GOVERNMENT OF MALAYSIA

THE FEASIBILITY STUDY OF COMPUTERISED AREA TRAFFIC CONTROL SYSTEM IN PENANG, MALAYSIA

FINAL REPORT

MAIN VOLUME

JANUARY 1988

JAPAN INTERNATIONAL COOPERATION AGENCY

ATC SYSTEM IN PENANG, MALAYSIA FINAL REPORT MAIN VOLUME JANUARY 1988

GOVERNMENT OF MALAYSIA

THE FEASIBILITY STUDY OF COMPUTERISED AREA TRAFFIC CONTROL SYSTEM IN PENANG, MALAYSIA

FINAL REPORT

MAIN VOLUME

JANUARY 1988

JAPAN INTERNATIONAL COOPERATION AGENCY

PREFACE

It is with great pleasure that I present this Feasibility Study on Computerised Area Traffic Control System in Penang, to the Government of Malaysia.

This report embodies the result of a feasibility study which was carried out in the Penang Island from July 1986 to January 1988 by a Japanese study team commissioned by the Japan International Cooperation Agency following the request of the Government of Malaysia to the Government of Japan.

The study team, headed by Mr. Kokuro Hanawa, and organized by Fukuyama Consultants International Co., Ltd. and Central Consultant Co., Ltd. had a series of close discussions with the officials concerned of the Government of Malaysia, conducted a wide range of field survey, and prepared the report.

I hope that this report will be useful as a basic reference for development of the region.

I wish to express my deep appreciation to the officials concerned of the Government of Malaysia for their close cooperation extended to the study team.

January, 1988

Keisuke Arita
President
Japan International Cooperation Agency

The **Final Report** on The Feasibility Study of Computerized Area Traffic Control System in Penang, Malaysia consists of four volumes:

(1) Summary Volume,

(2) Main Volumes,

(3) Supplementary Volume,

(4) Supplementary Volume : Drawings.

This is the **Main Volume** of the **Final Report** and contain six chapters.

Chapter 1 introduces the Study background, objectives, organisation and approach.

Chapter 2 discusses the present and future transportation conditions and problems in the Study Area.

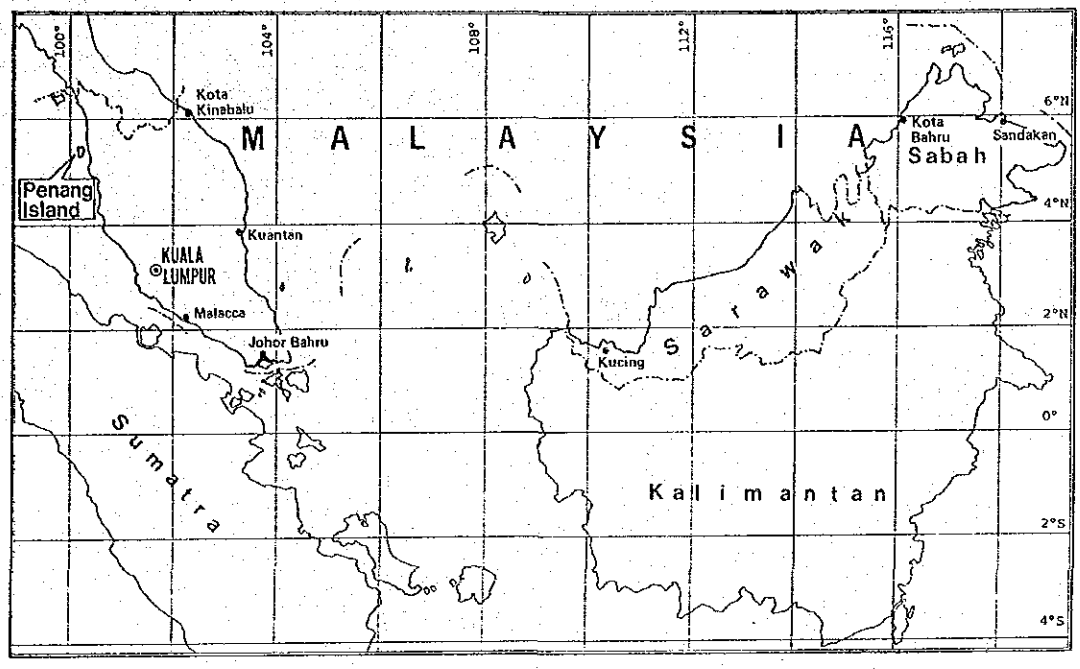
Chapter 3 presents the planning issues, goals and transport policies established in this Study.

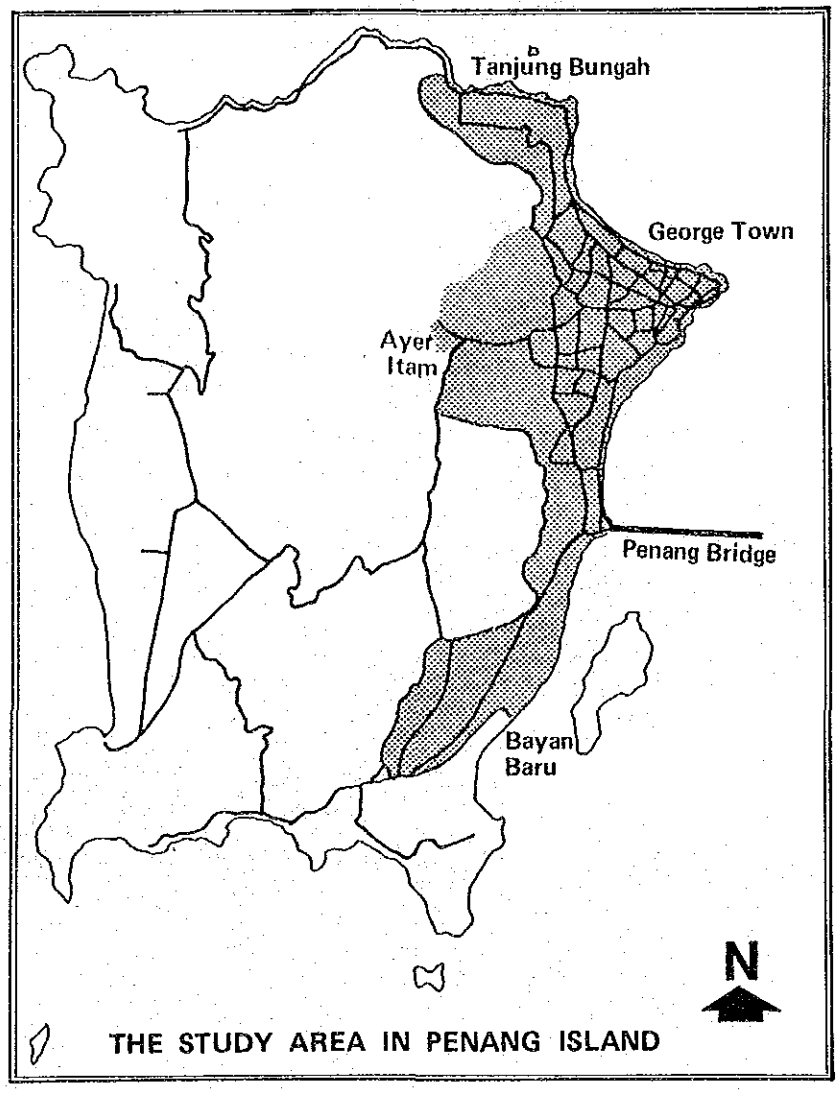
Chapter 4 describes each of the individual component plan in the proposed Transportation System Management Plan.

Chapter 5 presents the economic evaluation of the ATC System Expansion Plan and the financial analyses for the proposed CBD Bus Terminal and a Parking Building and finally,

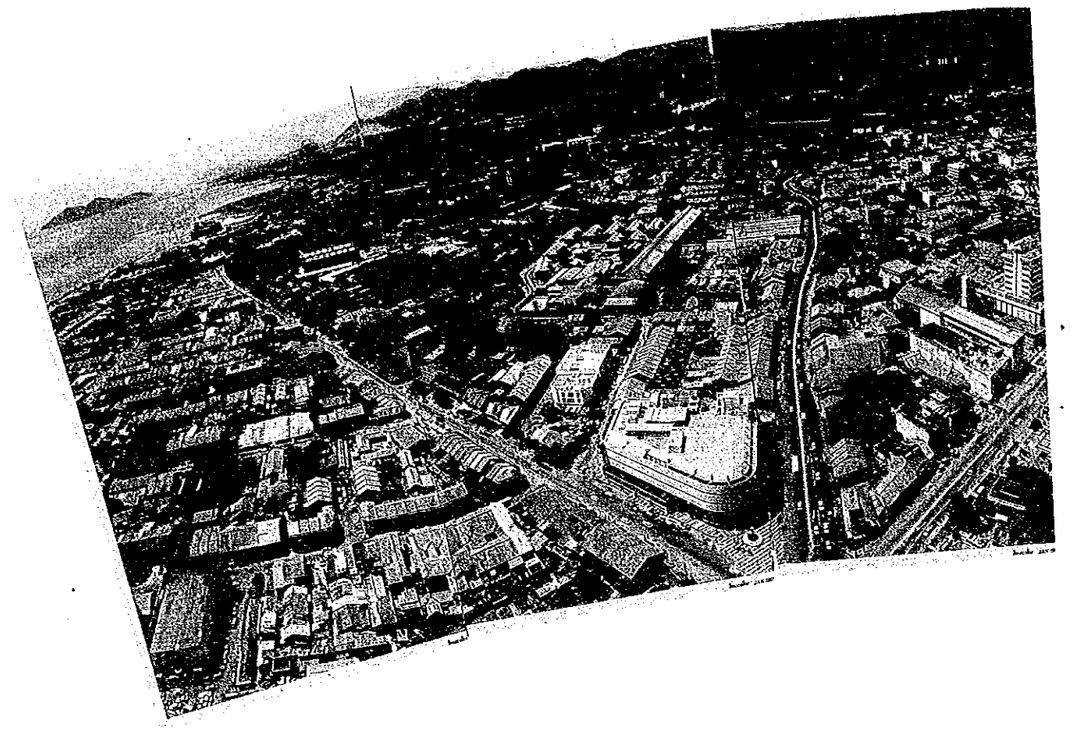
Chapter 6 describes the implementation plan for the proposed Transportation System Management Plan.

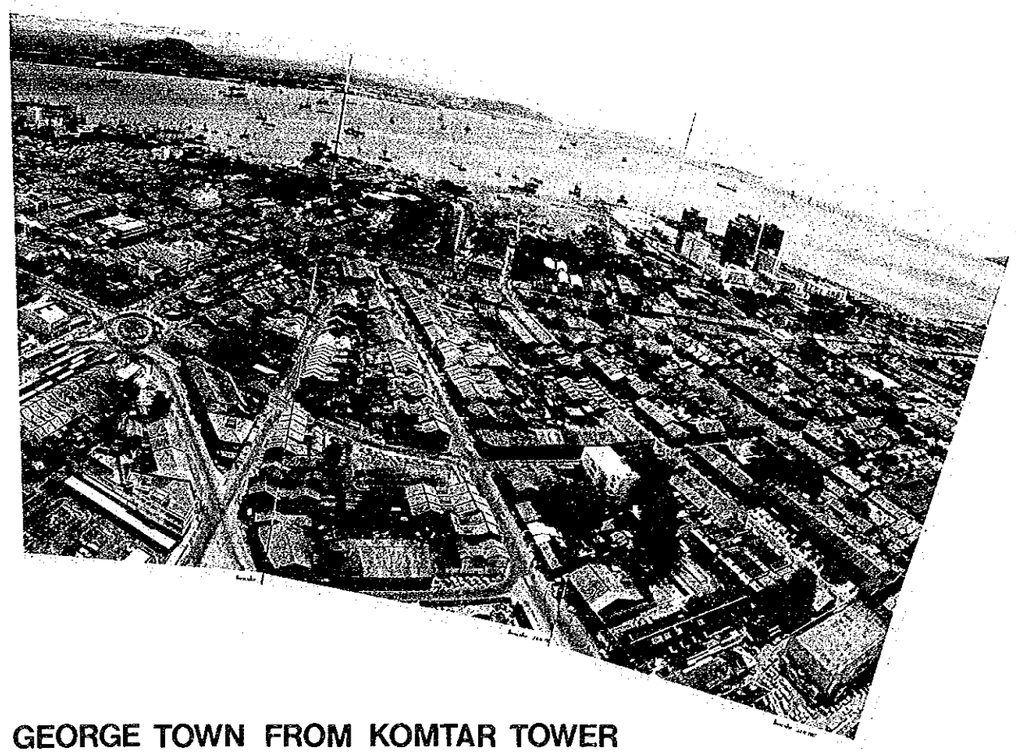
LOCATION MAP





THE STUDY AREA IN PENANG ISLAND





A 360 DEGREE PANORAMIC VIEW OF GEORGE TOWN FROM KOMTAR TOWER

CONTENTS

MAIN VOLUME

LIST OF FIGURES

CHAPTER 1:

CHAPTER 2:

CHAPTER 3:

CHAPTER 4:

LIST OF TABLES

CHAPTER 2:

CHAPTER 4:

CHAPTER 5

CHAPTER 6:

1 OUTLINE OF THE STUDY

1.0 OUTLINE OF THE STUDY

1.1 Background

In response to the request of the Government of Malaysia, the Government of Japan has decided to conduct a Feasibility Study for the Expansion of the Computerised Area Traffic Control System to the Greater George Town, Central District Development 21 and Bayan Baru District in Penang, Malaysia (hereinafter referred to as "The Study"), and in accordance with relevant laws and regulations enforced in Japan. The Japan International Cooperation Agency (hereinafter referred to as "JICA"), the official agency responsible for the implementation of technical cooperation programmes of the Government of Japan has conducted the Study in close cooperation with the relevant Malaysian authorities.

With a population of 260,000, George Town is the third largest city in Malaysia and an important centre for commerce and tourism. To overcome urban transport problems such as traffic congestion that George Town had been facing, a request has been conveyed to the Japanese Government to carry out a comprehensive study for preparing the George Town Metropolitan Area Transport Masterplan. Such a study was conducted by the Japan International Cooperation Agency (JICA) in March 1979 and an Urban Transport Masterplan was consequently prepared in 1980. The Masterplan has recommended a series of proposals that include the construction of the Penang Outer Ring Road as a Long Term Road Network Improvement Measure as well as short term or interim measures such as reorganization of bus network, parking regulation and control, intersection improvement and the implementation of an Area Traffic Control (ATC) System.

Consequently, with the acceptance of these proposals by the Malaysian Government, a Feasibility Study for the Outer Ring Road was conducted in 1981–1982 by JICA. In addition, technical experts have been dispatched to Penang for further technical cooperation and the undertaking of traffic management system planning.

With the completion of the Penang Bridge and the comprehensive Central Area Redevelopment Project (KOMTAR Project) in 1985, the volume of urban traffic has increased manyfolds, further aggravating urban transport problems in Penang. The Penang Municipality therefore decided to implement the first stage of the Area Traffic Control (ATC) System in 1985 with the help of the Government of Japan who contributed various necessary equipment such as the central microcomputer control and information display board.

Based on the above background of urban transport planning in Penang, this Study has structured a comprehensive urban transportation system management plan in examining the feasibility of expanding the ATC System in Penang.

1.2 Objective

The objectives of this Study are :

(1) To conduct traffic surveys and to formulate a comprehensive traffic management plan in the Study Area, including a pedestrian path network plan.

(2) To formulate a future computerised Area Traffic Control (ATC) System for the Study Area.

(3) To conduct the feasibility study of the proposed system.

(4) To propose the most appropriate implementation programme for the future ATC System in the Study Area.

The Study Area covers the eastern part of Penang Island (Greater George Town, Central District Development 21 (C.D.D. 21) and Bayan Baru district) as shown in Figure 1.1.

1.3 Organization

This Study is being carried out jointly by the Governments of Malaysia and Japan. The Malaysian Government has established two committees: The Steering Committee and the Technical Committee; the Japanese Government has set up an Advisory Committee.

These committees have been assisting the Study Team, providing it with advice and suggestions from time to time.

The organization set-up for this Study is shown in Figure 1.2.

