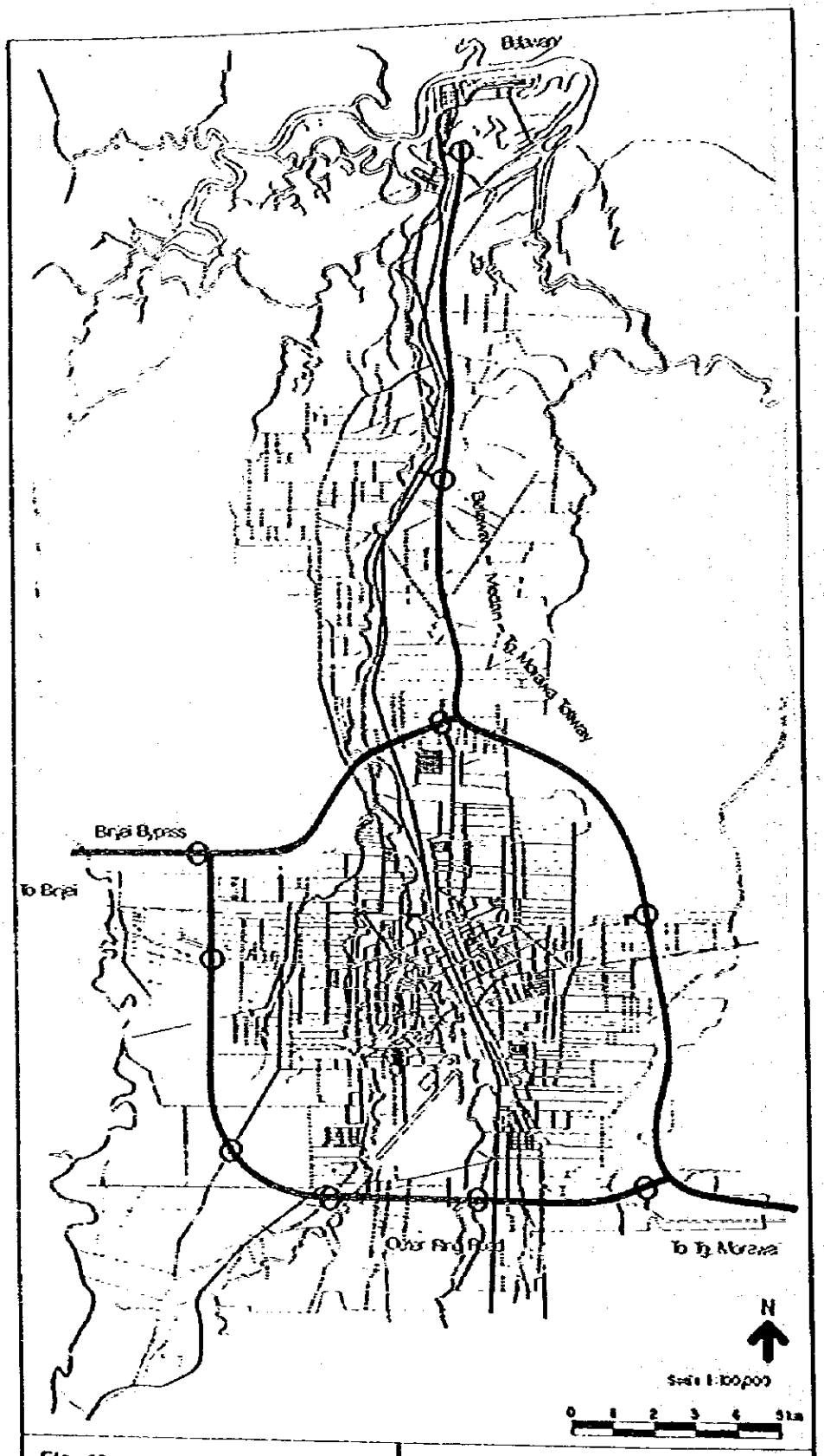


Fig. 22

Proposed Tollway Network in 2000 A.D.

