CEYLON

RECLAMATION OF MARSHES IN AND AROUND CITY OF COLOMBO

FEASIBILITY REPORT

Volume II TOWN PLANNING

Prepared for
OVERSEAS TECHNICAL COOPERATION AGENCY
GOVERNMENT OF JAPAN

by

JAPANESE SURVEY TEAM
FOR LAND RECLAMATION IN COLOMBO AREA

MARCH 1971

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PREFACE

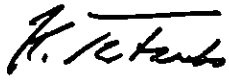
The Government of Japan, in response to the request of the Government of Ceylon, undertook to conduct a feasibility study for the reclamation and drainage project for the low-lying areas in and around Colombo City, the capital of Ceylon, the purpose of which is to provide land for residential, commercial and industrial districts in the future, and entrusted the implementation of the study to the Overseas Technical Cooperation Agency, an executing organization of the Japanese Government.

The Agency sent a seven-member survey team, headed by Professor Takashi Inoue at the University of Tokyo, to Ceylon over a period from March 30 to April 28, 1970, for the implementation of field survey. The survey team promptly summarized its findings into an interim report and submitted it to the Colombo District (Low-Lying Areas) Reclamation and Development Board during its stay in Ceylon.

After its return to Japan, the team made various studies and analyses on the data and materials gathered in Ceylon in drafting the final report. Furthermore, the team invited Mr. K. D. P. Perera, Deputy General Manager & Irrigation Engineer of the above-mentioned board, to Japan for about a month from October 19, 1970, as a senior-level trainee for the Colombo Project and jointly reviewed the contents of the report. As a result, the final report has been completed and is herewith submitted to the Government of Ceylon. I sincerely hope that the report will contribute to the further growth of Colombo City, help solve the problem of land shortage in the city and surrounding area and serve in promoting friendly relations between Ceylon and Japan.

Finally, I wish to take this opportunity to express my sincere appreciation and gratitude to the officials of the Ceylon Government for their wholehearted support and cooperation in the execution of the survey.

March 1971



Keiichi Tatsuke
Director General
Overseas Technical Cooperation Agency


HOUSING DEVELOPM
NAWARA HEEN FA

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PART I GENERAL

GENERAL

I. Introduction

1-1 Background

The Government of Japan, in response to the request of the Government of Ceylon, undertook to make a feasibility study on the development of low-lying areas in and around Colombo City, the capital of Ceylon, to form new land for use as residential, commercial and industrial districts, by constructing drainage system, as part of the reclamation project for the same area, and sent a survey team to that country for a period of one month from March 30, 1970.

The organization of the survey team and related functions were entrusted to the Overseas Technical Cooperation Agency, an executing organization of the Japanese Government.

1-2 Purpose and Scope of Survey

The purpose of the survey is to obtain necessary data for the planning of a reclamation project for 2,500 acres out of some 8,000 acres of low-lying land in and around Colombo City to form new land as a means of alleviating its serious land shortage brought about by the expansion of population in Colombo and the promotion of land development for industrial purpose in the surrounding area in recent years, and at the same time, to help establish a town planning project for the future of Colombo City as a whole including the area mentioned above.

To attain the above-mentioned objective, the following surveys and studies were made by the team.

1) Survey on natural conditions (meteorology, hydrology, hydraulics, topography, geology, etc.)

2) Field investigation of the reclamation project area (existing facilities, land use, etc.)

3) Formulation of a basic plan for land reclamation and estimation of cost of construction and maintenance

4) Formulation of a town planning project for the future of Colombo City

5) Economic and financial studies (economic effects, amortization plan, etc.)

1-3 Members of Survey Team

Name	Responsibility	Occupation
Head		
Takashi Inoue	Overall	Professor, Engineering Department, University of Tokyo
Deputy Head		
Yoshiaki Sadai	Town planning	First Coordinator, 2nd Planning Dept., National Capital Region Improvement Committee

Member		
Yoshikazu Yoshida	Drainage planning	Technical Section, Planning Dept., Agricultural Land Bureau, Ministry of Agriculture and Forestry
"		
Ryohei Kakino	Reclamation & drainage	Project Engineer, Irrigation and Reclamation Engineering Dept., Japan Engineering Consultants Co., Ltd.
"		
Hiroshi Yamamoto	- " -	Project Engineer, Irrigation and Reclamation Engineering Dept., Japan Engineering Consultants Co., Ltd.
"		
Tsuyoshi Takahashi	City planning	Project Engineer, Urban Planning Dept., Japan Engineering Consultants Co., Ltd.
"		
Hiroshi Hashiura	Coordination	Planning Section, Development Research Department, Overseas Technical Cooperation Agency

1-4 Activities of Survey Team

The survey team was engaged in field investigation, gathering of necessary data and materials and exchanging of views with the officials of pertinent agencies during a period from March 30 to April 29, 1970, and submitted an interim report to the Colombo District (Low-lying Areas) Reclamation and Development Board. The following is a summary of its activities:

Date	Activities
Mar. 30, 1970 (Mon)	Departed from Tokyo and arrived in Colombo.
31, (Tue)	Made a courtesy call on Ambassador Yamamoto at the Japanese Embassy and had consultations with officials in charge on the itinerary of the team.
Apr. 1, (Wed)	Visited the Reclamation and Development Board, consulted with officials on details of the activities of the team: exchanged views and gathered necessary data and materials.
2, (Thu)	Gathered data and materials at the Board. Head Inoue and two other members met with Mr. Damiencki, U. N. Expert, Town Planning, and exchanged views and obtained necessary information.
3, (Fri)	Made field investigations at Crown Island, Urugadawatta and Mutuwal
4, (Sat)	Made field investigations at Madiwella, Gathatuwa, Kotte and Heen Ela.

Apr.	5,	(Sun)	Exchanged views among team members on the results of the field investigations made in the past two days and reviewed the data and materials gathered.
	6,	(Mon)	(Poya Day)
	7,	(Tue)	Gathered data and materials at the Board and the Publication Bureau. Head Inoue and two other members met with the Permanent Secretary of the Ministry of Land, Irrigation & Power.
	8,	(Wed)	Gathered data and materials and exchanged views with officials of the Ministry of Planning and Economic Affairs. Held final meeting with the Chairman of the Board and exchanged views with him prior to the departure of Head Inoue.
	9,	(Thu)	Head Inoue departed for Japan. The team was divided into two groups (A-Group for reclamation and drainage and B-Group for town planning). A-Group made a detailed survey in Madiwela District, while B-Group gathered data and materials and exchanged views with personnel concerned at the Ministry of Local Government.
	10,	(Fri)	A-Group continued the activities begun the previous day, while B-Group gathered data and information at the Publication Bureau.
	11,	(Sat)	A-Group conducted field investigation in the Old Kotte District, while B-Group gathered necessary data and materials at the Port Commission.
	12,	(Sun)	A-Group continued the same work as the previous day, while B-Group gathered data and materials at the Central Bank of Ceylon.
	13,	(Mon)	(New Year Day) Both A and B-Groups summarized and reviewed the data and materials gathered so far.
	14,	(Tue)	
	15,	(Wed)	A-Group continued the same work as the previous day, while B-Group conducted a survey on the arrangement of residential and commercial districts in Colombo City.
	16,	(Thu)	A-Group made a detailed field investigation in Gothatuwa District, while B-Group continued the survey in the same districts as the previous day.
	17,	(Fri)	Both A and B-Groups reviewed the gathered data and materials, exchanged views with officials of the Board and made a study on the supplemental data and materials needed in the future.