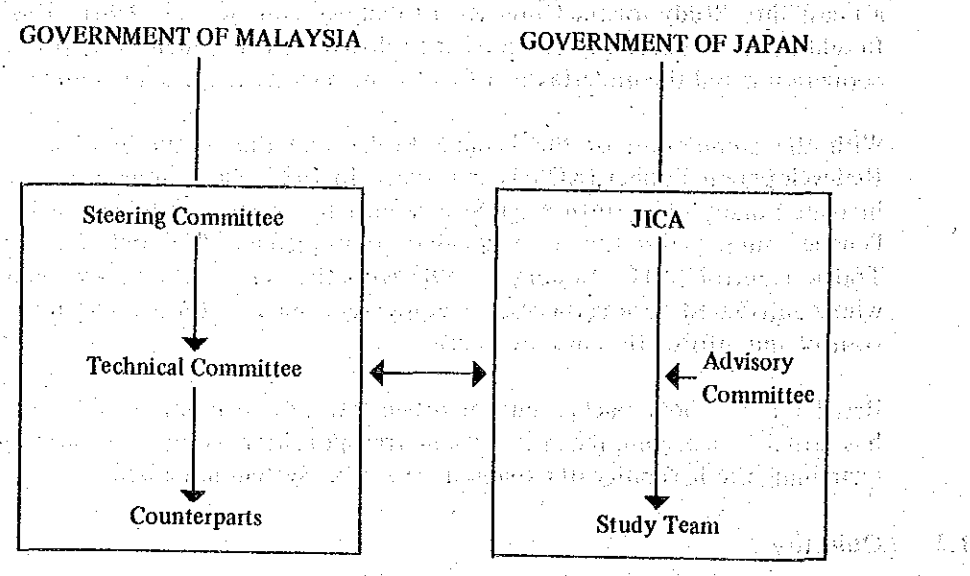


Figure 1.2 : Organisation Chart

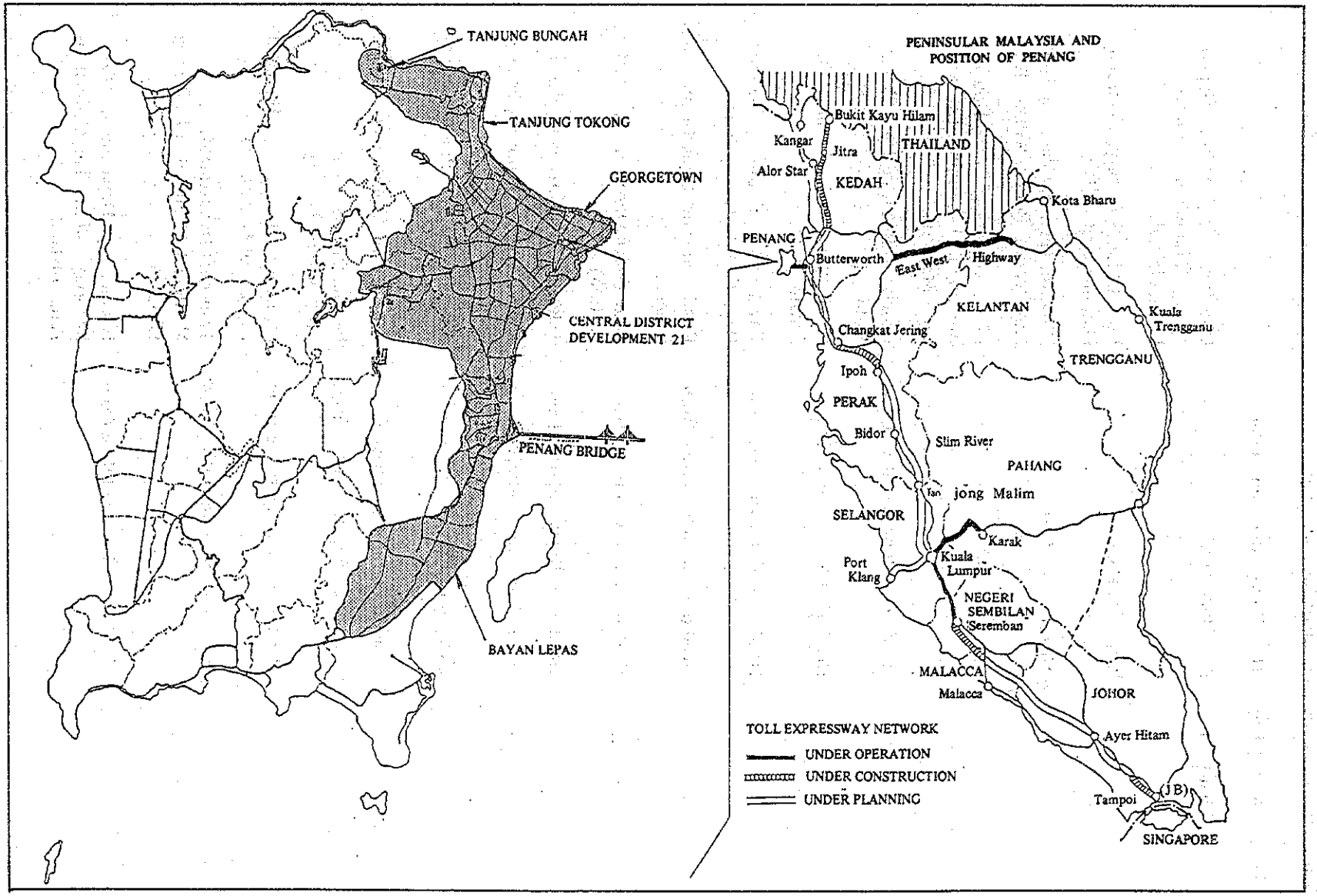


Figure 1.2.1 : Study Area

The committees are made up of the following:

(1) **Steering Committee, Malaysian Government**

Chairman	Koo Hock Song	Director, Engineering Department, Municipal Council of Penang Island.
	Wong Peg Har	Rep. Chief Secretary, Economic Planning Unit, K.L.
	Alexius Y. A. Loo	Director, Highway Planning Unit, Ministry of Public Works, K.L.
	Ghani bin Salleh	Dean, School of Housing, Building and Planning, Universiti Sains Malaysia.
	Head of or Representative from	Economic Planning Unit, Penang State.
	Head of or Representative from	Public Works Department, Penang State.
	Head of or Representative from	Town and Country Planning Department, Penang State.
	Head of or Representative from	Road Transport Department, Penang.
	Head of or Representative from	State Police Department, (Traffic Section).
	Head of or Representative from	Telecoms Department, Penang.
	Head of or Representative from	Water Supply Authority, Penang State.
	Head of or Representative from	National Electric Board, Penang State.
	Head of or Representative from	Penang Port Commission, Penang.
	Head of or Representative from	Penang Development Corporation, Penang.
	Head of or Representative from	Structure Plan Unit, Municipal Council of Penang Island.
	Head of or Representative from	Transport Department, Municipal Council of Penang Island.
	Head of or Representative from	Engineering Department (Road Sections), Municipal Council of Penang Island.

	Seki, Taichi (Fukui, Teru)	JICA Expert, Highway Planning Unit, K.L.
	Oyamatsu, Toshihiko	JICA Expert, Municipal Council of Penang Island.

(2) **Technical Committee, Malaysian Government**

Chairman	Koo Hock Song	Director, Engineering Department, Municipal Council of Penang Island.
	Ong Eng Poe	Highway Planning Unit, Ministry of Public Works.
	A. Thevarajah	Director, Public Works Department, Penang State.
	Zainol Rashid Zainuddin	Public Works Department, Penang State.
	Anwar Ahmad	Public Works Department, Penang State.
	Idris bin Abd. Rahim	Town & Country Planning Department, Penang State.
	S. Ambalawan	Deputy Director, Registration and Inspection of Motor Vehicle, Penang.
	Ng See Ghee	Inspector, Penang Police Headquarters.
	Rahim	Inspector, Penang Police Headquarters
	Hassim Mat	School of Housing, Building and Planning, Universiti Sains Malaysia.
	Abdul Jamal Mohd. Johar	Controller of Telecoms, Penang.
	Hj. Shafie Hj. Abd. Hamid	Controller of Telecoms, Penang.
	Khoo Say Keong	Penang Port Commission.
	Roslan Ishak	National Electric Board, Penang State.
	Jaseni Maidinsa	Water Supply Authority, Penang State.
	Tan Kim Pah	Penang Development Corporation.
	Mohd. Bazid Hj. Kahar	Penang Development Corporation.

	Tan Thean Siew	Project Manager, Structure Plan Unit, Municipal Council of Penang Island.
	Ong Siew Foon	Transport Department, Municipal Council of Penang Island.
	Tan Swan Teck	Deputy Director, Engineering Department, Municipal Council of Penang Island.
	Ang Aing Thye	Engineering Department, Municipal Council of Penang Island.
	Khoo Say Boon,	Engineering Department, Municipal Council of Penang Island.
	Seki Taichi (Fukui, Teru)	JICA Expert, Highway Planning Unit, Ministry of Public Works.
	Oyamatsu, Toshihiko	JICA Expert, Municipal Council of Penang Island.

(3) **Advisory Committee, Japanese Government**

Chairman	Katakura, Masahiko	Professor, Tokyo Metropolitan University.
	Asano, Mitsuyuki	Ministry of Construction.
	Hayashi, Koujiro	Urban Development Public Corporation.
	Fujii, Toshio	Tokyo Expressway Public Corporation.

(4) **Study Team**

Hanawa, Kokuro	Team Leader
Nabeshima, Yasuo	Transportation Planner.
Nakata, Katsuyasu	Urban Transport Planner.
Yamamoto, Toshinori	Traffic Engineer I.
Takahashi, Shunichi	Traffic Engineer II.
Sato, Takashi	Traffic Control System Planner.
Kaminaga, Akira	Transport Facility Planner.
Suzuki, Toshio	Transport Economic Analyst.
Takanashi, Naoki	System Analyst.

	Takagi, Michimasa	Public Transport Planner

(5) **Counterpart Engineers**

Tan Swan Teck	Engineering Department, Municipal Council of Penang Island.
Ang Aing Thye	Engineering Department, Municipal Council of Penang Island.
Kasa Ismail	Engineering Department, Municipal Council of Penang Island.
Hassim Mat	School of Housing, Building, and Planning, Universiti Sains Malaysia.
Tan Thean Siew	Project Manager, Structure Plan Unit, Municipal Council of Penang Island.

(6) **Local Engineers**

Chin Kar Keong	Fukuyama Consultants International
Ooi Peng Hong	Fukuyama Consultants International
Chua Mok You	Fukuyama Consultants International
Danny Tang	Fukuyama Consultants International

1.4 Study Approach

This Study was carried out in three (3) phases for a total of ten (10) calendar months in Penang, Malaysia.

Phase I commenced in July 1986 and ended in November 1986, Phase II was from November 1986 to the end of March, 1987 while Phase III started in July 1987 and ended in September 1987.

The main works in each phase are highlighted in a flowchart in Figure 1.3 and further elaborated below:

Phase I:

Phase I undertook the identification of existing as well as foreseeable future traffic and transport problems in Penang based on the results of the various traffic surveys and the future traffic-demand forecasts.

Phase II:

Phase II carried out the formulation of improvement plans for traffic and transport facilities essential for Transportation System Management (TSM). This involves in particular the preparation of improvement and expansion plan for the ATC System, improvement plan for the Pedestrian Path Network and other facility improvement plans.

Phase III:

Phase III put forward the proposal of an Implementation Programme for the recommended plan duely evaluated using the economic and financial analysis. From the proposed implementation programme, a set of priority projects were selected, taking into account their potential impact on the city's development.

In addition, this study was conducted in accordance with the schedule as shown in the detailed flowchart in Figure 1.4.

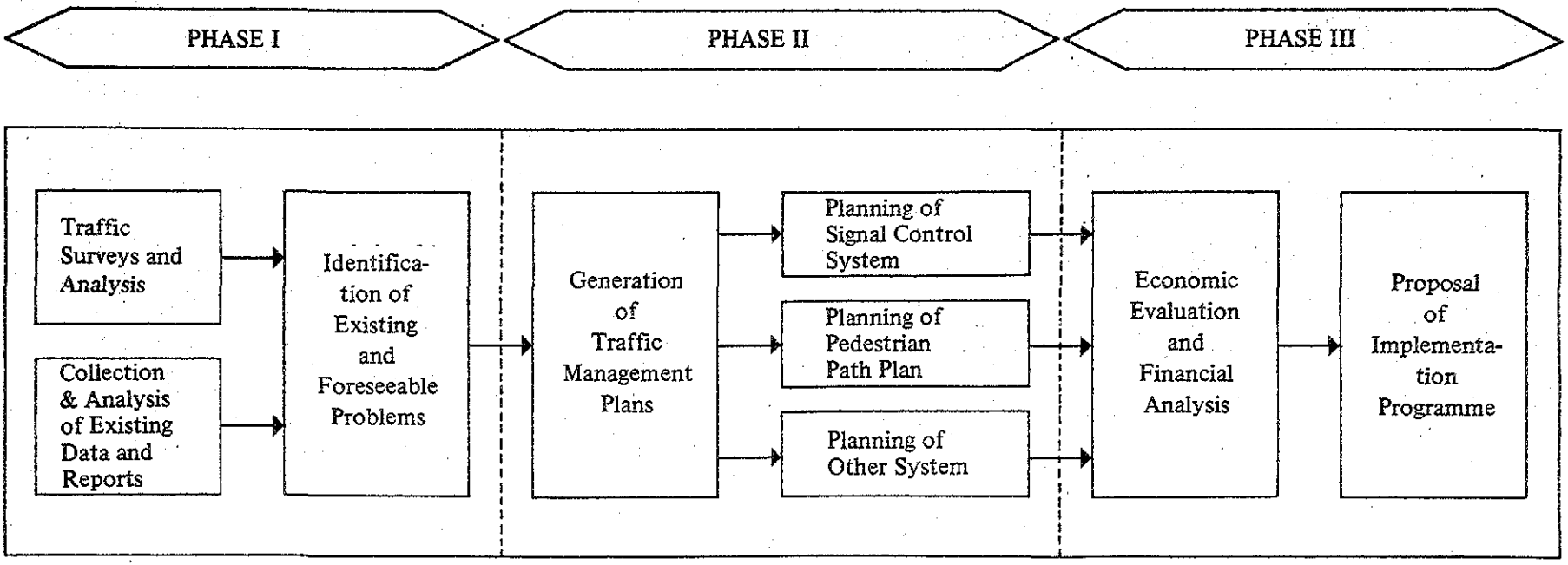


Figure 1.3 : Phasing of the Study

PHASE

PHASE I

P

* Determination of Traffic Survey Methods
* Preparation of Traffic Surveys
* Recruitment of Interviewers/ Enumerators

Preparation for Car-owner Home Interview Survey

* Design and Printing of Questionnaires
* Sampling of Car Owners
* Public Relation Activities

Execution of Traffic Surveys

* Car-owner Home Interview Survey
* Cordon Line Survey
* Screen Line Survey

Data Processing

* Coding
* Data Processing
* Preparation of Mastertape for Data Analysis

Calibration of Traffic Demand Models

* Traffic Demand Models
* Input Data from Traffic Surveys

Projection of Future Traffic Demand for Base Case

Simulatio
Condition
Plans usin
Simulatio

* Survey on Existing Landuse Conditions and Transport Facilities
* Analysis of Regional Development Trend

Prediction of Future Landuse and Zonal Socio-economic Framework

Identification of Future Transport Problems and Issues

Examination and Establishment of Transportation System Management (TSM) Strategies and Actions

Survey of Existing Traffic Conditions

* Intersection Traffic Count Survey
* Pedestrian Traffic Survey
* Parking Survey
* Bus Passenger Survey
* Travel Time Survey
* Congestion Degree Survey

Analysis of the Results of Traffic Surveys

Assessment on the Impacts of the Phase 1 ATC System in Georgetown

* Collection of Existing Data and Reports
* Preliminary Site Survey
* Inventory Survey

Analysis of Existing Traffic Data

* Analysis of Traffic Accident Data
* Analysis of Transport and Traffic Facilities condition and capacity
* Review of the Proposed and Committed Transport Projects and Improvement Plans.