Medan Area Transportation Study

Legend

Tollway (Zone Tariff System)

Interchange with On/Off Ramp

7.3 Bus Transport

(1) Bus System

Presently in 1980 the urban transport in Medan Area is performed by bus as well as by Bemo, Daihatsu and Becak, but the bus system in 2000 A.D. is proposed to be as follows:

(a) Becak

The basic concept on the utilization of Becak is proposed basically to abolish in Medan City Area although it will remain in 2000 A.D. only in the peripharal areas of the City. Consequently, the discussion on Becak in the Long-Term is not performed in this report.

(b) Bemo and Daihatsu

It is proposed to make a basic policy to abolish Bemo and Daihatsu by 2000 A.D., substancially they are proposed to be replaced with mini-bus of the capacity of 30 seats per unit to maintain the convenience in narrower local roads where the large buses will find it difficult to operate.

(c) Bus System

The bus system of Medan Area is proposed to consist of large-buses which operate on bus lanes on arterial roads and mini-buses which serve on narrower local roads as feeder routes to Large-bus routes. The large bus system supplemented by the mini-bus system is proposed to serve city area and supplements one another with the railway, to cover the whole Medan Area.

(d) Separation of Intra-City Service from Inter-City Service

Areas to be served by Intra-city buses and inter-city buses are clearly separated in such a way that the Outer Ring Road is regarded as their boundary.

The Inter-city bus routes originate and terminate at six suburban bus terminals to be established on the Outer Ring Road at the intersections with six radiating arterial roads where Inter-city bus routes originate and terminate to link with those suburban Intra-city bus routes which link with the central bus terminal of the city therefrom. (Refer to Fig. 23 and Fig. 24)

(2) Bus Network

The bus network is basically planned being based on the following three concepts:

(i) Establishment of a bus lane for large buses in each direction on arterial roads in specified peak hours on week days.

(ii) The overall bus network is formulated assuming the average walking distance of citizens to be approximately 300 m.

(iii) The mini-bus routes network are formulated to cover those areas beyond 300 m from the large bus routes.

(3) The bus passenger traffic demands expressed in desire-lines are shown in Fig. 25. The pattern of which reveals the noticeable character of concentration to the central districts of the city.

(4) Necessary Number of Bus Units

The estimated numbers of bus units necessary to handle the share by the bus system of estimated urban traffic are tabulated in the following.

Table 17 Necessary Number of Bus Units in 2000 A.D.

Type of service	Large buses	Mini-buses	Total
Intra-City	1,488	567	2,055
Inter-City	670	-	670
Total	2,158	567	2,725

(5) Bus Terminals

The strengthening of bus terminal facilities are based on the following concepts:

(i) To cope with the estimated bus traffic demand;

(ii) To secure the convenience of transferring passengers;

(iii) To reduce traffic complication and duplication;

(iv) To provide convenient links with other modes of transport such as railway and taxies at railway station plazas.

The bus passengers' movements of Medan Area in the long-term is classified into the inter-city movement and the intra-city movement; the latter is characterized by its strong concentration of desire-lines into the central districts. As for the convenience of transferring passengers, which depends much upon the network by route, it is necessary to arrange the network by route so as to keep the number of transferrings in a trip in minimum avoiding the concentration of bus routes into one central point in