Apr. 18, 1970	(Sat)	A-Group made a detailed field investigation in Urugadawatt District, while B-Group gathered data and materials at JETRO Colombo Office.
19,	(Sun)	A-Group exchanged views with officials of the Board, while B-Group obtained necessary data and materials from the Resident Representative, U. N. Development Project, and the Chief Accountant, Ceylon Government Railway.
20,	(Mon)	Both A and B-Groups summarized and reviewed data and materials gathered so far.
21,	(Tue)	(Poya Day)
22,	(Wed)	A-Group reviewed data and materials gathered so far, started preparation of an interim report and had consultations at the Board, while B-Group met with the Director of the Valuation Dept. and Asst. Architect of Town & Country Planning and obtained necessary data and materials from them.
23,	(Thu)	A-Group continued the same work as the previous day, while B-Group met again with Mr. Damiencki, U. N. Expert and U.N.D.P. Representative, and exchanged views.
24,	(Fri)	A-Group engaged in translation and typing of the interim report, while B-Group gathered data and materials at the Plan Implementation Div., Foreign Air Investment Loans & Provincial Property Investment Finance Ltd.
25,	(Sat)	Both A and B-Groups worked together and completed the interim report.
26,	(Sun)	Submitted the interim report to the Board Chairman, made additional comments on the report and exchanged views with the Chairman.
27,	(Mon)	Started preparations for depatrure. Made calls on the Board and the Japanese Embassy to bid farewell.
28,	(Tue)	Departed Colombo and arrived in Singapore.
29,	(Wed)	Departed Singapore and arrived in Tokyo

1-5 Acknowledgements

In the course of the survey, kind cooperation and advice were extended to the survey team from various quarters. The team is particularly grateful to the personnel mentioned below and expresses its sincere gratitude and appreciation to them.

T.B.E. Seneviratne	Chairman, Colombo District (Low Lying Land) Reclamation and Development Board
K.D.P. Perera	Deputy General Manager, "
W.J.C.M. Wimalaratna	Architect, "
K.D.A.H. Hanayakkara	Engineer, "
N. Gunaratne	Director of Town & Country Planning
P.N. Virjesingke	Asst. Architect of Town & Country Planning
Mr. Damiencki	U. N. Expert, Town Planning
Ambassador Yamamoto	Japanese Embassy in Ceylon
Secretary Nakamura	" "
Attache Date	" "
Secretary Yokoyama	" "
Mr. Murase	Director, JETRO Colombo Office

It must also be noted that valuable advice was given to the survey team by officials concerned in various agencies of the Ceylon Government in addition to the gentlemen mentioned above. To them also, the team expresses its profound gratitude.

2. Summary of Findings

2-1 Land Reclamation

2-1-1 Hydrological Analysis

The results of rainfall and run-off analysis conducted on the basis of observation data provided by the Colombo Observatory may be summarized as follows:

i. Analysis of rainfall

a. Estimated design rainfall: 19.6 inch (4 days rainfall with 50-year return period)

15.7 inch (for reclamation projects, 4 days consecutive rainfall with 50-year return period, for Madiwela.

b. Heavy rainfall: 21.8 inch (4 days consecutive rainfall with 100-year return period.)

c. Extraordinary rainfall: 24.1 inch (4 days consecutive rainfall with 200-year return period.)

ii. Analysis of run off

Maximum discharge (peak of hydrograph) of each catchment by estimated design rainfall are as follows:

Mutwal	622	cusec
Urugodawatta	885	"
Gothatuwa	1,165	"
Kotte	1,576	"
Heen-Ela	1,316	"
High Level Area	1,488	"
Madiwela Catchment	5,802	"

2-1-2 Isolation of Marshes and Proposed Drainage System

i. North Colombo

As a result of a detailed comparative study made from an economical and technical point of view, a system linking Mutwal and Urugodawatta with a culvert and draining with one pumping station, called a combined drainage system, has been adopted.

ii. South Colombo

After a detailed comparative study, the reclamation area in South Colombo was divided into three blocks - Gothatuwa, Kotte and Heen-Ela - as the areas to benefit directly from, the reclamation project, while the High Level Area and the Madiwela Catch. were selected as basins to benefit indirectly. For the three reclamation areas, a pumping drainage system is to be employed and for the two basins to benefit indirectly a gravity

Consolidated Table of Main Elements Under Overall Plan

Item	Name of basin	North Colombo	Gothatuwa	Heen-Ela	Kotte	High Level Area	Madiwela Diversion	Remarks
Area of drainage basin (ac)		1,850	1,352	1,140	1,450	3,436	12,160	
Maximum inflow (cusec)	Estimated design rainfall (50 year return period)	1,507	1,165	1,316	1,576	1,488	5,802	
	Heavy rainfall (100 year return period)	1,687	1,304	1,473	1,764	1,666	8,345	
	Maximum rainfall (200 year return period)	1,868	1,443	1,630	1,953	1,843	9,233	
Maximum outflow (cube)		350	200	200	250	1,066	460	
Cumulative storage (cube)	Estimated design rainfall (50 year return period)	449	503	386	490	–	9,520	
	Heavy rainfall (100 year return period)	500	638	458	594	–	12,790	
	Maximum rainfall (200 year return period)	634	763	563	730	–	14,897	
H. F. L. (M. S. L.)	Estimated design rainfall (50 year return period)	- 0.10	- 0.15	0.00	0 00	–	+6.80	
	Heaby rainfall (100 year return period)	+0.45	+1.40	+1 10	+1.25	–	+7.80	
	Maximum rainfall (200 year return period)	+1.90	+2.25	+2.05	+2.10	–	+8.40	
Volume of earthworks (cube)	Excavation	449,400	312,300	234,200	175,700	185,000	8,000	
	Filling and banking	203,200	255,700	145,300	113,900	60,700	5,000	
Surface dressing with gravel		188,440	254,000	178,200	205,500	–	–	
Pumping Unit equipment	Pumps fore and number	ϕ 42" x 4	32" x 4	ϕ32" x 4	ϕ 36" x 4	–	–	
	Motors output and number	Motor 213kw x 2 Engine 290ps x 2	96.6 kw x 2 131.4ps x 2	96.6 kw x 2 131.4ps x 2	120 kw x 2 163.2ps x 2	–	–	
Concrete revetment (ft)		59,600	25,000	45,400	37,800	87,000	0	
Rubble masonry (Sq.)		10,100	6,200	8,900	6,500	10,300	0	
Other facilities		Connecting culvert 2 Regulating flood gate 3 Emergency flood gate	Emergency flood gate	Emergency flood gate	Connecting Siphon Emergency flood gate	Regulating flood gate 2	–	
Direct cost of construction (Rs)		65,008,000	69,616,000	55,358,000	60,404,000	34,274,000	3,675,000	
Area of reclaimed land available for sale (ac)		324.5	437.3	306.8	353.8	–	–	

drainage system is to be employed. For the drainage in the Madiwela Catch., which plays a vital role in the drainage system for the entire project area, a short-cut drainage scheme by means of a tunnel has been adopted.