Identification of Existing Transport Issues and Problems

Generation of Alternative Plans for Transportation System Management (TSM)

* Traffic Control Measures (One way system, right turning prohibition measure, counter-flow lanes, etc.)
* Parking Regulation and Control and Off-Street Parking Facilities Improvement.
* Traffic Signal Control System Expansion
* Pedestrian Path Network Improvement
* Intersection and Selective Street Improvements
* Bus Transport System Improvements
* Introduction of Other Public Transport System

REPORTING	Inception Report					Progress Report		
TIME	1986 7	8	9	10	11	12	1987	

PHASE II

Data Processing
* Coding
* Data Processing
* Preparation of Mastertape for Data Analysis

Calibration of Traffic Demand Models
* Traffic Demand Models
* Input Data from Traffic Surveys

Prediction of Future Landuse and Zonal Socio-economic Framework

Projection of Future Traffic Demand for Base Case

Identification of Future Transport Problems and Issues

Examination and Establishment of Transportation System Management (TSM) Strategies and Actions

Simulation of Future Traffic Conditions for the Alternative Plans using the Traffic Assignment Simulation Models

Formulation of Alternative Plans for ATC System Improvement and Expansion

Evaluation of Alternative Plans

Preliminary Engineering Design of the Optimum Plan

Formulation of Pedestrian Path Network Plan

Formulation of Bus Transport Improvement Plan

Formulation of Other Transportation System Management Measures

Evaluation of ATC System – Stage I

Estimate of Project Costs

Estimate of Project Benefits

Economic Analysis and Evaluation

Analysis of MPPP's Financial Situation

Evaluation of Project Implementation Capability
* Financial Analysis and Evaluation
* Project Effectiveness Analysis
* Traffic Impact Analysis

sults of

Impacts of
System in

Identification of Existing Transport Issues and Problems

Generation of Alternative Plans for Transportation System Management (TSM)
* Traffic Control Measures (One way system, right turning prohibition measure, counter-flow lanes, etc.)
* Parking Regulation and Control and Off-Street Parking Facilities Improvement.
* Traffic Signal Control System Expansion
* Pedestrian Path Network Improvement
* Intersection and Selective Street Improvements
* Bus Transport System Improvements
* Introduction of Other Public Transport System

Progress Report

Interim Report

10	11	12	1987 1	2	3	4 5 6	7

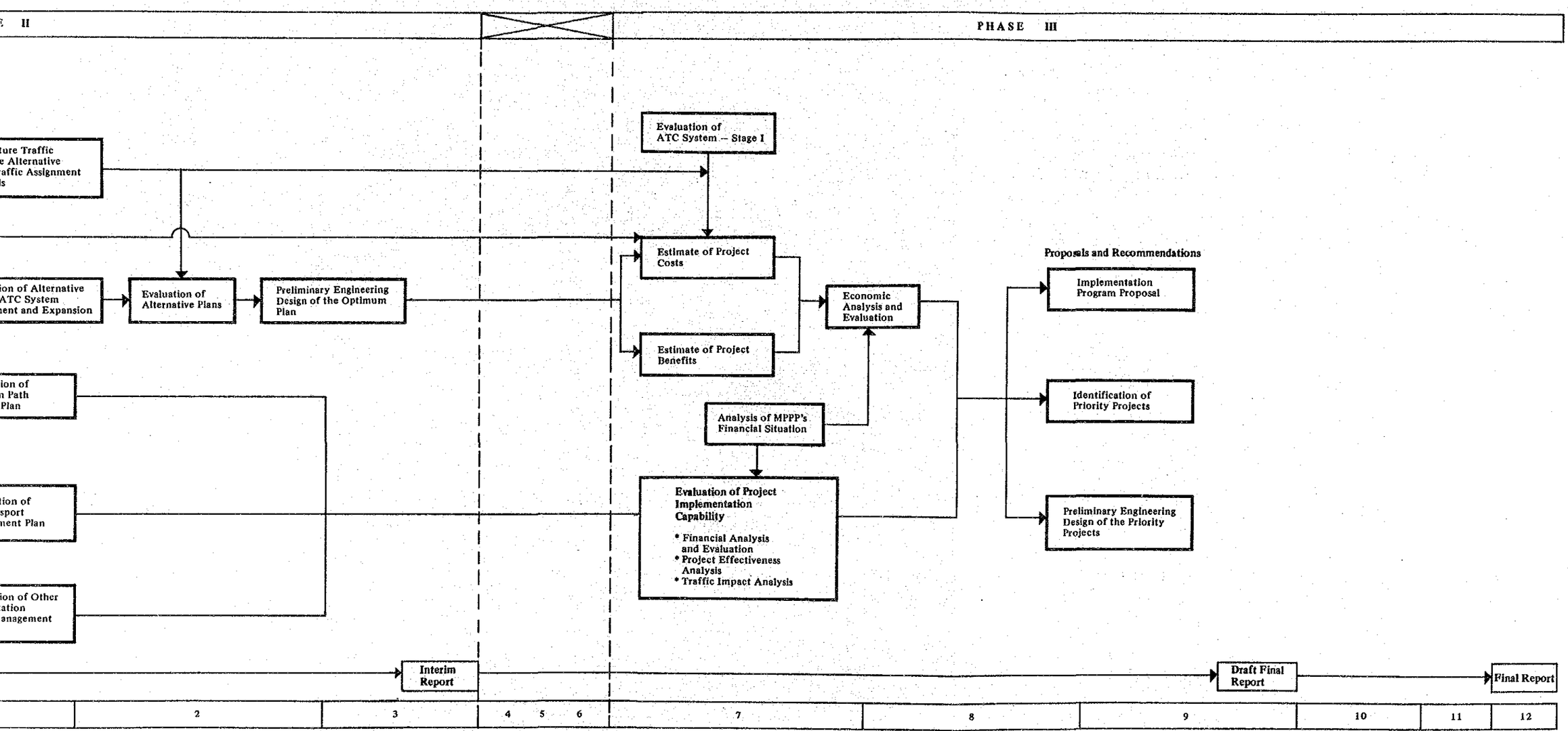


Figure 1.4 : Flowchart of the Study Process and Schedule

PRESENT AND FUTURE TRANSPORTATION CONDITIONS AND PROBLEMS

2

2.0 PRESENT AND FUTURE TRANSPORTATION CONDITIONS AND PROBLEMS

2.1 Introduction

In this feasibility study, many surveys were conducted, the main one being the Vehicle Owner Interview Survey (VOIS). Studies on the phenomena of traffic generation by various transport modes, vehicle OD movement patterns, travel time, past accident patterns, etc. were undertaken by the Study Team in the course of this study.

From these studies, the present and future (in year 2000) transportation conditions and problems in the Study Area can be discerned. The main transportation problems in the Study Area are listed below.

(1) The severe congestion on road sections especially along Dato Keramat Road, Jelutong Road and around the KOMTAR area is expected to worsen in the future.

(2) The accident rate in the Study Area is high and traffic safety policies including education regarding road-use, driving methods, etc. are lacking.

(3) Apart from the newly-installed traffic signals under the Stage I ATC System, most existing traffic signals are outdated and inadequate, causing unnecessary delay in travel.

(4) Provision of space for pedestrians is inadequate causing anxiety to pedestrians crossing the streets.

(5) Many stage buses are old; the bus services are not dependable and irregular and the present conditions show a general poor service level. In recent years the passenger volume has been declining and if no action is taken, the trend will continue in the future.

(6) High car traffic volume flowing into the Central Area of George Town is expected to create a shortage of parking space. In addition, stricter enforcement of on-street parking control is also expected to aggravate parking problems.

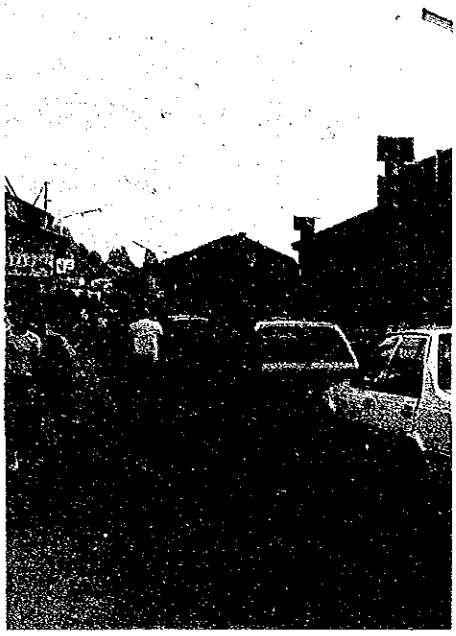
(7) The lack of good driving manners among most motorists, such as the refusal to abide by the traffic rules, reflects an inadequacy on road traffic education. On top of this, the existence of illegal taxis and trishaws has added to the obstruction of smooth traffic flow.

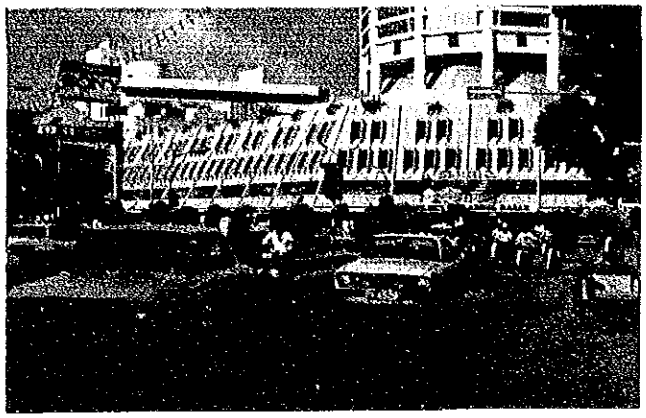
In the following sections, each of the abovementioned transportation problems will be discussed in detail.

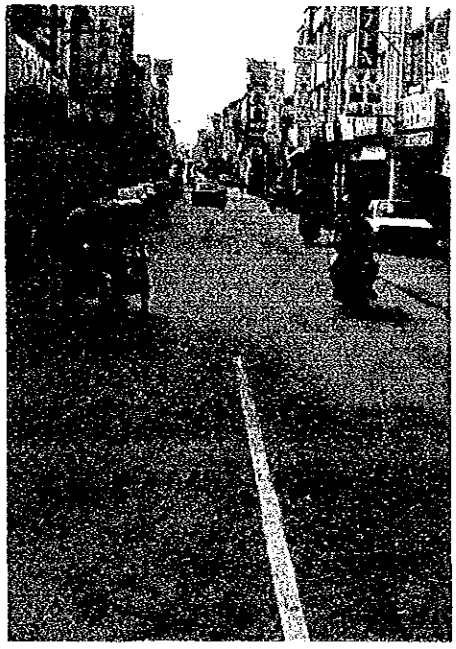
2.2 Traffic Congestion

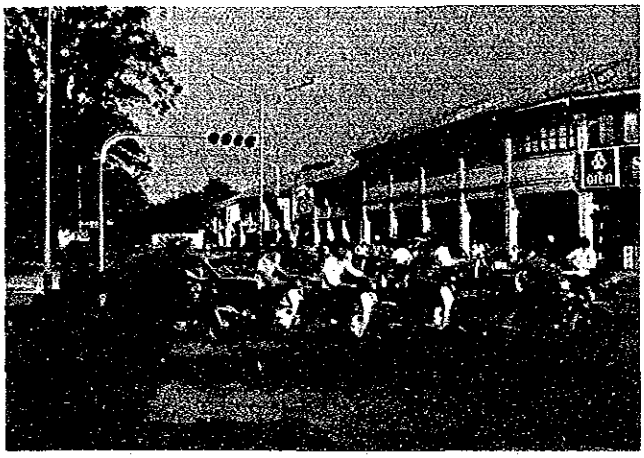
A. Complicated Road Network Configuration and Insufficient Traffic Capacity

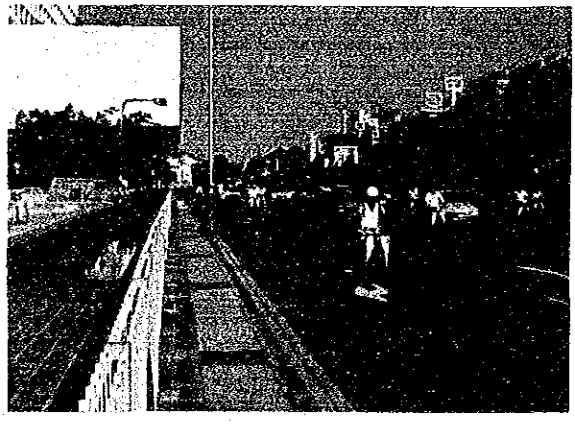
The existing road network configuration in the Study Area as shown in Figure 2.1 is complicated in the sense that a clear-cut hierarchial road system is absent. The major roads are not easily identifiable from the local roads.











1 2 3 6 4 5

1. *Traffic condition along Jelutong Road during the evening peak.*
2. *The second highest delay time has been recorded at Magazine Circus.*
3. *Traffic condition along Northam Road during the morning peak.*
4. *The highest delay time was recorded at the Perak Road/Dato Keramat Road Intersection.*
5. *Traffic Condition around KOMTAR along Magazine Road.*
6. *Absent or faded lane markings encourages careless or undisciplined driving habits.*

Furthermore, as indicated in Figure 2.2, high delay time on road sections manifested by traffic congestion in the CBD can be observed when a large volume of traffic is discharged on to the existing network. The reasons for traffic congestion can be broadly classified as those due to insufficient traffic capacity of the road network and those due to obstacles which reduce the capacity of road sections to permit smooth traffic flow.

1. Insufficient Traffic Capacity of Roads and Intersections

   Bottlenecks are caused by deficient traffic capacity of roads and intersections brought about by the following:—

   (1) Narrowness of roadway

   (2) Inadequate space provision at intersection approaches to accomodate the traffic demands

   (3) Improper signal phasing and timing at signalized intersections

   (4) Roundabouts with small islands

   (5) Irregularity of intersection type

   (6) Unclear demarcation of lanes

2. Obstacles to Smooth Traffic Flow

   Congestion caused mainly by inadequate provision of intersection approach facilities is also augmented by various adverse conditions as mentioned below:

   (1) Bus stoppages (especially on roadways with heavy traffic volume) that disrupt traffic flow

   (2) Parked cars and cars in the act of parking

   (3) On-street waiting cars

   (4) Loading and unloading of merchandise on busy roadways

   (5) Pedestrian movement on carriageway

   (6) Road-side activities

   (7) Trishaw and hawker movements on carriageway

   (8) Disrespect for traffic-control devices by drivers

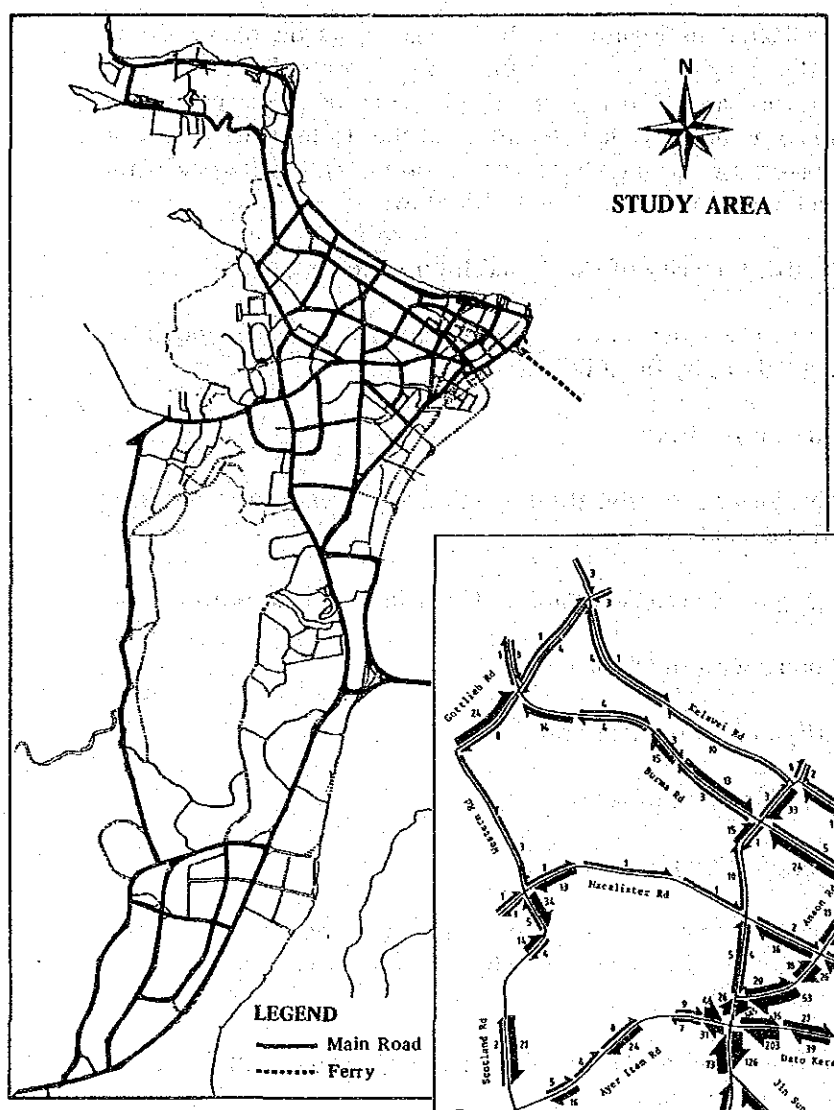


Figure 2.1 : Existing Road Network, 1986

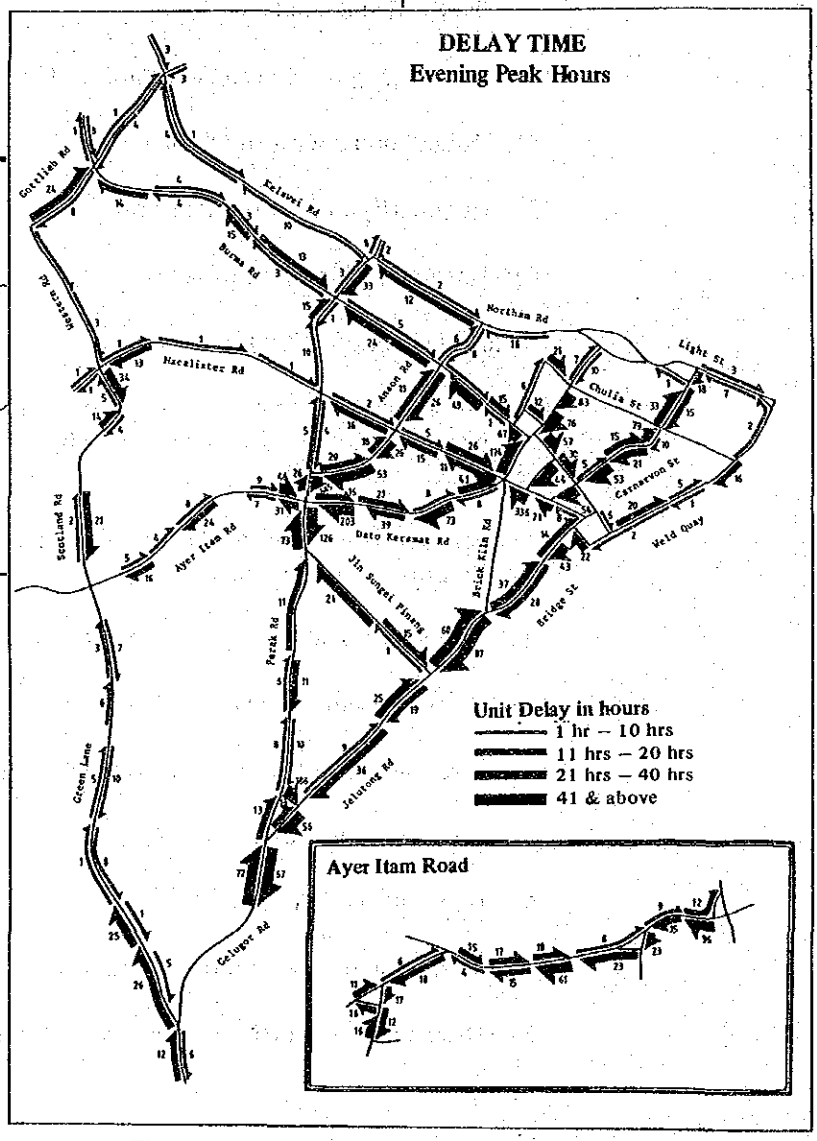


Figure 2.2 : Delay Time on Major Roads in George Town and Ayer Itam during Evening Peak Hours

B. Increment of Vehicular Traffic Demand

Figure 2.3 shows the trend of population and vehicle ownership in the Study Area. The expected number of vehicles in the Study Area by 2000 is estimated from the existing vehicle ownership pattern and the consideration of future improvement in the standard of living. Table 2.1 shows the vehicle ownership per capita in 1986 was 0.37 vehicle. This is expected to increase to 0.49 vehicle by year 2000.