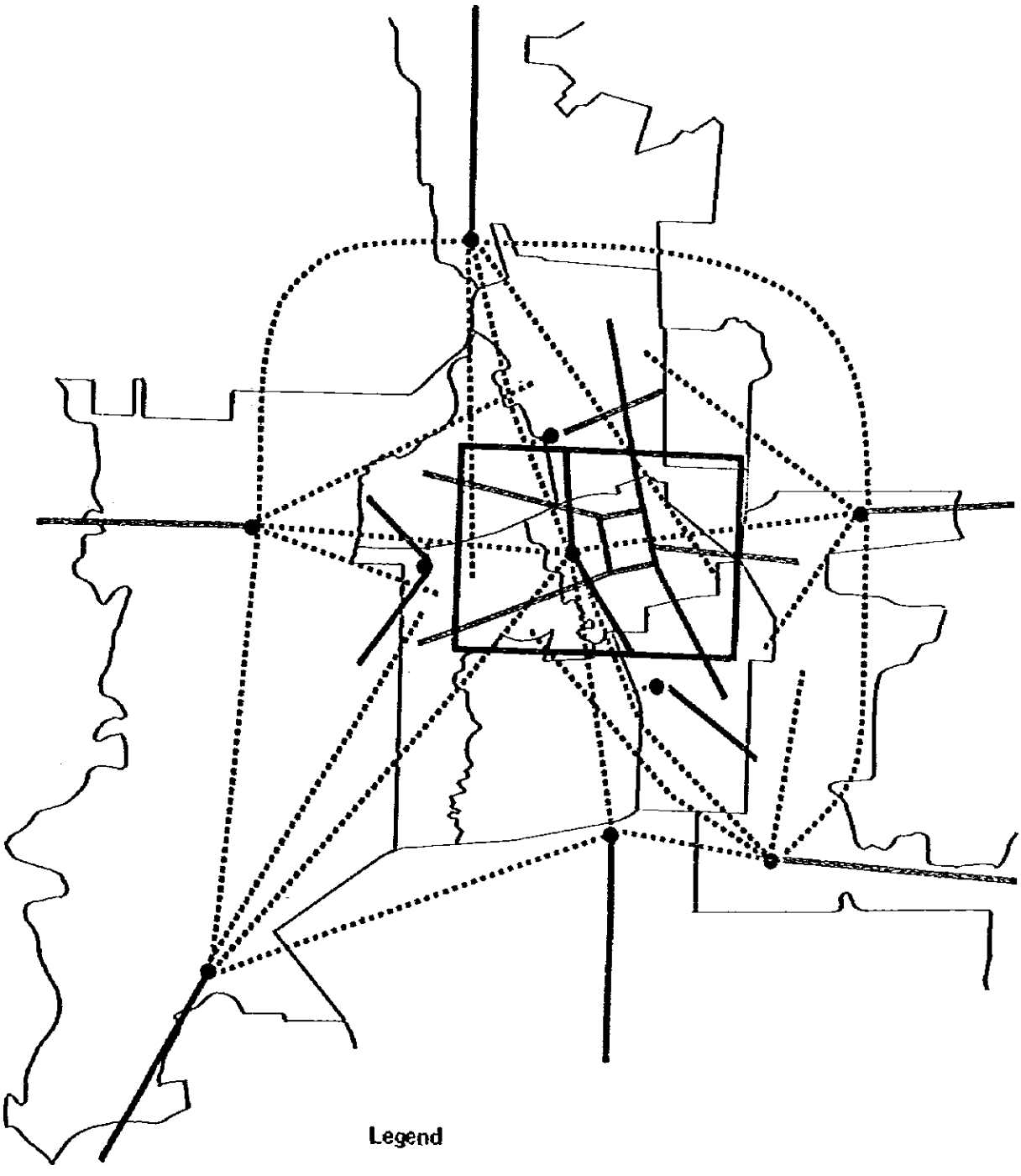


Fig. 23

Schematic Bus Route Map of Medan Area (2,000 A.D.)