2-1-3 Economic Scales of Drainage Facilities

Since the capacity of drainage equipment (pumps) is closely related to flood detention facilities and the total area of reclamation, this must be determined so as to minimize the cost of reclamation per unit area. As a result of a detailed comparative study, the capacity of pumps has been determined as shown in the table below. The average pumping capacity per unit area varies with the each project area, ranging from approximately 0.15 to 0.18 cusec/ac.

Project	Economic capacity of pump	Economic flood detention capacity	Acreage of reclaimed land economically available
	(cusec)	(ac. ft)	(ac)
North Colombo	350	460	445
Gothatuwa	200	520	610
Kotte	250	500	521
Heen-Ela	200	380	413

2-1-4 Summary of Major Feature Works and Tentatively Estimated Cost

On the basis of the discussion in paragraphs 5-4 and 5-5, a general plan was worked out for the entire project area, and a cost estimation of the project was tentatively made. Major features of work and estimated costs of the project are summarized in the following table.

2-1-5 Economic Evaluation of Benefits of Project

A simple comparison of the cost of land reclamation and the revenue from the sale of reclaimed land for each project area is shown below. The cost of work shown in the following table contains an allocated cost of High Level Canal and Madiwela Diversion Works.

Project	Total cost of work	Direct gross revenue
North Colombo	65.0 $\times 10^6$Rs	181.7 $\times 10^6$Rs
Gothatuwa	82.9	139.9
Kotte	85.5	123.9
Heen-Ela	64.6	98.2
Total	298.0	643.7

The feasibility of each project as indicated by investment efficiency, which is calculated on the basis of the interest during construction, depreciation of facilities and annual expenditure including maintenance cost, is shown below. In this case, the volume of construction work that can be performed annually was presumed to be Rs. 9,500,000 in value, taking into account the current situation of civil works prevailing in the Colombo District.

Project	Investment efficiency
North Colombo	2.8
Gothatuwa	1.3
Kotte	1.2
Heen-Ela	1.5

The order of priority given to the projects, determined from a technical and economical point of view but not taking into account their relations with city planning or social conditions, is shown below.

Top priority: North Colombo (Urugodawatta is to be implemented first and Mutwal second.)

Second priority: Heen-Ela

Third priority: Gothatuwa

Fourth priority: Kotte

2-2 Town Planning

2-2-1 Present Population

The population of Colombo Region within a radius of 10 miles from Fort District as of 1968 was approximately one million, of which 900,000 people or about 90% concentrated within the 5 mile radius. The major cities located within the 5 mile radius are Colombo, Kolonawa, Kotte, Mt. Lavinia, Wattala and Moratuwa.

The present Colombo Municipality has a population of about 560,000 and covers an area of about 9,200 acres with an average population density of 61 persons/acre. The distribution of population within the city limits of Colombo shows an excessive concentration of population in and around Pettah District, which is adjacent to Colombo Harbour and has been a city area from old times, with a density of well over 200 persons per acre in some part.

Meanwhile, the area shouth of the central city area forms a high-class residential district where each housing has a spacious lot and there is such an extremely low density of population as 25 persons/acre in part.

2-2-2 Present Land Use

Within the city limits of Colombo the use zoning system is adopted. Of the total city area covering over 9,166 acres, about 6,500 acres of land or 2/3 is designated as residential area or proposed residential district and 1,441 acres of land or 15.7% is used for commercial district, with nearly no district specifically designated for industrial area.

As for the present land use, the district of Fort, which may be called the center of Colombo City, enjoys brisk commercial and business activities, besides it being the center of government activities. In the adjoining district of Pettah, land use is characterized by a strong commercial color.

The area surrounding Fort and Pettah districts forms a housing district for commercial and port laborers, where the living conditions are very poor and most of houses have turned to slums. The only land use for industrial purpose is seen in Colombo Port district where only a few port related industries are established.

Within the city limits there are some marshy lands, which can be expected for use as an urban area in the future, extending over 1,000 acres inclusive of the land being developed.

2-2-3 Present Traffic Facilities

The present trunk road network in Colombo City consists of 5 radial roads which link the CBD of Colombo City to the outlying cities. They are; (1) the route running north along the coast and reaching Negambo, (2) the route running northeast and reaching Kegalla and Kandy, (3) the route extending almost due south and reaching Avisawella, (4) the route stretching southeast and reaching Ratnapura and (5) the route running down south along the coast and reaching Kalutara and Galle.

All of these radial roads possess a character of national trunk road and have an important function to link the capital city with all major cities in Ceylon.

As for arterial roads within the city limits, meanwhile, there are three roads of 60 ~ 80 feet in width, including Base Line Road, taking the shape similar to a loop.

Regarding transport facilities for passenger service, both railways and bus service are available, but commuters use mainly bus service. Bus service network not only covers the city area of Colombo but also links with the urban surrounding zone. The number of bus trips arriving in Colombo City from outside of the city limits was about 5,200 daily on the average in 1970 and the number of

bus passengers was about 240,000. Meanwhile, the number of railway passengers arriving in Colombo City from outside of the city was only 20,000, according to a survey conducted in 1969.

The traffic of motor vehicles is fairly large in CBD, particularly in the morning rush hours and due to lack of off-street public parking facilities, there are many instances of on-street parking, which further intensify already worsened traffic congestion.

The number of motor vehicles parked on-street during the morning peak hour (10 A.M. ~ 11 A.M.) in Fort District alone was about 1,600 according to a survey made in 1955. In view of the fact that the number of motor vehicles has increased to 1.8 times since then, the number of vehicles parked on-street in Fort District during the peak hour is estimated at about 3,000.

3. Conclusions

3-1 Land Reclamation

The main purpose of this report is to provide a feasibility survey. After making a comparative study of various proposals for a reasonable and economically justifiable drainage system and facilities, a general scheme for the entire project area was framed out and an estimate on the cost of construction was made. Calculating investment efficiency based on the amount of investment and revenue resulting from the investment for all project areas, it was found that the investment efficiency of all these projects was more than 1.0 and that all of these projects were feasible, not only technically but also economically. In this type of project, the economic value can be further increased by curtailment of the construction period. The investment efficiency given in this report was calculated by taking into account the legal restrictions imposed on the amount of borrowings by the Reclamation Board and the number and capacity of construction machinery available in Ceylon. Therefore these projects, with the exception of the North Colombo Project, cannot be considered as having absolute certainty, though they are economically sound. If the curtailment of the construction period is realized through revision of the provisions of the Land Reclamation Act or through loans from international monetary institutions, the economic evaluation of these projects will be further increased.

3-2 Town Planning

3-2-1 Future Urban Picture of Colombo

Planning target year: 1990
Planning area: Area within a radius of 10 miles from the center of Colombo City, including Wattala, Kolonawa, Kotte, Mt. Lavinia and Moratuwa.

Future population: The present population of one million (1968) id expected to expand by 2.2 times to 2.2 million in 20 years.