Therefore, the number of vehicles in the year 2000 will have increased 1.56 times from the number in 1986, i.e. from 164,000 vehicles in 1986 to 256,000 vehicles in 2000.

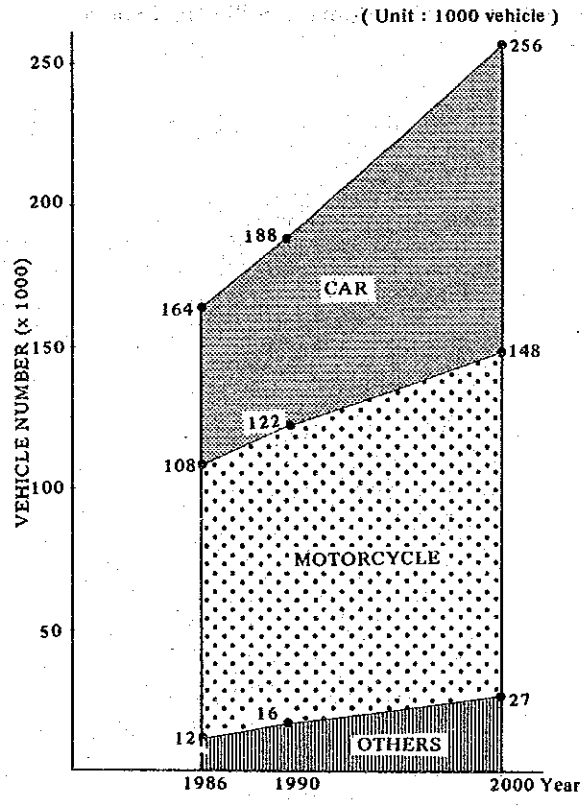


Figure 2.3 : Trend of Growth in Vehicle Number

Table 2.1 : Vehicle Number and Population

		1986	1990	2000	Average Annual Growth Rate 1990/1986	2000/1990
Car	Private	53,500	63,000	102,100	4.2	4.9
	Company	2,940	3,400	5,400	4.2	4.9
	Sub-Total	56,440	66,400	107,500	4.2	4.9
M/c	Private	90,400	100,300	115,300	2.6	1.4
	Company	4,760	5,300	6,100	2.6	1.4
	Sub-Total	95,160	105,600	121,400	2.6	1.4
Taxi		750	940	1,440	5.7	4.3
Van		1,580	2,120	3,690	7.6	5.7
Lorry		8,560	11,480	19,990	7.6	5.7
Bus	Schedule	210	260	390	5.3	4.0
	Other	940	1,040	1,540	5.3	4.0
	Sub-Total	1,050	1,300	1,930	5.3	4.0
Total		163,540	187,840	255,950	3.5	3.1
Population		437,200	460,900	517,600	1.3	1.2
Vehicle/Population		0.37	0.41	0.49		

Note : Figures modified by the Study Team from the analysis of the number of road tax disks issued.

On the other hand, the vehicular traffic demand is estimated from the data on vehicle ownership growth, population distribution in relation to landuse pattern, and the employee distribution pattern.

Figure 2.4 shows the OD distribution pattern for 1986 and 2000 while the population and employee distribution patterns taken from the Penang Island Structure Plan (PISP) are shown in Figures 2.5 and 2.6.

Future vehicular traffic demand in year 2000 is forecasted to increase by an average of 1.8 times the 1986 figure under the influence of increasing trip length resulting from the sprawling of population into the outskirts and increasing vehicle ownership. As can be observed from Figure 2.4, the most rapid growth in traffic volume is found in the corridor linking the Central Area and Bayan Lepas. The OD volume will increase 1.85 times from 18,300 pcu/day in 1986 to 33,800 pcu/day in 2000.

Since the existing road network is already experiencing congestion, it is likely that its inability to handle the impending huge traffic demand will affect social and economic activities in the Study Area.

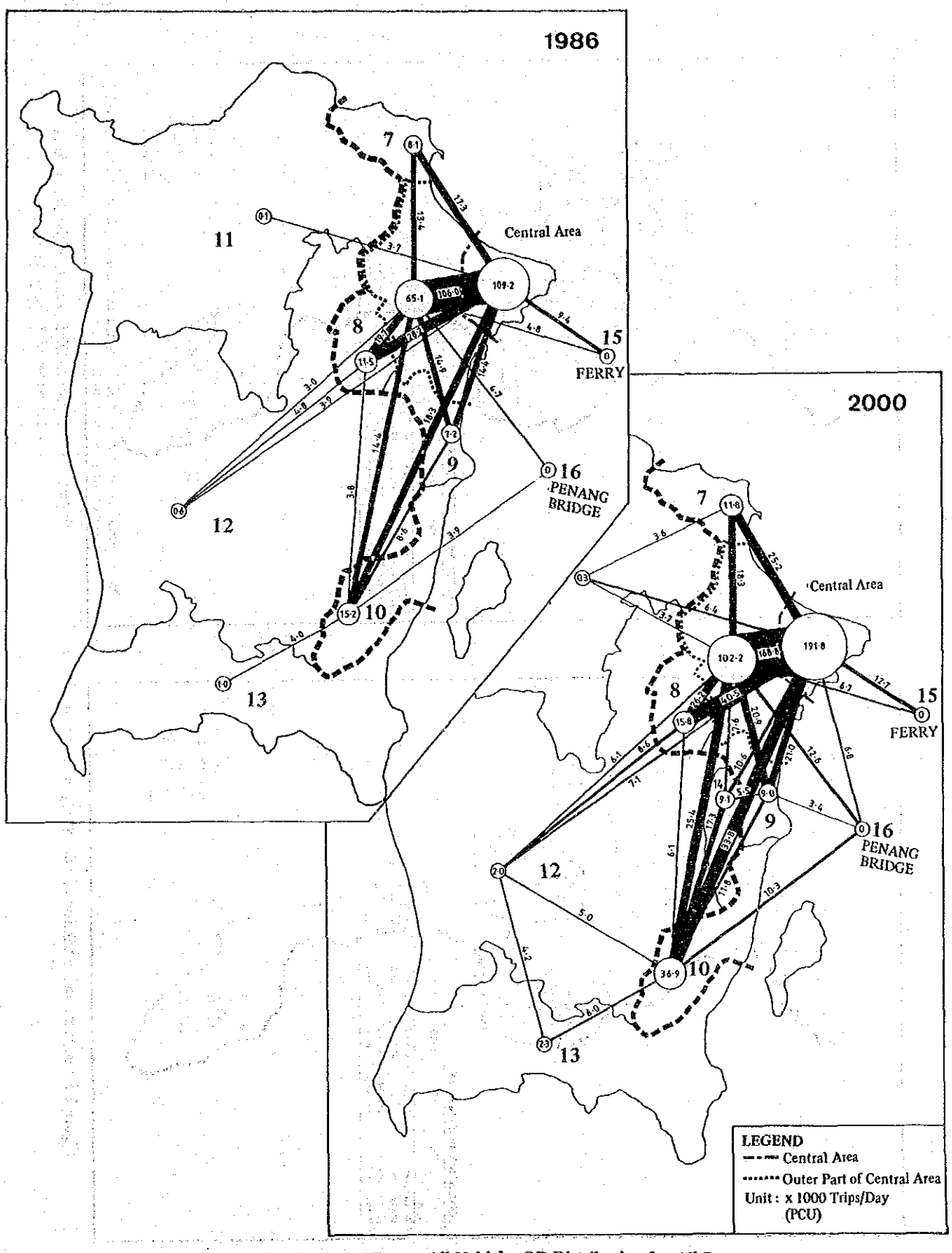
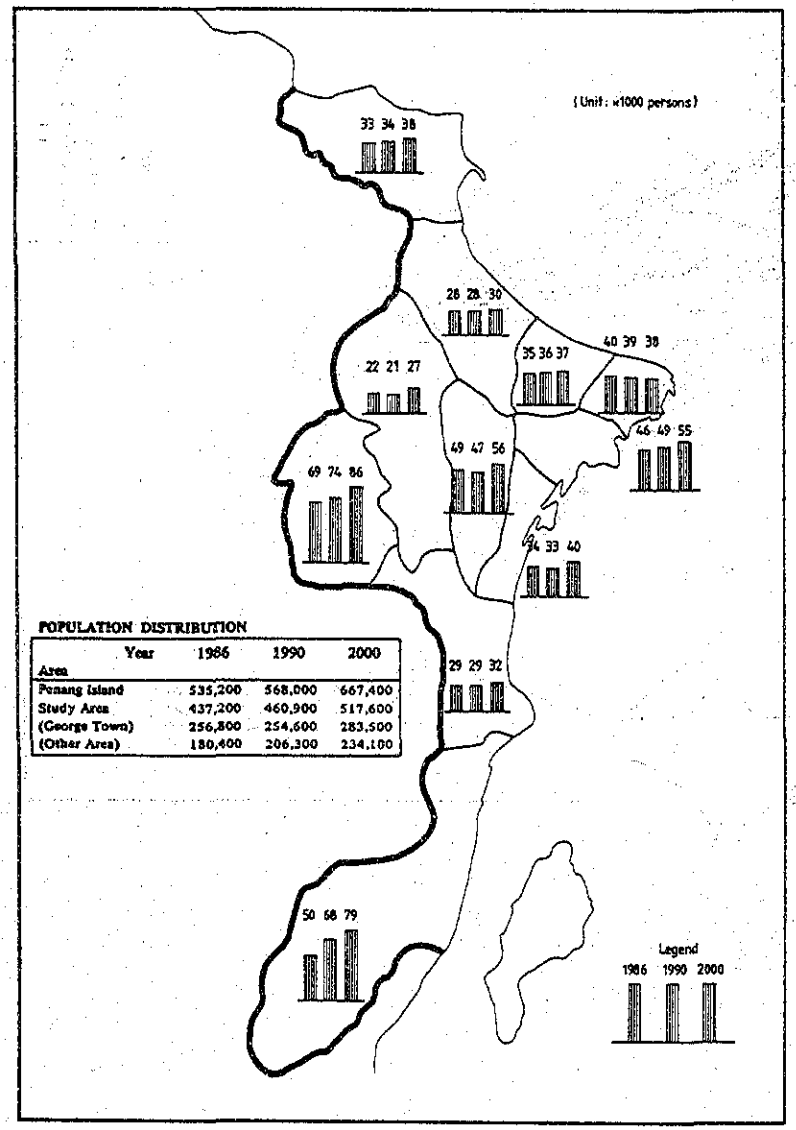


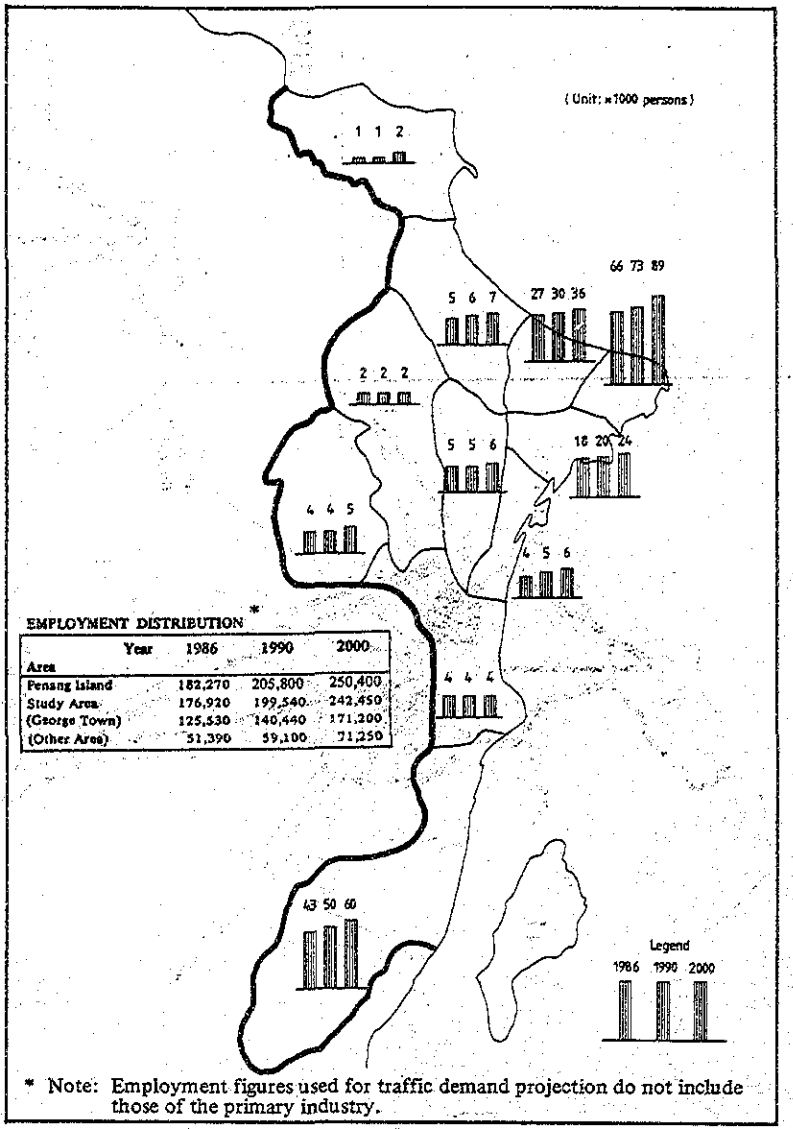
Figure 2.4 : Present and Future All Vehicles OD Distribution for All Purposes



POPULATION DISTRIBUTION

Area \ Year	1986	1990	2000
Penang Island	535,200	568,000	667,400
Study Area	437,200	460,900	517,600
(George Town)	256,800	254,600	283,500
(Other Area)	180,400	206,300	234,100

Figure 2.5 : Population Distribution in the Study Area



EMPLOYMENT DISTRIBUTION *

Area \ Year	1986	1990	2000
Penang Island	182,270	205,800	250,400
Study Area	176,920	199,540	242,450
(George Town)	125,530	140,440	171,200
(Other Area)	51,390	59,100	71,250

* Note: Employment figures used for traffic demand projection do not include those of the primary industry.

Figure 2.6 : Employee Distribution in the Study Area (Exclusive of Primary Sector)

C. Worsening of Traffic Congestion

The worsening of traffic congestion in the Central Area can be foreeseen judging from the results of traffic assignments of forecasted future traffic volume to the existing road network. The results are illustrated on Figure 2.7.

The following points are noted:

(1) Vehicle Running Hour in year 2000 is expected to be 2.5 times longer than the 1986 value.

(2) Vehicle Running Cost in year 2000 will double that of 1986.

(3) The average velocity in year 2000 will decrease by about 25% from the 1986 value.

These findings indicate a deterioration of traffic condition in the future.

Furthermore, as can be seen from Figure 2.8, the traffic volume on almost all the roads in the existing road network will be over their capacity by year 2000.