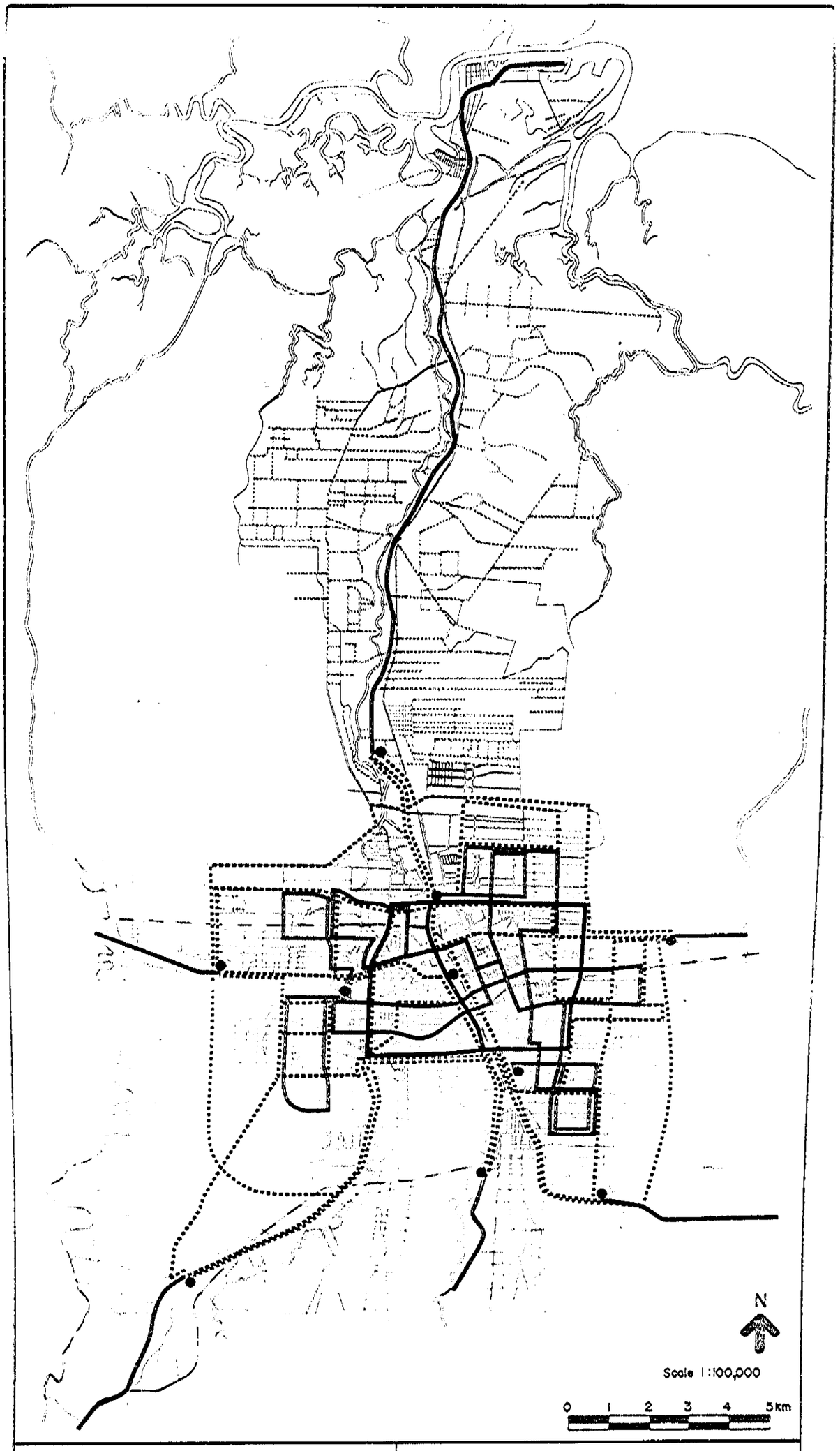


Fig. 24

Proposed Bus Route Map in Medan Area
(2,000 A.D.)

Medan Area Transportation Study

Legend

- Bus route on Intermediate Ring Road
- Long-distance bus route
- Bus route betw. Suburban bus terminal & Central bus terminal
- Bus route betw. Inner zones & outer zones
- Bus route betw. Suburban bus terminal & inner zones
- Bus route betw. Intermediate bus terminal & partially urbanized areas
- Bus route betw. Suburban bus terminal
- Bus terminal