The area within a radius of 10 miles from the center of Colombo City is to be disignated as the greater Colombo Region and the population in the region in 1990, 20 years hence, is expected to reach about 2.2 million. Of the total area of the region extending over 80,000 acres, about 70,000 acres of land is expected to be needed for urban area to accommodate the future population.

As for the directions of land use, formation of new urban area is to be contemplated by reclamation of low lying areas in and around Colombo City and at the same, redevelopment of CBD of Colombo City is to be attempted by improvements of the present deteriorated urban environments such as slums in the existing city area.

3-2-2 Directions of Land Use in Reclaimed Area

In planning land use of reclaimed land in low lying areas (Mutwal, Urugodwatta, Marigawatta, etc.) around the Port of Fort for urban area, the priority should be given to the establishment of residential quarters and the inhabitants are to be workers related with the Port of Colombo and those in commercial activities in Fort District. As most of the residents in the proposed residential district are expected to be low income earners, emphasis should be placed on construction of flats rather than detached houses with a garden to ensure intensive land use.

Meanwhile, as the districts of Nawala-Heen-Ela and Kotte, situated southeast of Colombo City, form a large development area, the development of these districts should aim not only at providing a function as bed town of Colombo City but also at promoting urban redevelopment incorporating urban facilities required for balanced function of Colombo City as a whole.

In other words, development of these districts should be studied with a view of providing the districts on important role as part of a comprehensive urban development project to accelerate relocation of government facilities now located in Fort District or to secure land space for distribution facilities to help promote smooth function of distribution system and instead of getting through with providing "housing complexes" for those suffering from a shortage of housing, it is essential to promote town making by incorporating more positive meaning.

3-2-3 Model Pattern of Housing Development (Nawala, Heen-Ela)

Location: Narahenpita of Colombo City and Welikada of Kotte U.C.
Total area to be developed: 750 acres
Population to be accommodated: 40,000

The planning area is situated within a radius of 4 miles from CBD of Colombo City and can be reached in half an hour by bus. The main objective of development is to provide a residential quarter for commuters to CBD of Colombo City and Mt. Lavinia but the project also aims at providing various public facilities for the residents of the project area in an attempt to create a community with better environment. Consideration was also given to the establishment of wide area urban facilities (government facilities, parks, etc.) for the benefit of residents outside of the planning area.

The proposed development area extending over 750 acres includes the existing urban area in the high land in addition to the planned reclaimed land. As the living environment in the existing urban area is very poor, a proposal was made for redevelopment of hign land simultaneously with the development of low lying areas by means of reclamation, to provide mainly detached houses with a garden in the low lying area and flats in the high land. As a river flows from north to south almost in the center of the planning area, a wide area trunk road was planned in parallel to the river.

Accordingly, a plan was made to use the strip of these public facilities as a dividing line of neighborhood so that the trunk road will not run through neighborhood. The population of one neighborhood was set at 8,000 ~ 12,000.

4. Recommendation

4-1 Land Reclamation

As previously stated, the City of Colombo and its suburbs are situated in a vast lowland area where there are many marshes left abandoned. Run-off water from the catchment flows over into these low-lying marshes before being discharged gradually into the sea through drainage canals as the surrounding water-level decreases. Therefore, the marshes, though seemingly left unexploited, function as a detention reservoir and play a vital role in protecting the surrounding developed area from the threat of flood. In other words, it seems that in the City of Colombo and its outlying areas, flood damages are kept to a minimum by the balance of three factors, namely, the flood inflow, outflow and the detention capacity of existing marshes which act as a detention reservoir.

Such being the case, it is important to avoid a reduction in the existing capacity of these marshes in planning reclamation projects. It should be kept in mind that any development scheme which disregards this point will result in making the drainage situation in the developed area worse. Some small reclamation projects, which depend solely on filling, and take no account of the overall drainage system, have been undertaken by private enterprises in and around the City of Colombo. This type of works destroys the balance between the inflow and outflow of flood water and the flood-regulating function of the marshes. Therefore such works should be prohibited from the standpoint of the overall development of the Colombo Region, by legislation or regulation if necessary.

In planning a reclamation project, therefore, even if it is a small project or a project undertaken by private sectors, there must always be a scheme for a detention reservoir with adequate function and capacity corresponding to or exceeding that of the existing marshes. When a reduction in the flood detention capacity of the marshes is contemplated, the plan must provide for the installation of additional pumps to compensate for the reduction in the flood detention capacity of the marshes. These are the points which were first to be important by the survey team during the field investigation of the project area and to which the agencies concerned as well as the Board should pay particular attention.

The next important subject is the views concerning the diversion plan of the Madiwela Catchment, which has an important bearing on the entire project, particularly on the reclamation project in South Colombo, and plays as important role in its success or failure. As a result of economic comparisons of various drainage systems, the short cut, using the route of the Old Moat, has been adopted. As stated in the staging program of the project, the reclamation works in Colombo North, Heen-Ela and Gothatuwa can be accomplished without diversion of the Madiwela Catchment. After completion of the reclamation projects for the above-mentioned area, the run-off water from the Madiwela Catchment will flow through Kotte Lake and Kirillapone Canal and then will be discharged into sea at the Wellawatta outlet and Dehiwela outlet, following the existing drainage canal traces. With the growth of demand for more land following the concentration of the population in the city area and the expansion of commerce and industry,

reclamation in Kotte will also have to be considered. To reclaim the marshy land in Kotte, the diversion work of Madiwela Catchment must be carried out by means of a tunnel as mentioned in the general plan. This route is considered to be most reasonable and economic at present. However, it will pose some problems in the future when the development of the Madiwela Catchment for housing development is taken into consideration.

The first problem likely to be encountered following the progress of the development in the Madiwela Catchment is an increase in run-off coefficient caused by changes of surface material in the basin. The area around the Kirillapone Canal and Wellawatta Canal are highly developed, making it very difficult or almost impossible, to widen these canals.

In view of these factors, the most ideal way would be build a diversion canal from the south end of the Madiwela Catchment and to discharge into Weras Ganga as described in the I.D. Report.

The third question is the groundwater in the surrounding area. All reclamation areas in this project will depend on a pumping system. Originally, it was proposed to maintain the estimated normal water level in the detention facilities at -6 MSL or -8 MSL. However, due to the fall down of ground water level in the surrounding area, it is quite possible that the ground level will subside owing to consolidation of the foundation. Accordingly, it was proposed to maintain the normal water level at 0 MSL during dry weather and to lower it to -6 or -8 MSL by pumping immediately before the start of run-off following rainfall. Judging from the data of daily precipitation, a considerably heavy rainfall is expected almost every day during the rainy season. To ensure the safety of the reclaimed land, therefore, it is necessary to maintain the normal water level at -6 or -8 MSL as far as the rainy season is concerned. Since the groundwater gets a sufficient supply of rain water during the rainy season, the lowering of water level in the scheme would not cause serious effects on the surrounding area of the project.