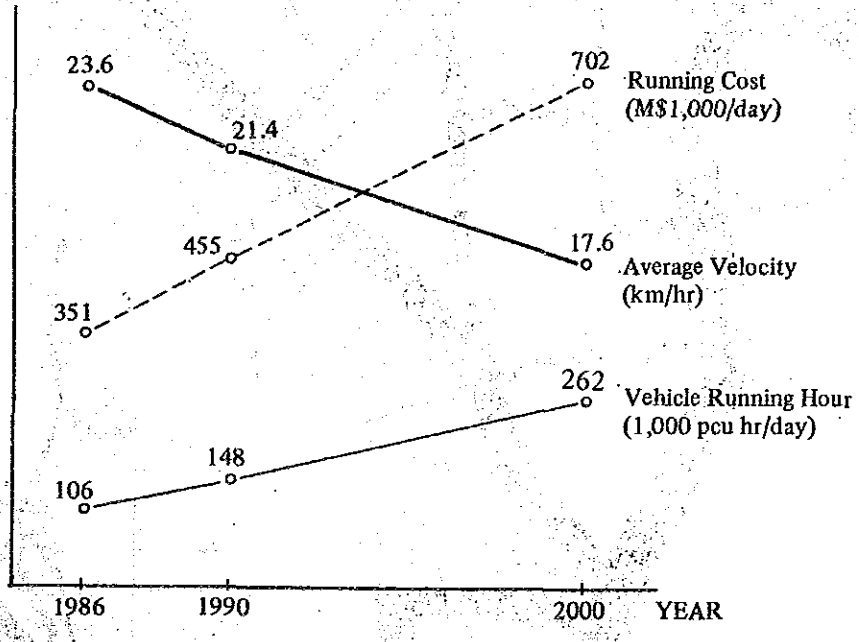


Figure 2.7 : Present and Future Traffic Conditions obtained from Traffic Assignment to Existing Road Network in Central Area

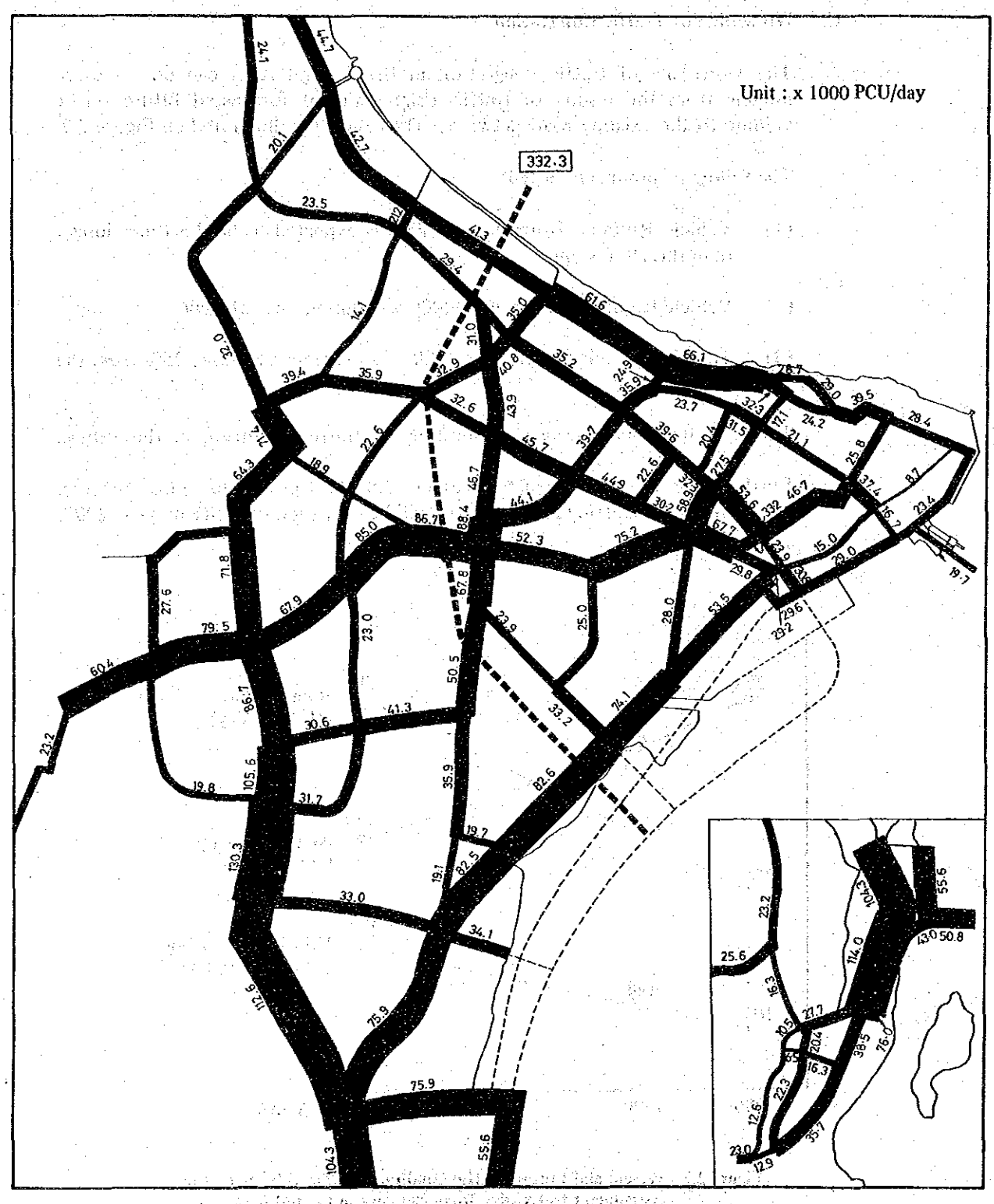


Figure 2.8 : Traffic Assignment Under Do-Nothing Case, 2000

2.3 Traffic Accidents

A. Large Number of Traffic Accidents

According to the traffic accident record, the number of traffic accidents in George Town was 5,856 in 1985 and its related deaths was 103.

The analyses of accident records were carried out separately. High accident-rate locations are identified based on the number of accidents for intersections and number of accidents per kilometer for stretches of road.

Figure 2.9 shows the number of accidents at major intersections in George Town. The following intersections experienced the highest number of accidents in 1985.

Intersection	Number of Accidents
(1) Green Lane/Ayer Itam Road	44*
(2) Dato Keramat Road/Perak Road	34
(3) Green Lane/Gelugor Road	33
(4) Burma Road/Gottlieb Road	28

* The data was obtained when the intersection was still signalised. However, since then, a flyover has been constructed.

Figure 2.10 depicts the composition of collision pattern. Car/motorcycle collisions are prominent in terms of number and severity. Car/motorcycle collisions account for a high percentage in the number of fatal accidents, injury accidents and the total number of accidents at 17.0%, 41.7% and 30.7% respectively.

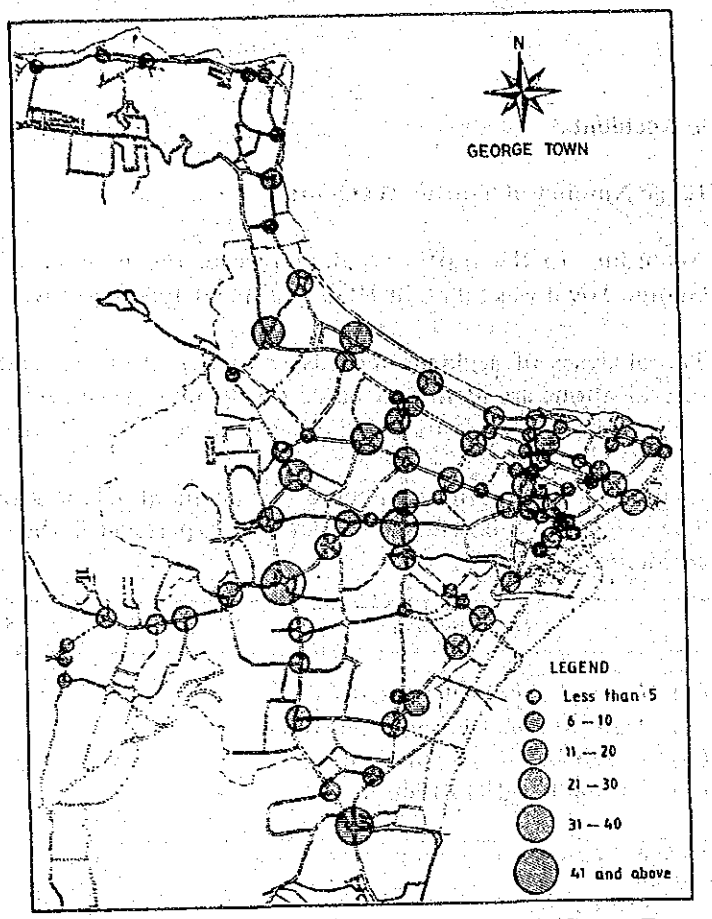


Figure 2.9 : Number of Accidents at Major Intersections in George Town, 1985

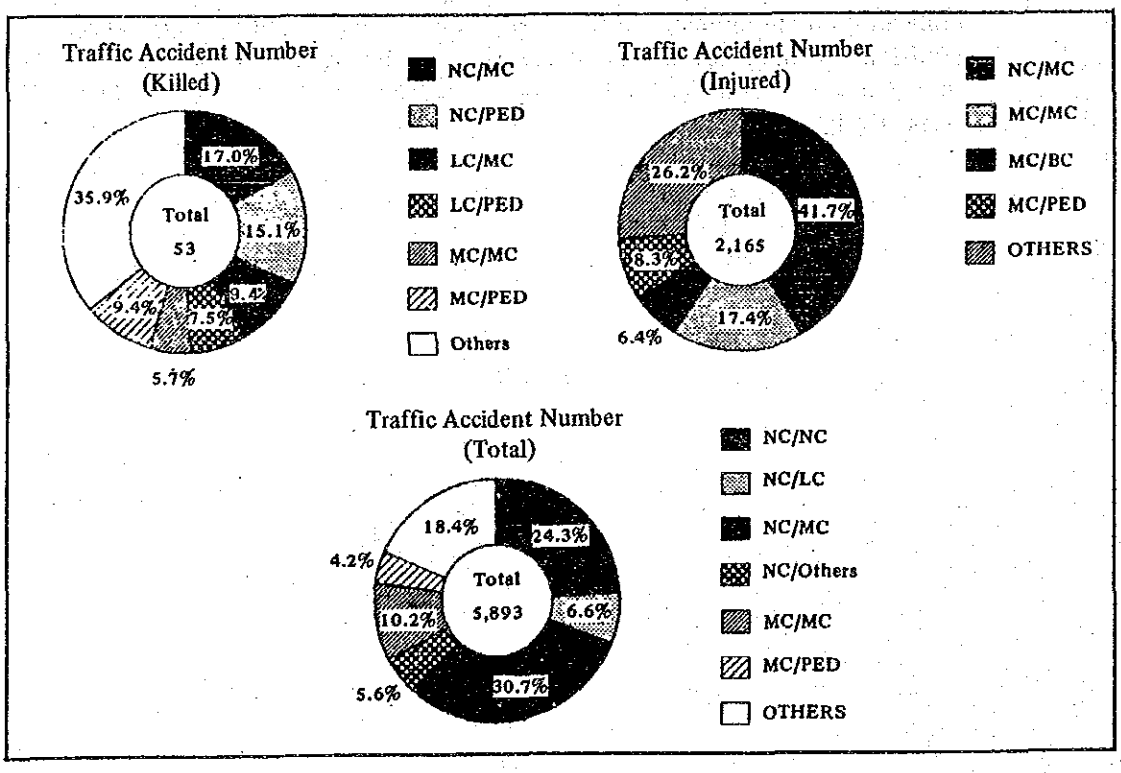


Figure 2.10 : Analysis of CCollision Pattern

B. High Traffic Accident Rates

Table 2.2 compares the accident rates in George Town, Kuala Lumpur and Japan.

Fatal accident rates as well as injury accident rates in George Town are conspicuously higher than those in Kuala Lumpur and Japan.

Table 2.2 : Comparison of Accident Data

	George Town	Kuala Lumpur	Japan
Fatal accident per 100,000 population	41.6	8.1	7.6
* Injury accident per 100,000 population	1,009.6	121.9	527.5
Fatal accident per 10,000 vehicles	6.9	5.2	1.6
* Injury accident per 10,000 vehicles	167.5	78.4	107.1

Note : * For reference only, because the definition of injury may be different in different data sources.

2.4 Traffic Signals

A. Inadequate Traffic Control Signals Prior to Stage I ATC System

1. Type of Traffic Signals

Prior to the implementation of the Stage I ATC System, there were thirty-eight (38) sets of traffic control signals in George Town. In addition, five (5) sets of traffic control signals were located outside the city.

The types of traffic control signals used are:

(1) Two-phase pre-timed traffic signals (5 locations)

(2) Two-phase pre-timed traffic signals co-ordinating three (3) intersections (3 locations)

(3) Fully actuated signals with three (3) or four (4) phases (22 locations)

(4) Pedestrian signals actuated by push buttons (6 locations)

(5) Pedestrian signal co-ordinating vehicle signals (1 location)

(6) Vehicle signal controlled by operator for access to/from the ferry terminal (1 location)

Figure 2.11 shows the location of these different types of signals.

2. Installation of Traffic Signals

In preserving the aesthetic beauty of the city, an underground wiring method is used for cable installation and loop-coil type of vehicle detectors adopted instead of the overhead ultrasonic type.

Two types of signal lamp poles are used in the city: the overhead pole with arm and the short vertical pole (Pedestal pole). The short vertical pole is installed at the near-side of all intersection approaches as the primary signal and at the far-side of some intersections as the secondary signal, while the arm-type pole is used at the far-side of important and critical intersections as the secondary signal.

Also, at important and critical intersections, right-turn lanes and traffic signals with green arrows are provided for right turning traffic.

3. Problems of Signal Control Prior to Stage I ATC System

The two phase pre-timed traffic signals installed at five (5) intersections have various disadvantages. The cycle length and split cannot be adjusted according to the variations of traffic demand. Besides, this type of signal reduces the intersection capacity and causes undue delay especially for right-turning traffic during high volume periods. In addition, the old signals are too small and have poor visibility.

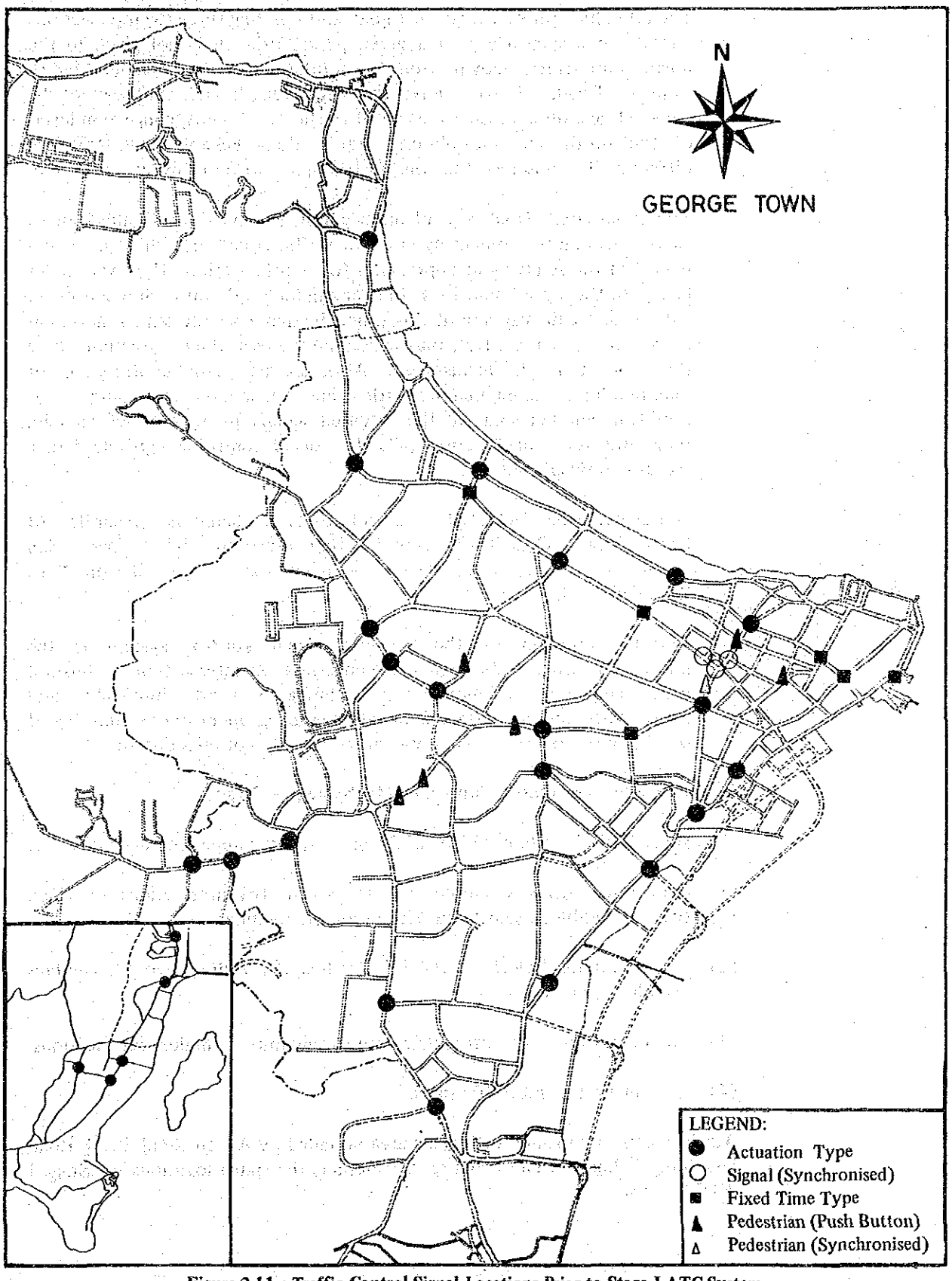


Figure 2.11 : Traffic Control Signal Locations Prior to Stage I ATC System

The two-phase pre-timed traffic signal co-ordinating three (3) intersections operate in a such a way that green period priority is not given to the north-bound traffic moving from the southern section of Penang Road to Transfer Road. Furthermore, the cycle length and split cannot be adjusted according to the variation of traffic flow. Thus, congestion levels of the north and south-bound traffic along Penang Road are very different; it is observed that the north-bound traffic is always congested.

Traffic-actuated signal control units permit the cycle length and split to vary according to moment-by-moment traffic counts by vehicle detectors placed in the roadway at approaches to the intersection. However, under heavy traffic flow conditions, the maximum limits on each green phase will occur frequently and at this time, the signal has the same function as a pre-timed signal control, thus causes problems at the intersection where this type of signals are installed. Also, actuated signal controls are not operated in a linked manner with other signals along the route. It is doubtful whether some of the actuated signals are working effectively. When the detector function fails, the signal control is equivalent to a fixed-time signal control.

Pedestrian signals actuated by push-buttons are being used regardless of traffic flow. Thus, traffic flow is often interrupted by the pedestrian signals, increasing undue delay on major roads, especially on Dato Keramat Road.