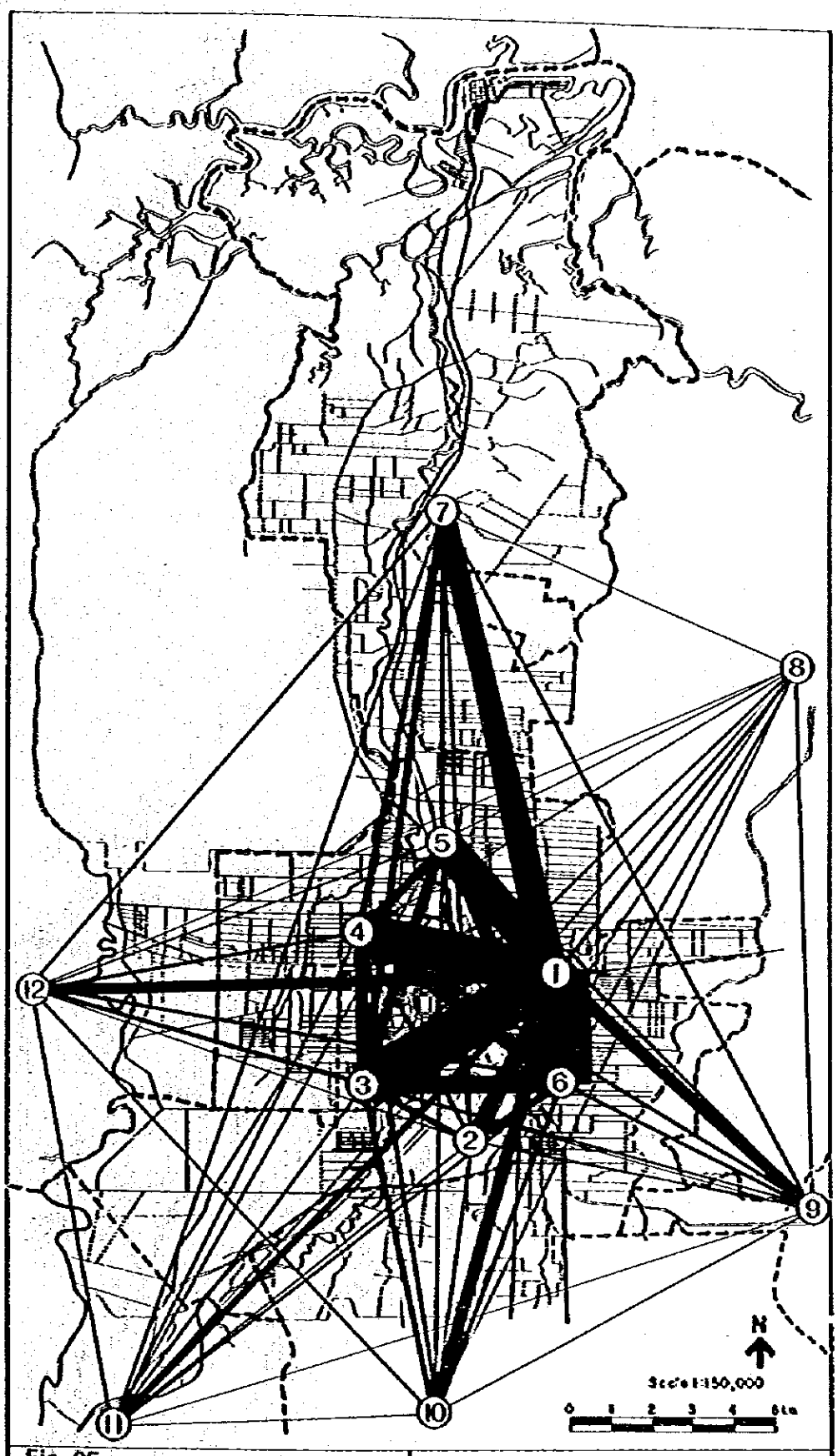


Fig. 25 Estimated Desire-Line Pattern of Bus Passengers (2,000 A.D.) (Case 5-B-3)