The surface soil layer in a depth of 10 feet consists mainly of clay, silt and peat in entire project area and the coefficient of permeability is considered to be relatively small. Though a definite conclusion cannot be made because of a total lack of data on the fluctuation of the groundwater, the influence of a mere 8 feet downward in the water level at the drainage canal will not cause any serious problems as the need for payment of compensation for the subsidence of ground level and the lack of groundwater. In any event, the fluctuation of the groundwater caused by a lowering of the water level in the detention facilities is a matter of great concern for the residents in the surrounding area. In implementing a reclamation project, therefore, it is important first to obtain the understanding and cooperation of the residents of the area by providing satisfactory technical explanation. For this reason, it is necessary to make efforts to analyze this problem in detail in the near future while gathering data on the fluctuation of the groundwater.

The fourth question is concerns the quality of the redish brown soil brought in for dressing ground surface. Though a definite conclusion cannot be made on the quality of this soil at present because data on soil dynamics is not available, the soil appears to have a tendency to become very muddy and sticky when wet. It is considered advisable, therefore, to spread sand about 6 inches in thickness for the surface dressing, if possible, to ensure better environment upon completion of land reclamation.

Fortunately, sand bars, which develop to such an extent as to close up the outlet of the canals, are found on the coast of Colombo, and therefore there is no difficulty in obtaining sand. The distance between the beach and the reclamation ar a is relatively short and the cost involved is not considered to be expensive compared with the transport cost of the redish brown soils. As the soil for surface dressing is required in large quantities and is one of the materials that have an important bearing on the economy of the project, any use of sand for dressing materials should be preceded by making a comparison of unit cost between the so soil and sand, and the proportion of sand in the mixture must be determined so as not to upset the balance of the economy of the project.

The fifth question concerns the concrete revetment for canals and lakes. Under the existing condition, many of the concrete revetments provided for part of the main drainage canals have tilted or have fallen and are not functioning well. The main cause of this failure is presumed to be the insufficient depth of the footing of the revetment post. In designing the revetment, therefore, it will be necessary to make a stability analysis by taking into account the surcharge over the bank and the groundwater pressure. In Japan, there are many cases where steel sheet piles are employed for the protection of canals. The design incorporating the use of steel sheet piles might appears to be expensive, but they are more durable, stable and workable and are most satisfactory both from the standpoint of hydrography in canal and maintenance. Since the project, including urban drainage, requires stability over a long period of time, the use of such dependable materials as sheet piles will be more economical in the long run.

The sixth question is the management and maintenance of the drainage system upon completion of the project. The main drainage canals in and around the City of Colombo are under the jurisdiction of the Irrigation Dept., but the annual budget for the maintenance of these canals seems to be very small. Taking the Dutch Canal, for example, it is believed that the canal had sufficient depth at the initial stage and that the flood detention reservoirs including Kotte Lake, had a fairly large detention capacity. However, because of a lack of proper management and maintenance, the capacity of these canals and detention reservoirs has gradually deteriorated, and at present, even the land of +6 MSL, which otherwide could be available for use as a residential or industrial area in respect to the elevation, is being flooded, inundated, and still remains a complete marshy land. It must be remembered, therefore, that even a splendid land successfully reclaimed under the project might revert to the situation of marshes before long if and when proper supervision and maintenance are ignored upon completion of the project. According to the estimate on the economic evaluation of the project, all the management and maintenance cost are to be formed by each project. In actuality, however, the drainage system under this project is only a part of the overall drainage system for the entire Colombo Region. Therefore, most of the management and maintenance costs should be borne by the Government or public organizations.

The maintenance of such main structures as pump stations and regulators offers little problem because they are easily noticeable. However, the degree of silting in the drainage canal or in the detention lake is not as conspicuous and is therefore often neglected. It is advisable, therefore, to purchase several small amphibious self-moving dredgers equipped with a Fathometer, a device which is capable of recording the degree of silting accurately and promptly, and to use these dredgers for desilting by assigning them on patrol missions for all drainage canals and detention lakes.

There are many other points to be kept in mind in connection with the maintenance of the drainage system. No matter how reasonable and sound the project may be and how carefully it may be implemented, its overall success will be denied if proper maintenance is not provided following the compeltion of the work.

In fact, looking over the existing condition of the drainage canals in and around the City of Colombo, the need of full maintenance after completion of the project is deeply felt.

The seventh question is the necessity of gathering long-range observation data which may be used as the basis of the scheme in working out a large project such as this one. Though hydrologic data is available in relative abundance even at present, the data, particularly data on the run-off coefficient and on the discharge of each canal, which are most needed for the project, is very scarce. The data on the coefficient of run-off may be obtained easily by selecting a model area of small catchment and observing the discharge at the run-off outlet. An accurate measurement of the discharge in the drainage canal is made difficult by the hydraulic condition of back-water in the slow gradient stream. However, a fairly accurate estimate may be obtained by installing a pair of automatic water level gauges at intervals of about 1/2 mile. Thus, the trend of flow in the Colombo Region during floods may be grasped.

The eighth point is the question concerning the procurement of funds for the project. Under the current Reclamation Board Act, the amount of Government-guaranteed loans is limited. As a result, the staging of the project is so restricted that the implementation of the whole project will require more than 30 years.

As mentioned previously in reference to investment efficiency, the economic evaluation of the project may be increased through the reduction of interest paid by shortening the construction period through the mobilization of all available construction machinery. Therefore, a substantial curtailment of the construction period should be attained through an increase in the amount of land by revising the provisions of the Reclamation Board Act or by seeking loans from international monetary organizations. Recommendations on this project may be summarized as follows.

1) As the existing marshes play a vital role in flood detention for the entire Colombo Region as detention reservoirs, full efforts should be made so as not to decrease this detention capacity in implementing a reclamation project. Particularly, unplanned land reclamation by the private sector should be restricted.

2) The decision on the Madiwela diversion route in this report has been made on the assumption that there will be no land development scheme in Modiwela even in future. Accordingly, if such a scheme is planned for the Modiwela catchment in the future as a result of the concentration of the population in the Colombo Region and the expansion of commerce and industry, the Modiwela diversion scheme to Weras Ganga as suggested in the I.D. Report, would be better than any other proposal due to the lack of conveyance capacity of Kirillapone canal and Welawatta canal.

3) The influence of the reclamation project on the groundwater in surrounding area is not considered as causing any serious problem from a geohydrological

point of view. However it will be necessary for the purpose of obtaining the understanding and cooperation of the surrounding residents.

4) As sand of good quality is available at a relatively short distance from the location it should be used as part of the soil for dressing ground surface to ensure good drainage conditions of the reclaimed land.

5) Durable drainage facilities must be provided by placing emphasis on the dependability required of the urban drainage system even though such facility may entail higher cost.

6) Although the main purpose of the project is land reclamation, its ultimate result will be to serve as the urban drainage for the entire Colombo Region. Therefore, most of management and maintenance costs should be borne at public expense. It should be well recognized that the management and maintenance of the system after its completion will determine the success or failure of the project.

7) Efforts should be made to gather various kinds of observation data, which may serve as the basis for planning the project, in order to make this large scale project a success.

8) As a curtailment of the construction period is most essential to ensure the economic soundness of the project, consideration should be given to obtaining loans from international monetary institutions.

4-2 Town Planning

It has already been mentioned that the current survey in Colombo City and the surrounding area included a study on the project area from the standpoint of town planning in addition to studies on reclamation, drainage and land formation projects.