Another problem of the previous signal control system is the unsynchronised coordination between signalised intersections. Constant maintenance of optimum control timing is nearly impossible and unnecessary energy wastage is inevitable during operation as dimming of traffic signals and use of energy-saving lamps are not introduced.

B. Computerised Area Traffic Control (ATC) System – Stage I

The Stage I ATC System which MPPP has already implemented consists of:

(1) Centralised signal system controlling sixteen (16) intersections, of which two (2) mid-block signals for pedestrians are included.

(2) Closed Circuit Television (CCTV) System controlling two (2) cameras installed at key locations.

(3) Channelization and geometric improvements at major intersections.

(4) Lane markings and traffic signs.

All the signals are located within the area bounded by Anson Road, Perak Road and Sungai Pinang Road. Figure 2.12 depicts the signal locations for Stage I ATC System.

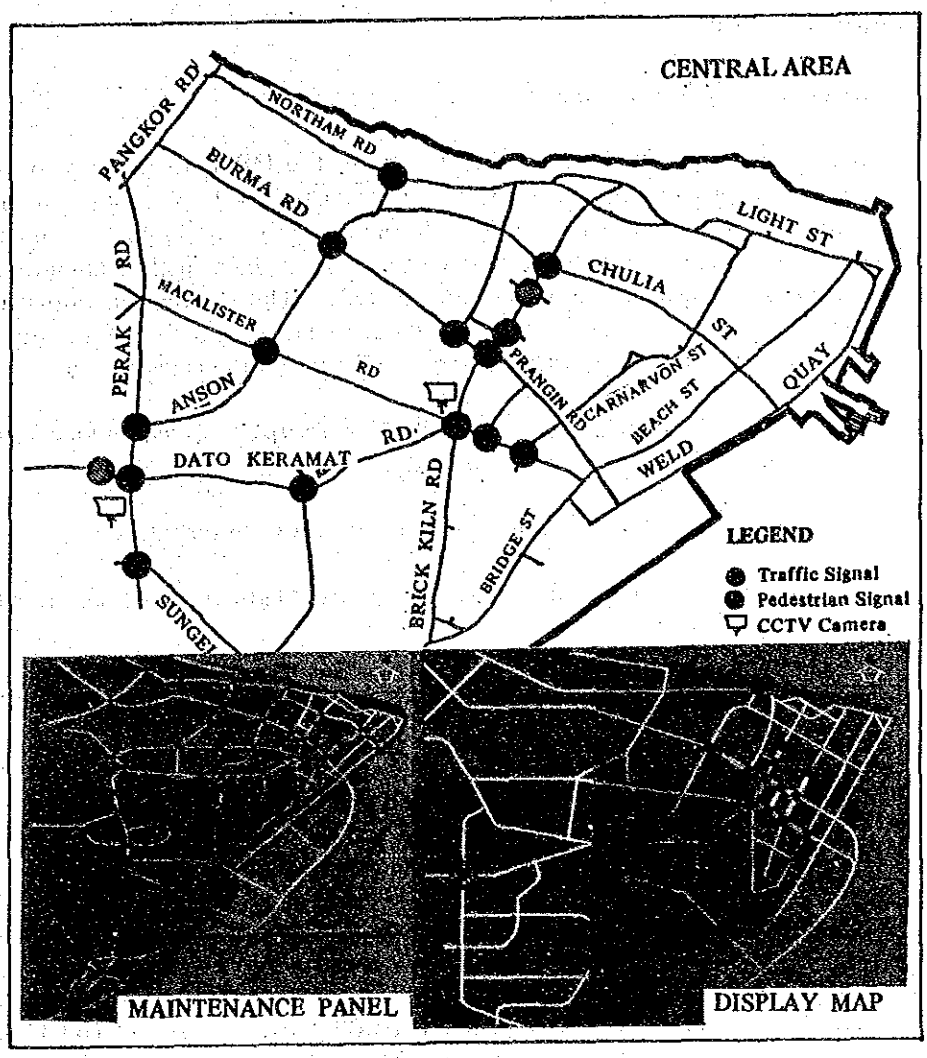


Figure 2.12 : Signal Locations in Stage I ATC System

2.5 Pedestrian Facilities

A. Inadequate Pedestrian Space

While on-going efforts are being made by the MPPP to improve pedestrian paths, the progress is still too slow. The existing pedestrian space in the city would be inadequate to accommodate the increasing urban pedestrian demand. Even in the Central Area where there is a high pedestrian movement, continuous pedestrian access is non-existent. The existing corridors are too narrow to accommodate all the pedestrians who want to enjoy shopping along busy streets. This forces the pedestrians to walk on the carriageway.

On top of this, obstructions on pedestrian footpath which hinder a smooth pedestrian movement in the city include:

(1) Merchandise being placed on the five-foot way or corridor.

(2) Structures such as fire-hydrants and street-light posts which are sited on the pavement.

(3) Unlawful parking of cars and motorcycles on pedestrian footpaths.

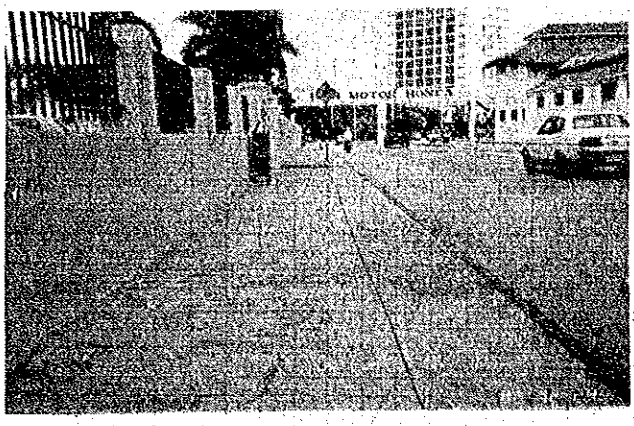
Figure 2.13 shows the existing types of pedestrian facilities and their location in the Central Area.

B. High Pedestrian Accident Rate

The accident exposure rate of pedestrians is quite high in George Town based on the 1985 traffic accident data. The result shows that the accident exposure rate of pedestrians is estimated to be 175 per 100,000 persons and the pedestrian fatality rate is at 12.8 per 100,000 persons in George Town, while in Japan, the rates are 70 and 2.1 respectively.

C. Low Pedestrian Safety Priority

Jay-walking has become a common sight in George Town. The primary reason is attributed to the inadequate pedestrian crossing facilities at busy intersections and across heavily trafficked roads. There are stretches of street of about a kilometer long without any pedestrian crossing facility along them at all. Consequently, pedestrians have inculcated a habit of crossing the street wherever they please. Such a habit if left unchecked would pose a hazard to road users and pedestrians alike.



Pavement

Corridor

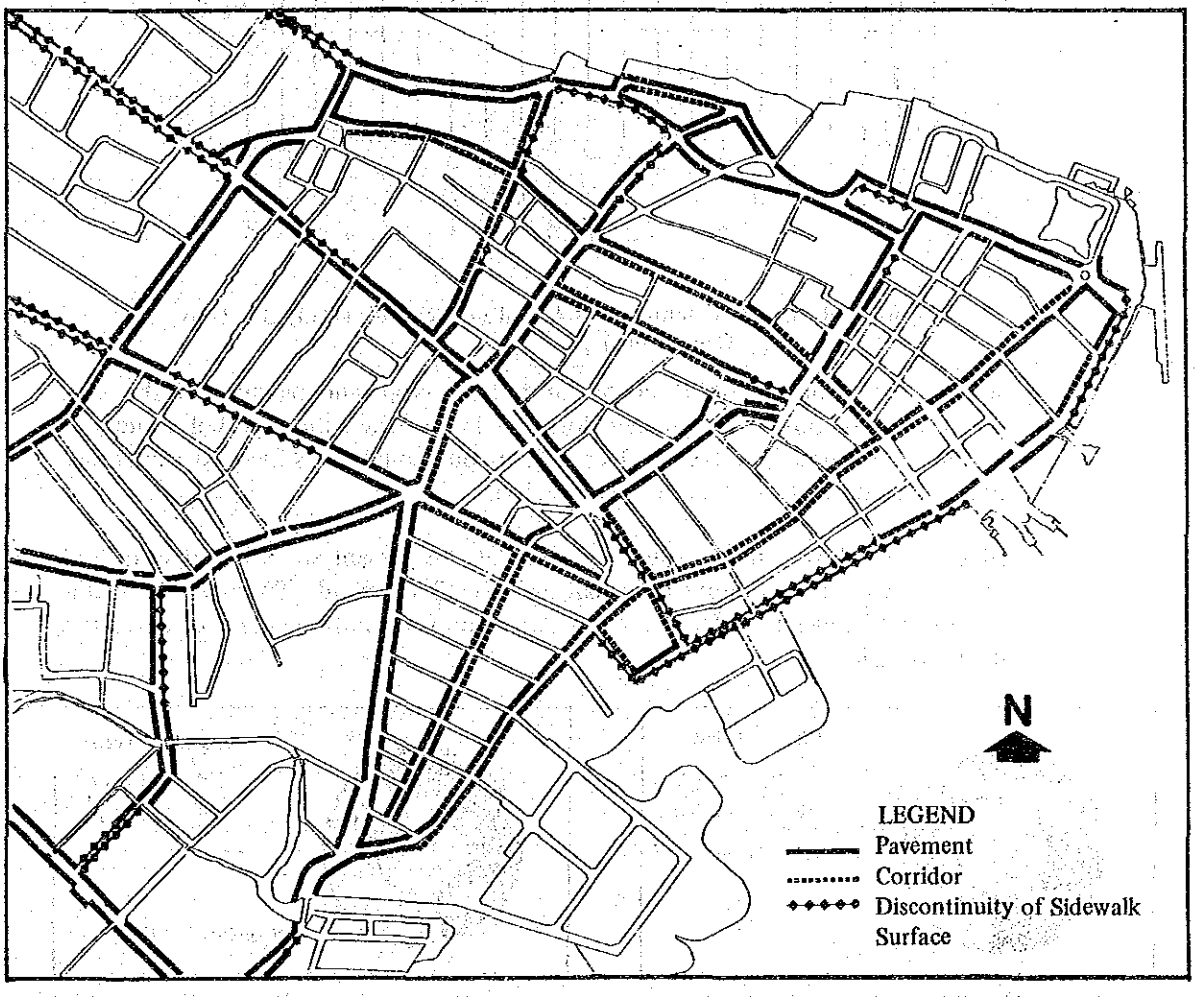


Figure 2.13 : Existing Types of Pedestrian Facilities in the Central Area of George Town

2.6 Bus Transportation

A. Insufficient Bus Services

The actual frequency of bus services is supposedly about 75% of the scheduled frequency of bus trips as shown in Figure 2.14 which gives the hourly fluctuation of actual and scheduled daily bus trips by City Council buses.

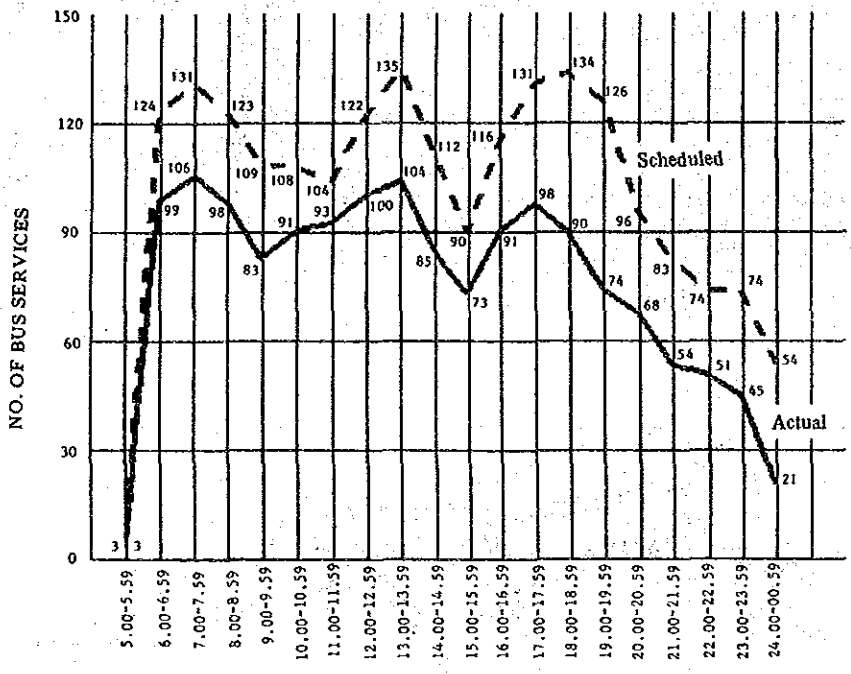


Figure 2.14 : Hourly Fluctuation of Actual and Scheduled Daily Bus Trips (City Council Bus)

Since there is no timetable posted at the bus-stop, and because of the non punctuality of buses, a passenger does not know when the bus will come and has to wait for a long time. Over 50% of bus commuters have to wait more than 20 minutes for a bus (see Figure 2.15).

Figure 2.16 shows the bus fleet by age. Of the present stage bus fleet of 222 (as of August 1986), more than half are over 8 years old. There is also no air-conditioned stage bus. Thus, there is much room for improvement of amenities in the vehicle.

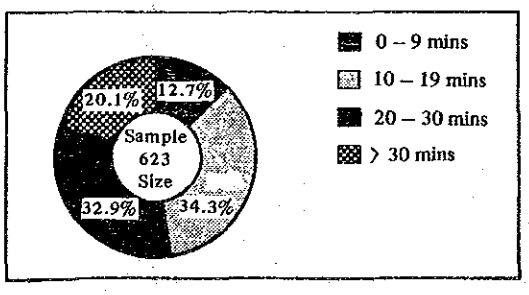


Figure 2.15 : Waiting Time for Bus Service

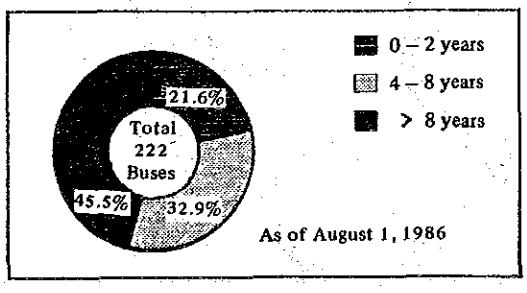
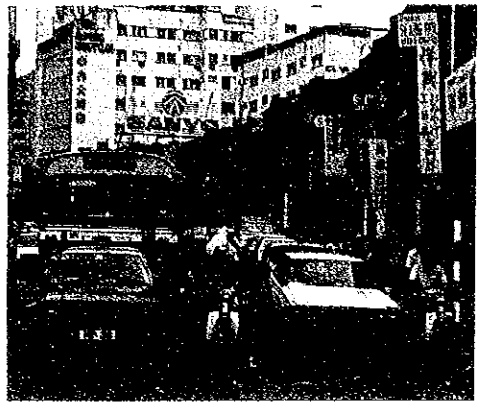
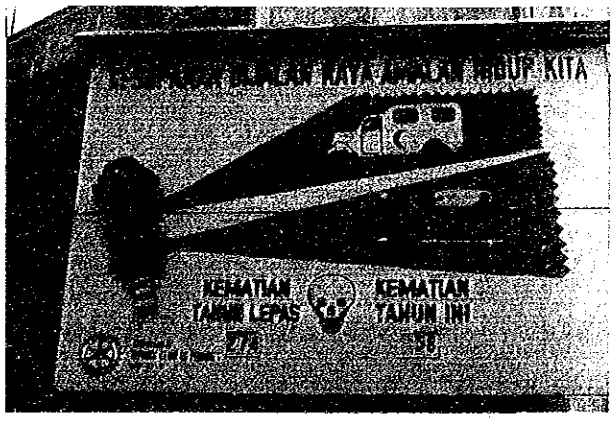
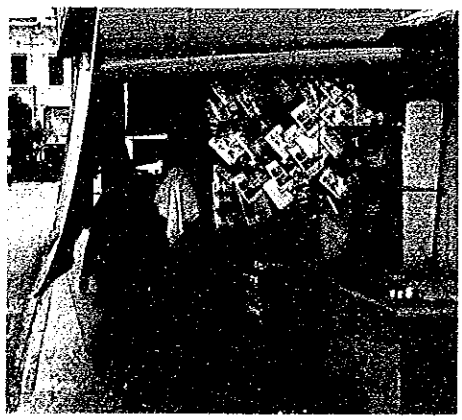


Figure 2.16 : Bus Fleet by Age



7. *The crowded Prangin Bus Terminal.*
8. *The heavily trafficked Penang Road Shopping Street*
9. *Poor facilities at the Jetty Bus Terminal.*
10. *Improved pedestrian path along Penang Road Shoppers and pedestrians now can stroll in a safe and condusive atmosphere.*
11. *One of the many examples of pedestrian space taken over by street vendors.*
12. *A reminder to the road users – "274 fatal accidents last year and 58 this year." Accident rate in Penang Island has been alarmingly high.*
13. *An example of a bus stop needing improvement.*





In recent years, efforts were made to improve bus-stop facilities. Some bus-stops were equipped with shelters. However, the provision of bus information boards, benches, trash receptacles, shelters, etc. at many more bus-stops is necessary.

B. Declining Bus Passenger Volume

Figure 2.17 illustrates the declining trend in the number of passengers carried annually by stage bus companies in the Study Area vis-a-vis the growth of motorization in Penang State between 1975 and 1985. From 1975 to 1980, the number of bus passengers remained steady at 65 million but it has declined by 7.2% annually since 1980 while motorization has advanced steadily at 9.7% per annum. By 1985 the number of passengers carried by all the stage bus companies had been reduced to 60% of the amount in 1975. In particular, over a decade the number of passengers carried by buses serving George Town had been reduced drastically to merely half of the volume in 1975.