Medan Area Transportation Study

Legend

x 10^3 Person/day

100 80 60 40 20 5

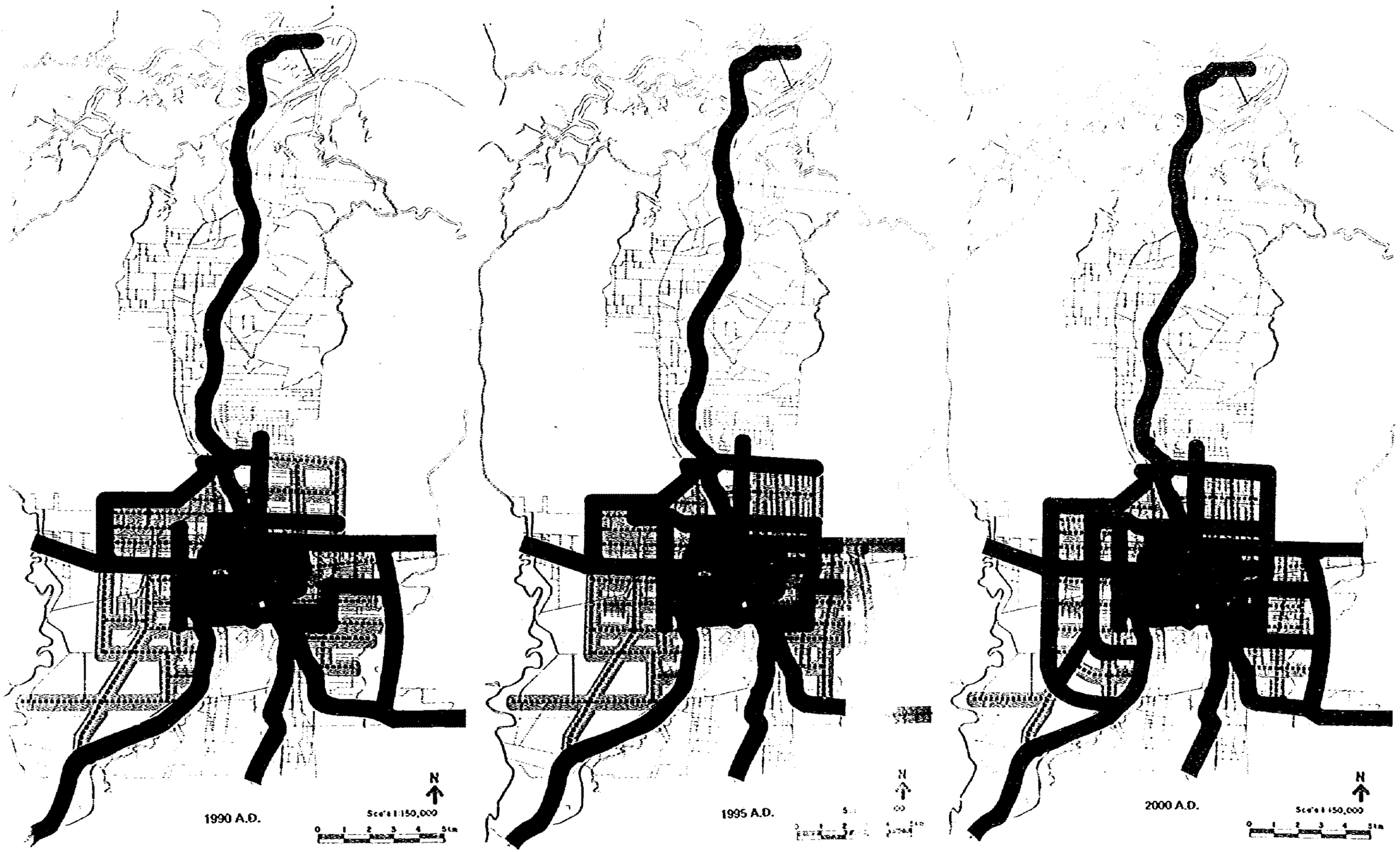


Fig. 26 Estimated Areas to be Served by Large-Bus & Mini-Bus Systems (1990 A.D. ~ 2,000 A.D.)