The points which must be given special attention in the future in relation to these studies and projects are described later. The points which should be given particular emphasis above all may be summarized as follows: (1) In planning the future of Colombo City and the surrounding area, it is essential that it be dealt with from a broad point of view as the capital city of the nation, instead of limiting the scope of the study to its administrative jurisdiction; (2) it is desirable to establish an executive organ directly under the Prime Minister to assume the responsibility for controling development projects and construction in these areas; and (3) the Board, which is responsible for planning projects and implementing the work, should not be confined to reclamation in its activity but should be given expanded functions so that it may also be able to participate in the comprehensive town planning project and give positive cooperation in solving the problem of "Shanties" which is expected to become a serious issue in the future. The following is an outline of the recommendations made by the survey team.

(1) In order to make the area a place conductive for healthy and affluent living standards, a basic plan for the Greater Colombo Region, most suited to the natural features of Ceylon, and plans for its implementation must be formulated as soon as possible. For that purpose, it is essential to determine the framework of the project, including housing construction,

improvement of transport facilities and the preservation of park areas, and to consider the establishment of an executive organ equipped with co-ordinating functions directly under the Prime Minister. It is also important to establish clear-out lines to determine the role and function of land re-claimed by the Board in the Greater Colombo Metropolitan Area Project.

(2) As the establishment of good residential districts cannot be accomplished only through reclamation work in the Board, it is desireable to carry out land readjustment in the surrounding areas, including districts where shanties exist, in order to create a community with good environment (Nawala Heen Ela for example). This will make it possible eliminate existing and to establish better neighbourhoods as the nucleus in the re-construction of the capital city.

The development of surrounding area, including the districts where shanties exist, serves the double purpose of eliminating slums and improving the environment in the reclaimed land. Furhtermore it is felt that the time is opportune for the redevelopment of urban area. It is earnestly hoped, therefore, that the matter is dealt with in a manner which will leave no source of trouble for the future.

It is also recommended that plans for the establishment of an industrial complex along with the residential district be adopted so that the residents in the project area may be provided with housing as well as employment opportunities.

(3) For the planning of a feasible and reasonable town planning project, many basic data on such items as population, present state of land use, transport facilities, traffic volume, origin and destination survey, industrial activities and economic statistics are indispensable. At present, however, such data is not sufficiently available and it is essential that efforts be made to gather necessary data and materials and make required surveys.

(4) In order to solve the traffic problem in CBD, it is recommended that such measures as the enforcement of one-way traffic, prohibiting of traffic control, establishment of off-street parking facilities, redevelopment of delinquent districts, relocation of government and public buildings, alteration of design and improvement of facilities for the bus terminal in front of Fort Station and reorganization of bus service network be taken.

(5) It is advisable that necessary studies be made on the feasibility of delegating more extensive and powerful authority to the Board in order to entrust to the responsibility for public undertakings as well as land readjustment in the reclaimed land and the surrounding area. It is particularly important to assign the Board the responsibility for providing public housing for small and medium income classes in the area so that it will be enabled to play a greater role in the city facility improvement project and, at the same time, to adopt a forward looking attitude in studying the advisability of granting subsidies. For this purpose, it will be necessary to revise the provisions of Act No. 15 of 1968 and related regulations and to reorganize and expand the structure of the Board.

(6) It is understandable that the acquisition of working funds for the Board, particularly the required foreign currency, will be extremely difficult

in the face of the acute financial situation of the nation and continued deficits in the trade balance. It is strongly hoped, however, that the Government will utmost effort to secure the necessary funds for the Board which is charged with the urgent task of solving a serious housing problem and a chronic unemployment problem brought about by the intensified concentration of population in Colombo City. Since the acquisition of foreign currencies depends on foreign aids, it will be necessary for the Government to seek the source of required foreign currencies in the World Bank or the Asian Bank, through bilateral aid programs, or importing necessary machinery and equipment through aid in goods.

On the other hand, it is also important for the parties concerned to make every efforts to save foreign currencies through originality and ingenuity in the selection of the construction method and materials and the introduction of new construction techniques and materials. Therefore, it is desirable that efforts be made for the establishment and promotion of domestic industry.

(7) As for the project assigned to the Board, it is essential to avoid a sudden expansion but to make a gradual expansion of the work so as to facilitate the acquisition of required capital and engineers. While energitic and capable high-class engineers are available in the field of reclamation and town planning, there is a shortage of lower-class engineers. It is desirable, therefore, to give special consideration to the training of many lower-class engineers.

For the efficient implementation of the project, the personnel assigned to the Board should be kept to a minimum as practically as possible to increase the productivity of each employee. At the same time, flexible measures should be taken in the employment of personnel, short-term transfer of personnel from other agencies should be avoided and salaries for the staff should be better than government employees.

(8) It is essential for the Board to formulate a 3 - 5 year program to increase the number of personnel, expand the organization of the Board and for fund-raising.

As for the implementation of the project, it is desirable for the Board to set up regulations for accounting and contracting procedures; establish standards for compensation for land and buildings and a guideline for computing of compensation; and prepare standard designs for structures, standard work specifications, construction management and supervision manuals, so that the project may be handled efficiently and smoothly in a business-like manner.

PART III TOWN PLANNING FOR CITY OF COLOMBO AND SUBERBS

CHAPTER I. PRESENT STATE OF CEYLON

1-1 Natural Conditions

1-1-1 Geographical Location and Topography

Ceylon is an island situated in southeast of Indian Peninsula and a self-governing state of the British Commonwealth of Nations. The area of the country is 65,610 km^2 and the population is 10,624,507 (1963) with the density of population being 162/km^2. The capital of Ceylon is Colombo.

The island is near egg-shaped and measures about 430 km from north to south and about 200 km from east to west. The Straights of Pork lying between the island and India is linked by sand bars at Adams Bridge but a part has been cut off since the 15th century.

It is a block island comprising granite, gneiss and crystalline rock. The southern half of the island is high in elevation and Pidurutalagala (2,527 m), the highest mountain in the country and the Adams Peak (2,245 m) are in this region which is thickly vegetated. The north edge of the mountain area forms a sharp cliff and borders with the plain of the northern half of the island. In the south the mountain area becomes an undulating hill and transforms into a plain which stretches along the coast. The plain accounts for 3/4 of the total land area of the island and is covered with reddish laterite. In the plain many low hills scatter here and there in the form of an island hill. The sea is generally shallow to some distance and there also are many sand bars. In the southwestern part of the island there are developed coral-reefs which make the navigation extremely difficult during the summer monsoon.

Some small rivers originate in highland and such rivers as the Gal Oya on the east coast and the Laxapana in the central part of the island, both of them have a potentiality for hydroelectric development, are being developed.