In Figure 2.18, the passenger share by transportation mode on the screen line in 1986 reveals that buses comprise of 23%, of which stage bus constituted only 13.4%. Cars and motorcycles transported 40% and 37% of total passengers respectively. Considering the fact that buses are a means of mass transportation, there is plenty of room for improving the modal share of buses.

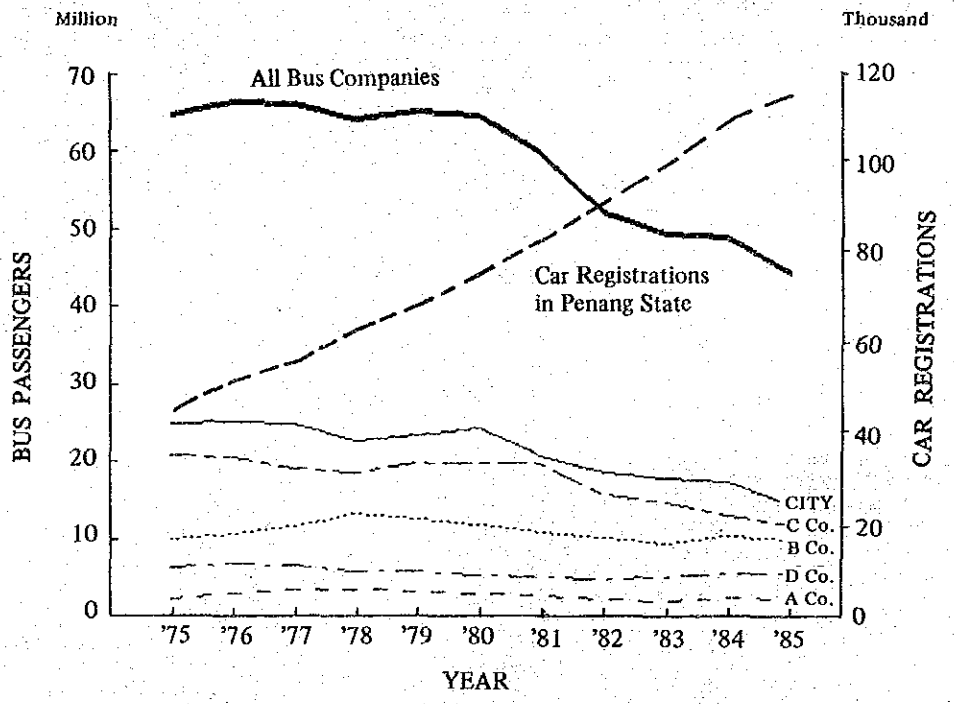
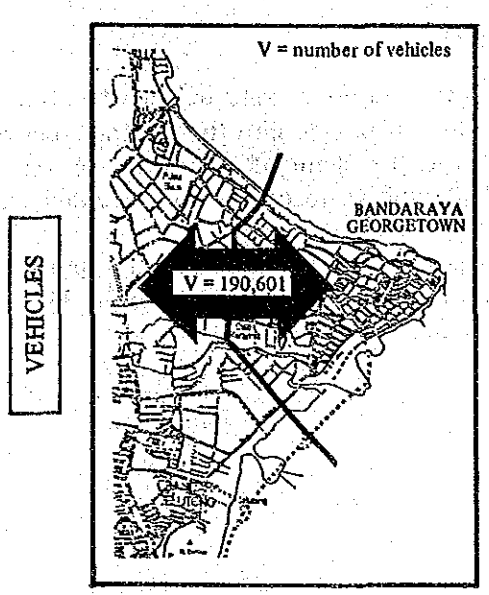
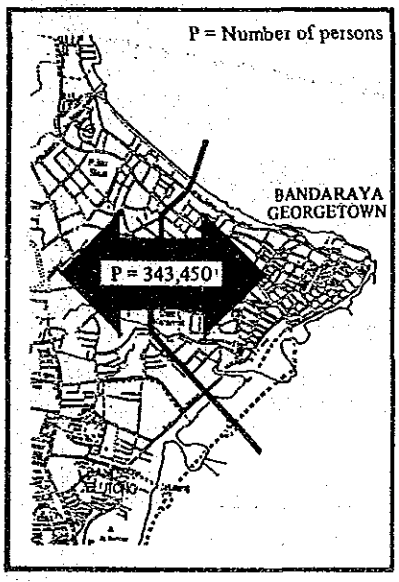


Figure 2.17 : Annual Trend of Stage Bus Passengers and Growth of *Motorization (1975–1985)*

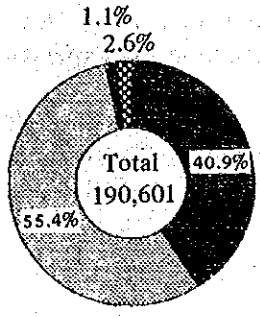


VEHICLES



PASSENGERS

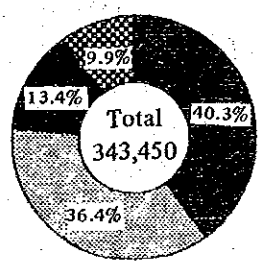
Composition of Vehicles



(TOTAL)

Car & pick-up
Motorcycle
Stage Bus
Van, Factory & School Bus

Passengers by Transportation Mode



(TOTAL)

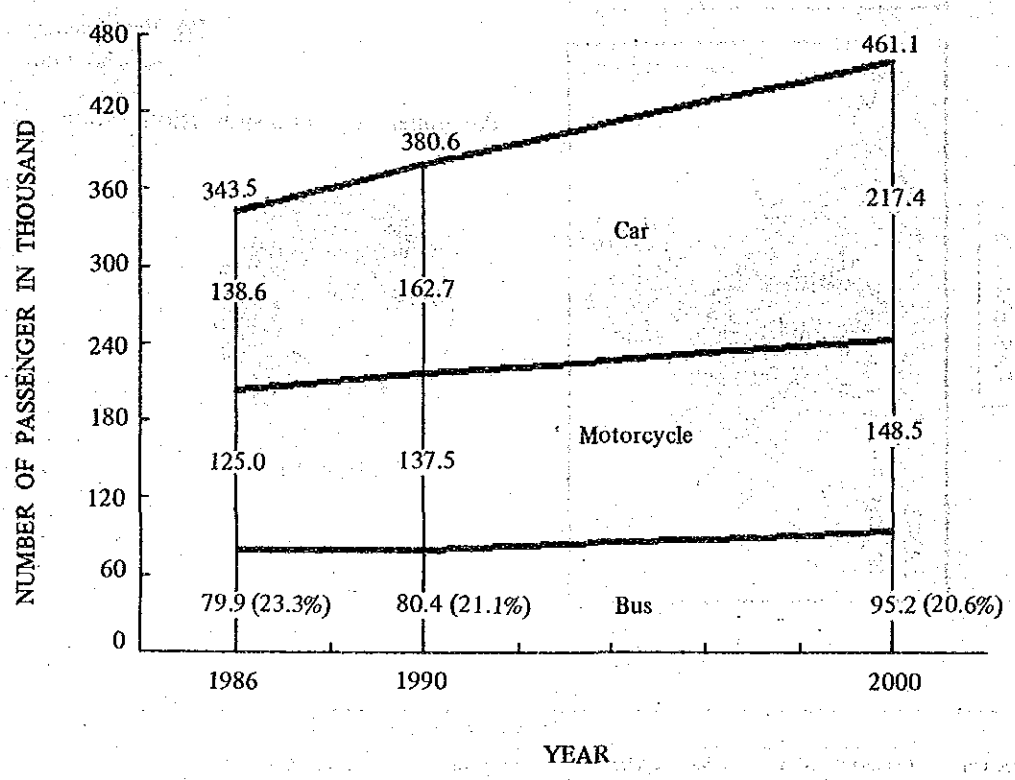
Direction of Traffic	Transportation Mode									
	Car and Pick-Up		Motorcycles		Stage Bus		Factory & School Bus, Van		Total	
	Vehicle	Passenger	Vehicle	Passenger	Vehicle	Passenger	Vehicle	Passenger	Vehicle	Passenger
Inbound	41,548	74,667	52,524	62,665	1,052	23,865	2,540	17,250	97,664	178,447
Outbound	36,485	63,890	53,028	62,315	1,075	22,055	2,349	16,743	92,937	165,003
Total	78,033	138,557	105,980	124,980	2,127	45,920	4,889	33,993	190,601	343,450

Figure 2.18 : Number and Composition of Vehicles and Passengers by Transportation Mode Entering and Leaving the Central Area (1986)

C. **Foreseeable decline in share of bus users**

With the future vivacity of urban activities in the Central Area and the dispersal of population to the suburbs, the inflow of people into the Central Area will no doubt increase. However, because the share of car or motorcycle as transport mode is expected to be high, the share of bus will inevitably fall.

As indicated in Figure 2.19, the forecasted share of passengers transported by bus (including factory and school buses) is expected to drop from 23.3% in 1986 to 21.1% and 20.6% in 1990 and 2000 respectively.



Note : ( ) figures show the bus users share

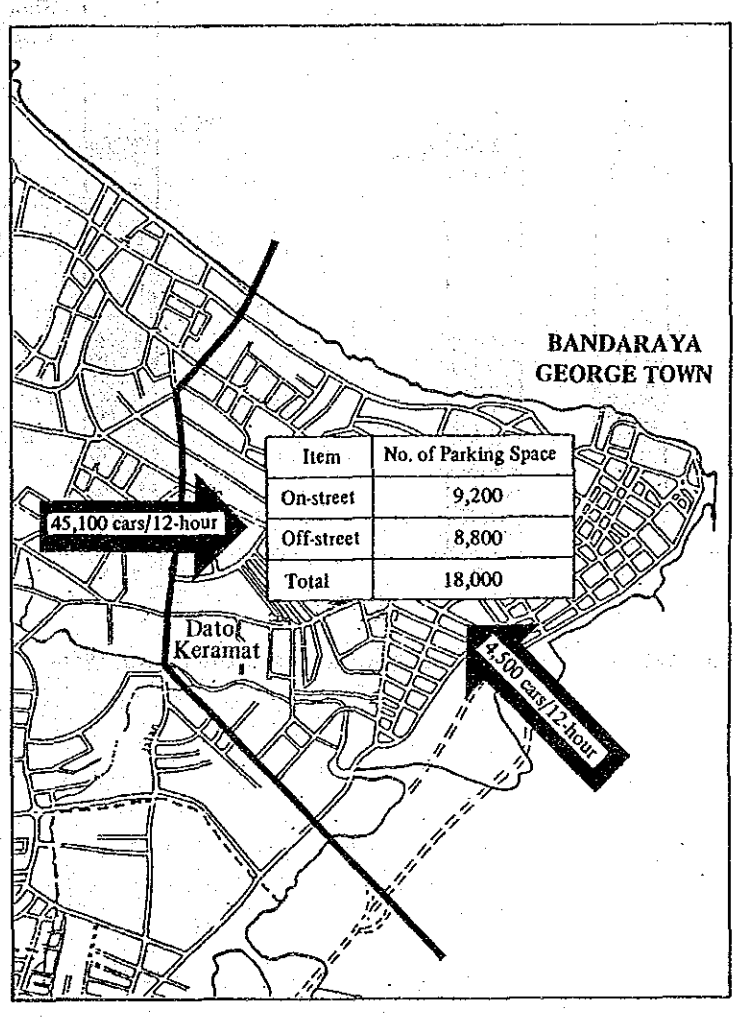
Figure 2.19 : Passengers by Transportation Mode (1986, 1990 & 2000)

2.7 Parking Situation

A. Long Searching Time for Empty Parking Space

Figure 2.20 shows in 1986 there are about 18,000 parking lots provided by both on-street and off-street parking facilities. On the other hand, the number of cars flowing into the Central Area is about 50,000, which means an average turn-over of 2.8 cars per lot in the Central Area. This figure can be considered high.

In the business and commercial zones very high parking demands are also evident. As a result, the time spent in driving around while searching for an empty space can amount to a considerable part of the total travel time. Such traffic may cause congestion and therefore delay to other non-parking traffic.



Item	No. of Parking Space
On-street	9,200
Off-street	8,800
Total	18,000

Figure 2.20 : Parking Space and Inflow of Car Volumes

B. Foreseeable Shortage of Parking Supply

Based on the proposed On-street Parking Control Plan, the future parking requirement has been forecasted as shown in Figure 2.21. It is assumed that the natural increase of off-street parking provisions due to new developments or redevelopment would grow at the same rate as the employment growth rate in the Central Area. Therefore in 1990, about seven hundred (700) more parking lots will be required at peak hours. By the year 2000, there will be a total shortage of nine thousand six hundred (9,600) parking lots.

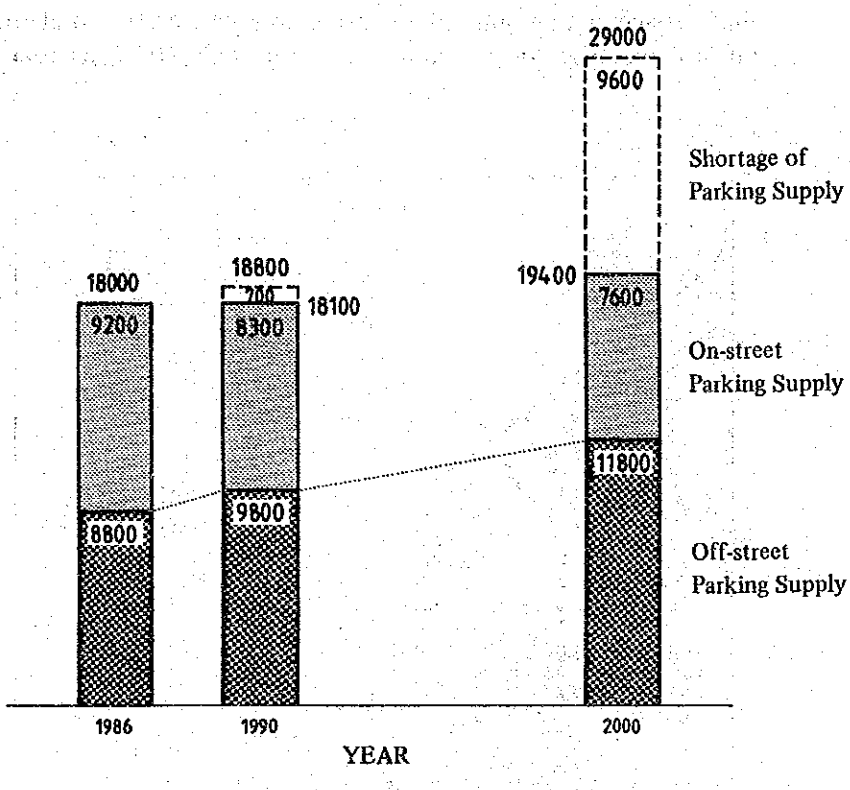


Figure 2.21 : Parking Supply and Shortage in the Central Area, 1986–2000

2.8 Other Problems

A. Insufficient Traffic Education

Most motorcyclists ride their vehicles recklessly on the streets. This lack of discipline has also been observed among car and bus drivers.

Drivers, in general, are not exposed to proper education and discipline. The concept of 'right-of-way' does not seem to exist or seems to be ignored in most cases. Dangerous lane-changing, encroaching into the opposite side of the street while overtaking as well as violating signals can be observed in the Study Area.

B. Traffic Flow Obstruction by Trishaw and Illegal Taxi

1. Trishaw

Although trishaw movements account for only 2–3% of the total traffic volume on the streets, their presence at the major intersections nevertheless impede smooth traffic circulation. A peak hour volume of two hundred and seventeen (217) trishaw trips was observed at the intersection of Penang Road and Prangin Road.

2. Illegal Taxi

Illegal taxis are seen as depriving the bus and taxi operators of their rightful market share. Police enforcement, although important, causes their number to decrease to a certain extent during the enforcement period only and at the same time causes much inconvenience to the users. The existence of these illegal taxis clearly indicates the lacking of good public transportation services.

3

PLANNING ISSUES, GOALS AND TRANSPORT POLICIES

3.0 PLANNING ISSUES, GOALS AND TRANSPORT POLICIES

3.1 Introduction

Herein, the planning issues and goals for the Study Area are established based on premises identified from the present and future transportation conditions and problems and the role of Penang Island as a growth pole in the north within the national development context.

In addition, transport policies necessary for the achievement of these goals are proposed. A simplified flow chart showing the planning process to establish the planning issues, goals and transport policies is illustrated in Figure 3.1.