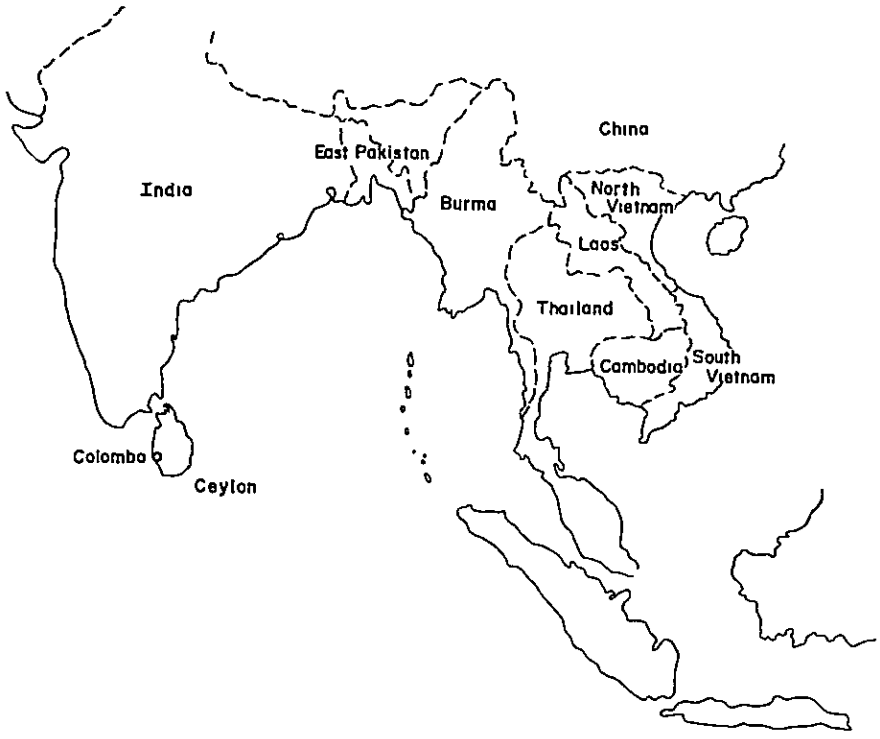
1-1-2 Climate

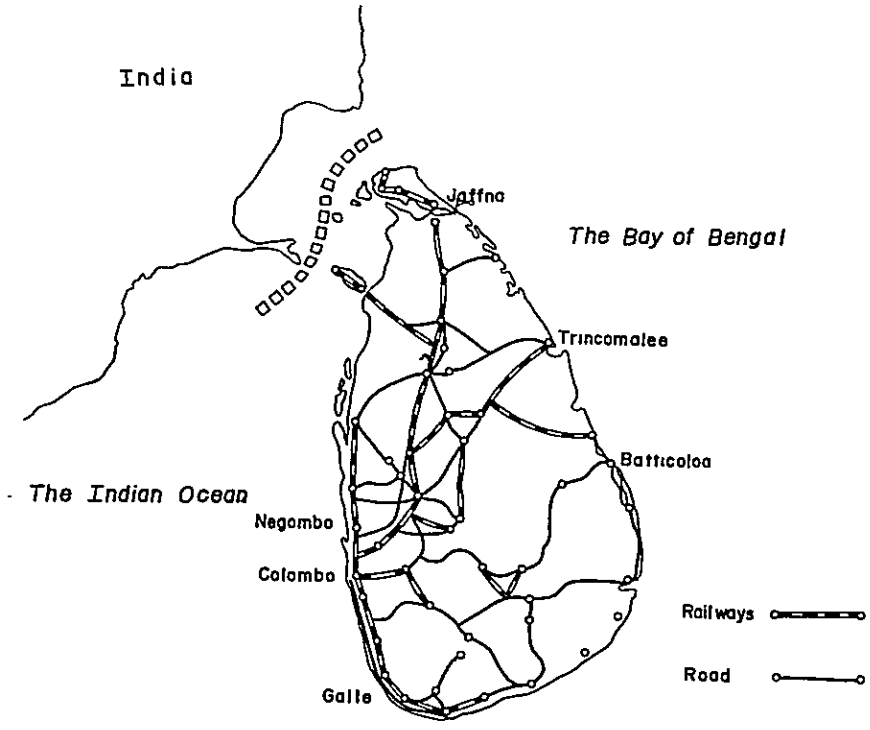
1) Ceylon

The climate in this country is fairly mild being influenced by tropical oceanic climate of high temperature and humidity. The year is divided largely into two seasons, the South-West monsoon season covering a May - October period and the North-East monsoon season in a November - April period. Between the two seasons, however, there is an intermediate season which is shown in Table III-1-1.

There is very little change in the temperature throughout the year. In the municipality of Colombo the average temperature of 30 years is 26.9°C and the mean minimum temperature in a November ~ February period is 26.3°C while the mean maximum temperature in an April ~ May period is 27.8°C with a small margin of 1.5°C. The temperature varies with the elevation and in Nuwara Eliya (6,000 above sea-level) the temperature is constantly within the range of 15°C ~ 17°C and for this reason the district is known as a summer resort. The maximum temperature is often experienced in the northwest and northeast regions, the so-called dry zone, and the highest

Fig. Ⅲ-1-1 Geographical Location of Ceylon





temperature recorded in Trincomalee in April 1956 was 38.6°C.

The humidity is generally high and the annual mean maximum humidity recorded in Galle on the south coast was 81% and the annual mean minimum humidity recorded both in Trincomalee on the northeast coast and Anuradhapura in northwest was 66%, with the mean humidity for the country being 71%.

There is much rain on the island as a whole. Because of the projection of mountains at the center of the island, the influence of the monsoon varies greatly between the southwestern part and the northern part. The southwestern part has much rain brought by the humid South-West monsoon and therefore is called the "Wet Zone" and the northern part where the rainy season is short and there is less rainfall is called the "Dry Zone". The influence of rainfall on the industry is very great.

Table III-1-1 General Condition of Climate

Month	Monsoon	Remarks
May		
June		High humidity
July	S.W.	High precipitation in plain and high land in
August		the southwestern part
September		
October	Intermediate season	Rainfall accompanied by thunder-storm due to tropical low pressure
November		Highest rainfall during the year
December		High precipitation in the north-eastern part.
January	N.E.	
February		Land-breeze and sea-breeze in the morning and evening
March	Intermediate season	Rainfall accompanied by thunder-storm due to oceanic wind
April		

Table III-1-2 Annual Rainfall (mm)

Location	1954	1955	1956	1957	Average of 1911 ~ 1940
Colombo (West coast)	2,626	2,439	2,005	2,472	2,368
Hambantota (South coast)	1,335		708	1,306	1,069
Batticoloa (East coast)	1,710	1,577	1,659		1,752
Trincomalee (Northwest coast)	1,689		1,440	2,525	1,646
Jaffna (North coast)	1,479		1,052	1,965	1,350
Nuwara Eliya (Mountain area)	2,098	2,342	1,975	2,658	2,296

Fig. Ⅲ-1-2

Climate division of Ceylon

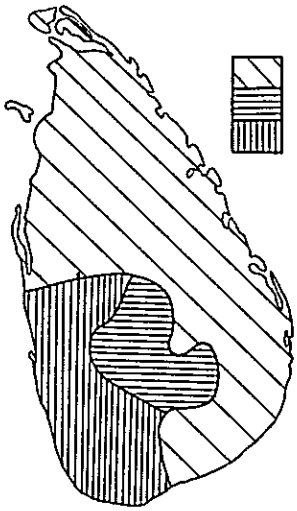


Fig. Ⅲ-1-3

Precipitation in Ceylon during South-West Monsoon season

(May-Sep.)