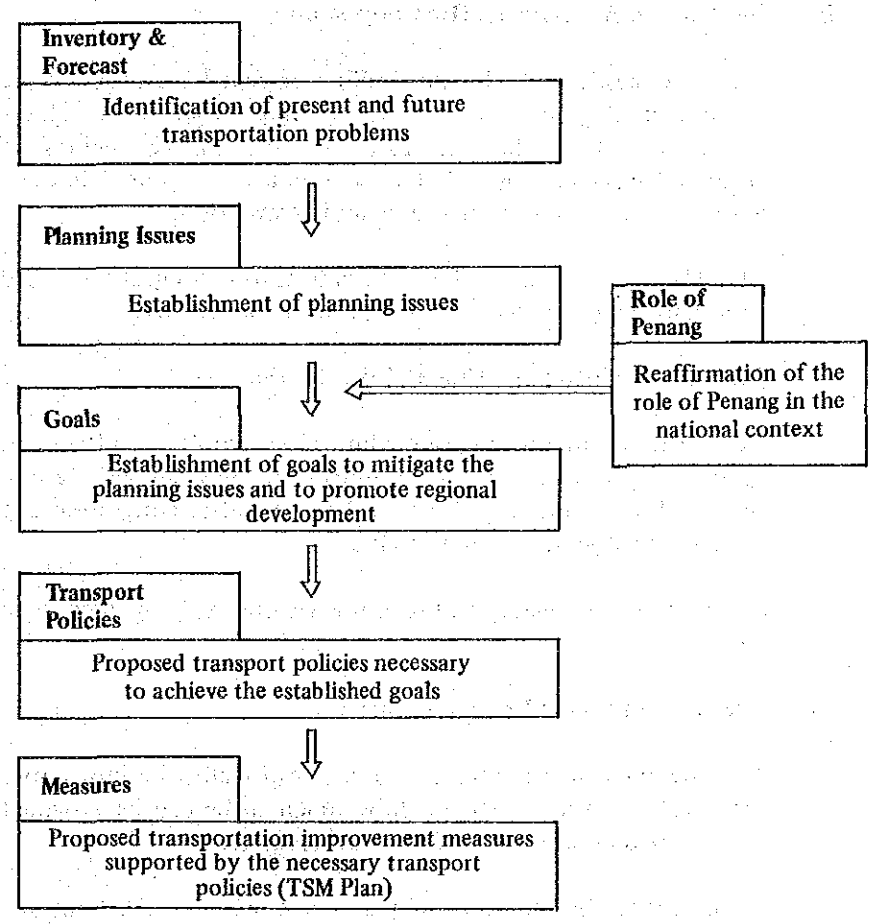


Figure 3.1 : Simplified Flow Chart of Planning Process.

3.2 Major Planning Issues

The following major planning issues for traffic and transportation in the Study Area are identified based on the premises identified from existing and future transportation conditions.

A. The Need to Enhance Traffic Safety

One of the fundamental issues on traffic and transportation in the Study Area is to secure traffic safety in order to reduce the high accident rate manifested in the present transportation conditions. It is therefore necessary to enhance traffic safety so that pedestrians and vehicles can move safely on the same urban streets.

B. The Need to Alleviate Traffic Congestion

Traffic congestion which causes idling of vehicles on roads aggravates not only environmental pollution by causing huge volume of exhaust fume to be discharged admist the deafening din of running engines and honking by irritated drivers, but also hinders economic development in the city because of wasteful fuel consumption and delay in travel time.

Therefore, there is a need to alleviate traffic congestion in order to promote economic and regional development in the Study Area.

C. The Need to Encourage Usage of Bus Services

The drastic decline in bus ridership causes problems in the management of bus operations. Service level (in terms of frequency, amenity, etc.) deteriorates on one hand while on the other hand more traffic congestion occurs due to the increase in usage of private vehicles.

It is therefore necessary to break this vicious cycle by encouraging usage of bus services.

D. The Need to Create Pedestrian Space

The economic development of a city, especially the bustle of the commercial area, depends very much on how much space can be provided for the movement of people who generates the urban activities.

In particular, the creation of pedestrian space in the Central Area of George Town is necessary because of the city's dependancy on commerce and tourism.

E. The Need for a Balanced Parking Policy

A look at the present and expected future parking situations shows that one related problem is the obstruction of traffic flow by cars parked on the streets. Another problem is the inaccessibility to some locations due to lack of nearby parking space. Therefore there is a need to consider how on-street parking control should be implemented on one hand and how to provide for parking needs on the other hand.

3.3 Goals and Objectives

In this section, the goals and objectives for the Transportation System Management Plan (hereinafter called TSM Plan) in the Study Area are established by taking into account the role of Penang in the national context such as:

(1) A major trading and commercial centre in the northern region of Peninsular Malaysia

(2) Among the top three rankings of urban centres based on population sizes and distributive trades

(3) A northern regional centre for Peninsular Malaysia

(4) A renowned tourist resort area

Generally, the following goals and objectives can be established.

G–1 To promote economic and regional development of the Study Area

(1) Provide an economical and efficient transportation system compatible with national and regional development schemes

(2) Encourage economic activities in the Central Area of George Town

G–2 To improve traffic safety

(1) Reduce occurrence of traffic accidents

(2) Reduce casualties resulting from traffic accidents

G–3 To bring about greater mobility

(1) Increase person and goods movement capacity of existing transportation facilities

(2) Improve service level of urban transportation mode

(3) Improve reliability of transportation mode

(4) Improve facilities for non-motorized transportation mode (pedestrian and bicycle).

G–4 To enhance environmental and community quality

(1) Enhance aesthetic qualities of urban environment

(2) Minimize adverse impacts of transportation development on natural environment

G–5 To improve economic efficiency of transportation

(1) Reduce fuel consumption in urban transportation system

(2) Reduce personal and public costs of urban travel

(3) Minimize adverse economic impacts caused by urban transportation..

3.4 Proposed Overall Transport Policies

In order to improve the economic efficiency of transportation and also to promote economic and regional development in the Study Area, it is necessary to ensure traffic safety and at the same time to secure mobility. In addition, adverse impacts on environmental and community quality must be minimized.

Given these goals, the following basic transport policies are proposed:

TP–1 To ensure safety for pedestrians and other road users whether by car, motorcycle or bicycle in the Study Area

TP–2 To create lively and refreshing urban space where tourists and shoppers congregate and ensuring public safety, convenience and comfort of walking

TP–3 To provide easy accessibility to the Central Area to commuters and shoppers via public transport by improving bus frequency and dependability of bus services

TP–4 To provide a balanced transportation system consisting of both public and private modes in meeting the future transport demand through the implementation of appropriate and timely measures.

TP–5 To implement a beautification programme which blends with the area's historical and cultural heritage and further enhances the image of a garden city for the urban area

TP–6 To utilize existing transport facilities more efficiently so as to increase the economic benefit of the transportation investments

PROPOSED TRANSPORTATION SYSTEM MANAGEMENT PLAN

4

4.0 PROPOSED TRANSPORTATION SYSTEM MANAGEMENT PLAN

4.1 Introduction

The Transportation System Management Plan (hereinafter called TSM Plan) proposed for this Study consists of the following components:

(1) Area Traffic Control System Expansion Plan

(2) Road Network Improvement Plan

(3) Bus Transport Improvement Plan

(4) Traffic Circulation System Improvement Plan

(5) Pedestrian Path Network Plan

(6) Parking Plan

(7) Other Improvement Measures

In order to formulate a comprehensive TSM Plan, it is necessary to investigate and adjust the inter-relationship of each individual component plan of the TSM Plan to ensure compatibility and rationality of the plans.

Thus, the proposed TSM Plan presented herein is formulated after the necessary adjustments are made to each individual plan. Figure 4.1 shows a schematic illustration of the adjustment process to formulate the proposed TSM Plan.

For convenience and clarity in reporting, the components of the proposed TSM Plan will be grouped into three (3) plans namely ATC System Expansion Plan, Regional Transportation Plan and Central Area Transportation Plan as presented in the following sections.

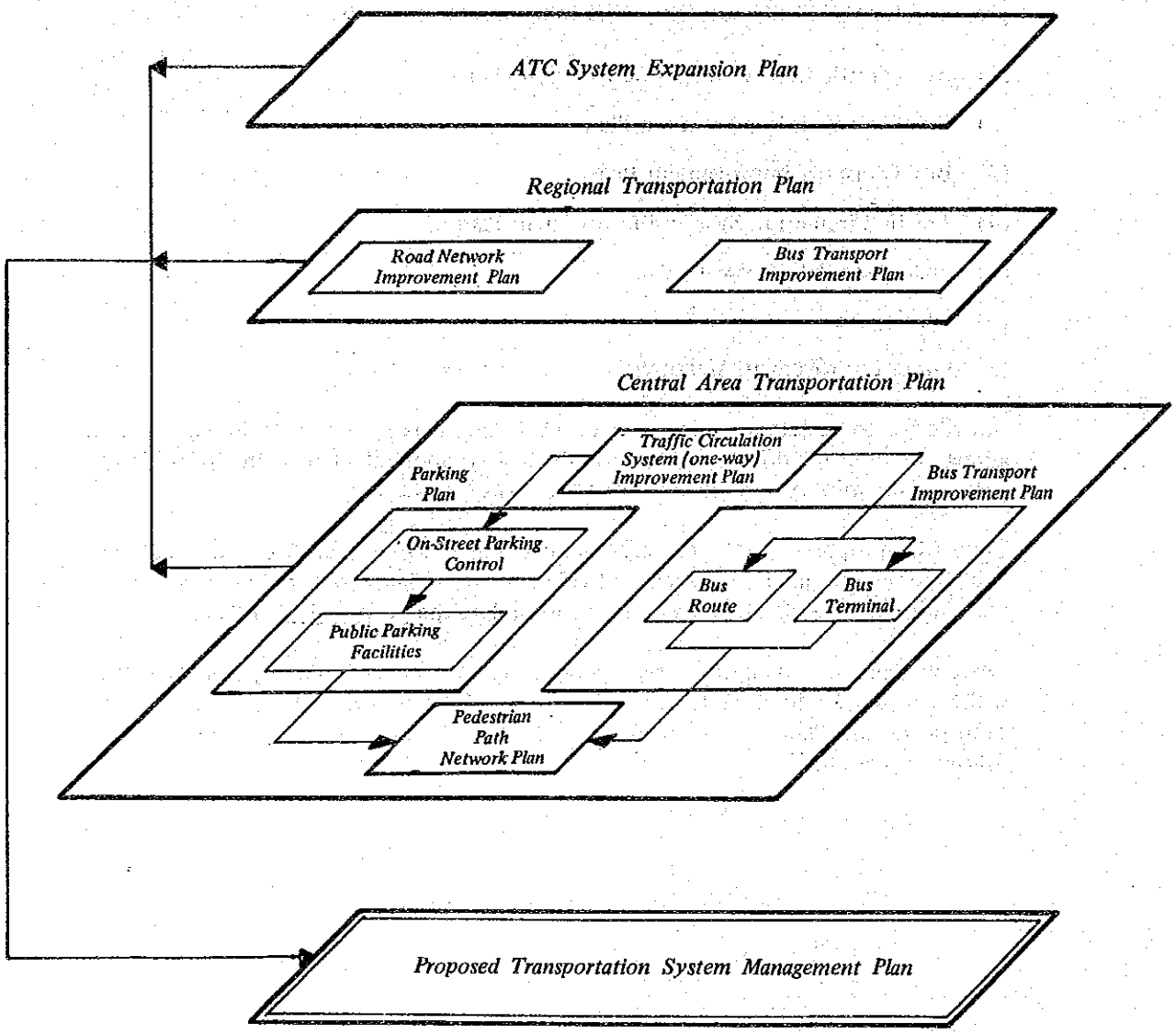


Figure 4.1 : Schematic Illustration of Adjustment Process To Formulate the Proposed TSM Plan

4.2 Proposed Area Traffic Control (ATC) System Expansion Plan

4.2.1 Introduction

This section describes the proposed Area Traffic Control System Expansion Plan (hereinafter called ATC System Expansion Plan) and its associated works, taking into consideration the first stage (hereinafter called Stage I ATC System) which has been implemented by the Majlis Perbandaran Pulau Pinang (MPPP), and future road facilities as well as projected traffic conditions by the year 2000 in the Study Area. In addition, this section includes a discussion on the beneficial effects of the ATC System which can be expected by its implementation.

The objectives of the ATC System are as follows:

(1) Alleviation of traffic congestion

(2) Reduction of traffic accidents

(3) Comprehensive interpretation of traffic conditions

(4) Conveying traffic related information to drivers

(5) Others (Training for specialists)

The main principles of the Expansion Plan are:

(1) Required control functions of the system and its capabilities can be expanded by adding necessary equipment without explicit modifications of the Stage I ATC System.

(2) Finally, the comprehensive ATC System for the whole island and part of the mainland will be developed effectively.

4.2.2 Stage I ATC System

In 1983, the MPPP initiated plans to introduce a computerised area traffic control system in Penang.

The MPPP accepted the ATC System Plan proposed in the report 'Basic Design for Area Traffic Control System in George Town, Penang' in April 1985.

In 1987, the Stage I ATC system are implemented and began operation from April, 1987, but its scale has reduced from that of the original plan.

Each component of the Stage I ATC system is explained in the following sections.

A. **Traffic Signal System**

The traffic signal system controls a total of sixteen (16) sets of signals, of which two (2) are for pedestrian crossings. All the signals are located within the area bounded by Anson Road, Perak Road and Sungai Pinang Road.

The traffic signal control system is centrally controlled from the Control Centre located at 13th floor, KOMTAR in Penang. At the Centre, the wall-map display indicates location, signal status and traffic congestion level.

The signal system consists of the central computer system, local controllers, detectors, communication cables and other equipment.

The system diagram of the Stage I ATC System is presented in Figure 4.2.

B. **Closed Circuit Television System**

The closed circuit television (CCTV) system consists of two cameras, two monitors and a control desk. The CCTV cameras are installed at (a) level 64, KOMTAR Tower and (b) intersection of Dato Keramat Road and Perak Road. Each camera can be remote-controlled from the control desk at the control centre. Zooming, tilting and panning are possible.

In addition, a video-tape recorder is provided as an additional element to analyse the transient phenomena of traffic.

C. **Geometric Improvement and Channelization**

Most of the sixteen (16) intersections selected for signalization required geometric improvements. These involved the provision of traffic islands, turning lanes, adequate number of lanes, and road markings that collectively or singularly contribute to safe and efficient operations.

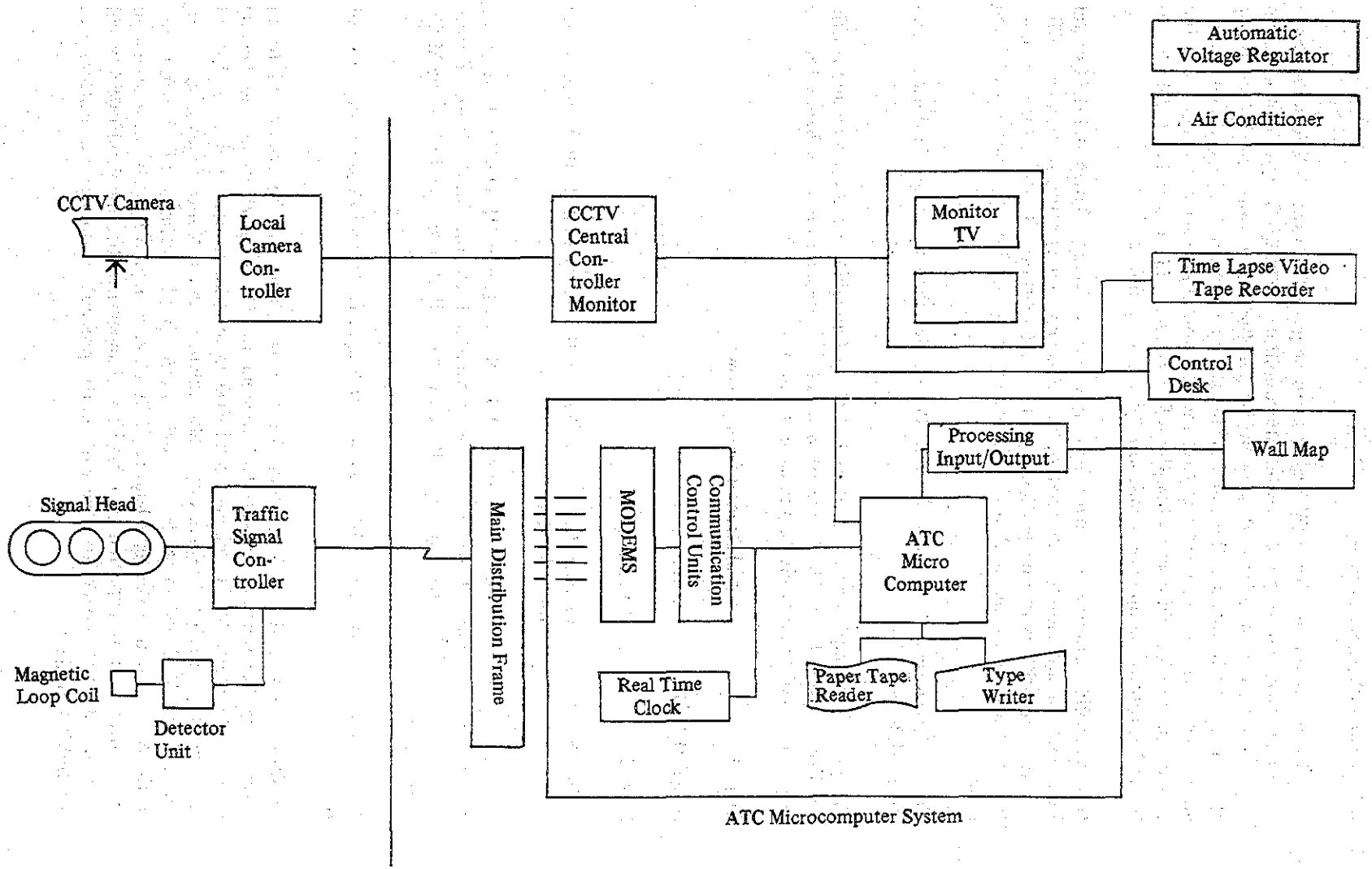


Figure 4.2 : Stage I ATC System Diagram