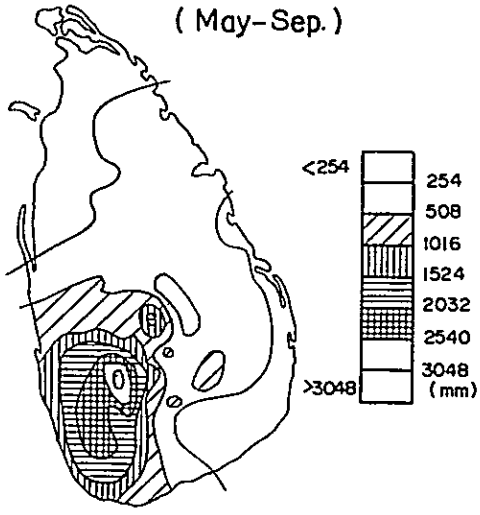
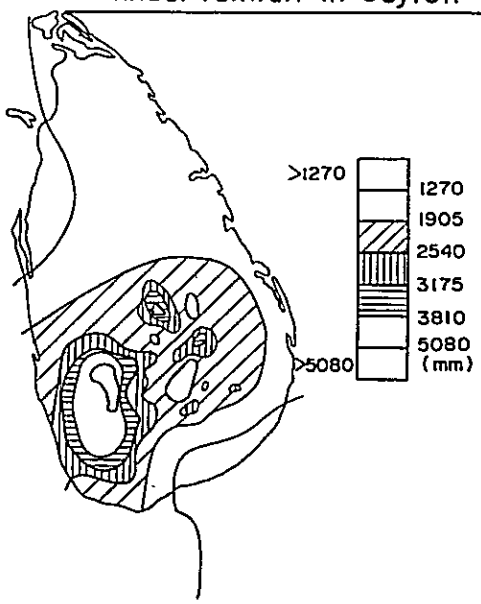


Fig. Ⅲ-1-4

Annual rainfall in Ceylon



2) Municipality of Colombo

o Temperature and humidity

The mean temperatures and mean humidity in 1968 are shown in Table III-1-3. The table shows very little change in temperatures through the year and around 80°F is recorded throughout the year on the average. The monthly mean maximum temperature is around 85°F and the mean minimum temperature is around 75°F. The daily fluctuation of temperature is generally low being around 10°F.

The mean humidity through the year is around 75% in daytime and about 90% at night. The lowest daily fluctuation of humidity is 6 ~ 7% in a July - August period compared with 20% in February.

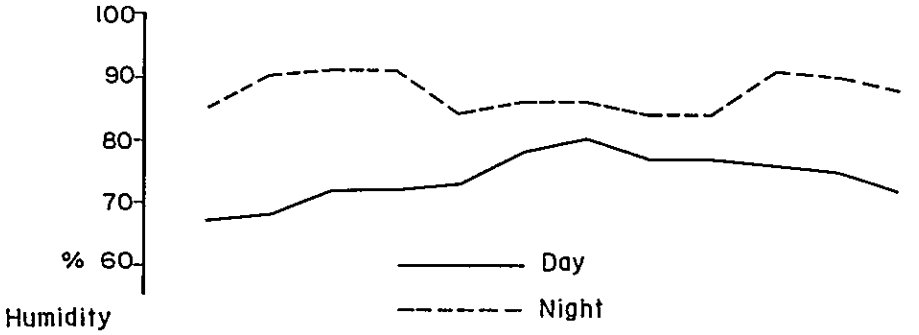
o Rainfall

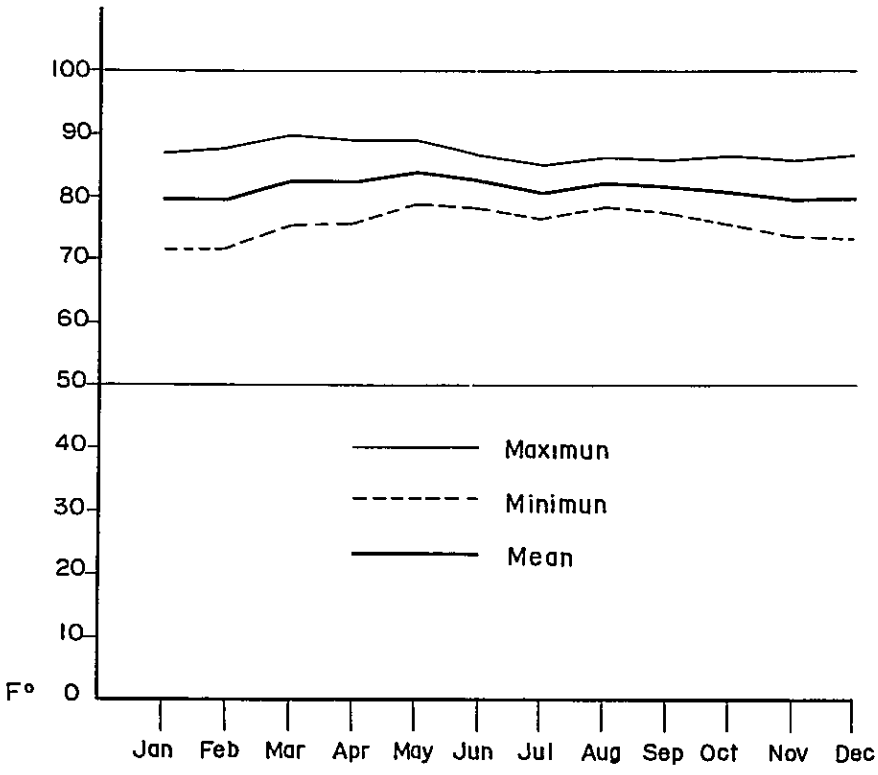
As shown in Table III-1-6, the annual rainfall in 1968 was 73.33 inch (1,863 mm) which was far below the 118.02 inch (2,997 mm) recorded in the previous year. The months in which there was most rainfall were April, June, July and November. The average annual rainfall of the past 30 years (1931 ~ 1960) is 94.31 inch (2,395 mm) as shown in Table III-1-6. It is known therefore, the annual rainfall of 73.33 for 1968 is below the average rainfall of normal years.

Table III-1-3 Temperature and Humidity - 1968
(Municipality of Colombo)

Month	Temperature			Mean Humidity	
	Maximum F°	Minimum F°	Mean F°	Day %	Night %
January	86.8	71.4	79.1	67	85
February	87.2	71.3	79.2	68	90
March	89.3	75.1	82.2	72	91
April	88.7	75.4	82.0	72	91
May	88.8	78.7	83.8	73	94
June	86.4	78.0	82.2	78	86
July	84.8	76.3	80.6	80	86
August	86.0	78.2	82.1	77	84
September	85.6	77.2	81.4	77	84
October	86.4	75.3	80.8	76	91
November	85.6	73.6	79.6	75	90
December	86.4	73.3	79.8	72	88
Average	86.8	75.3	81.0	74	88

Fig.Ⅲ-1-5 Temperature and Humidity - 1968
(Municipality of Colombo)





Temperature

Fig. III-1- 6

Rainfall in Colombo by Months-1967 & 1968

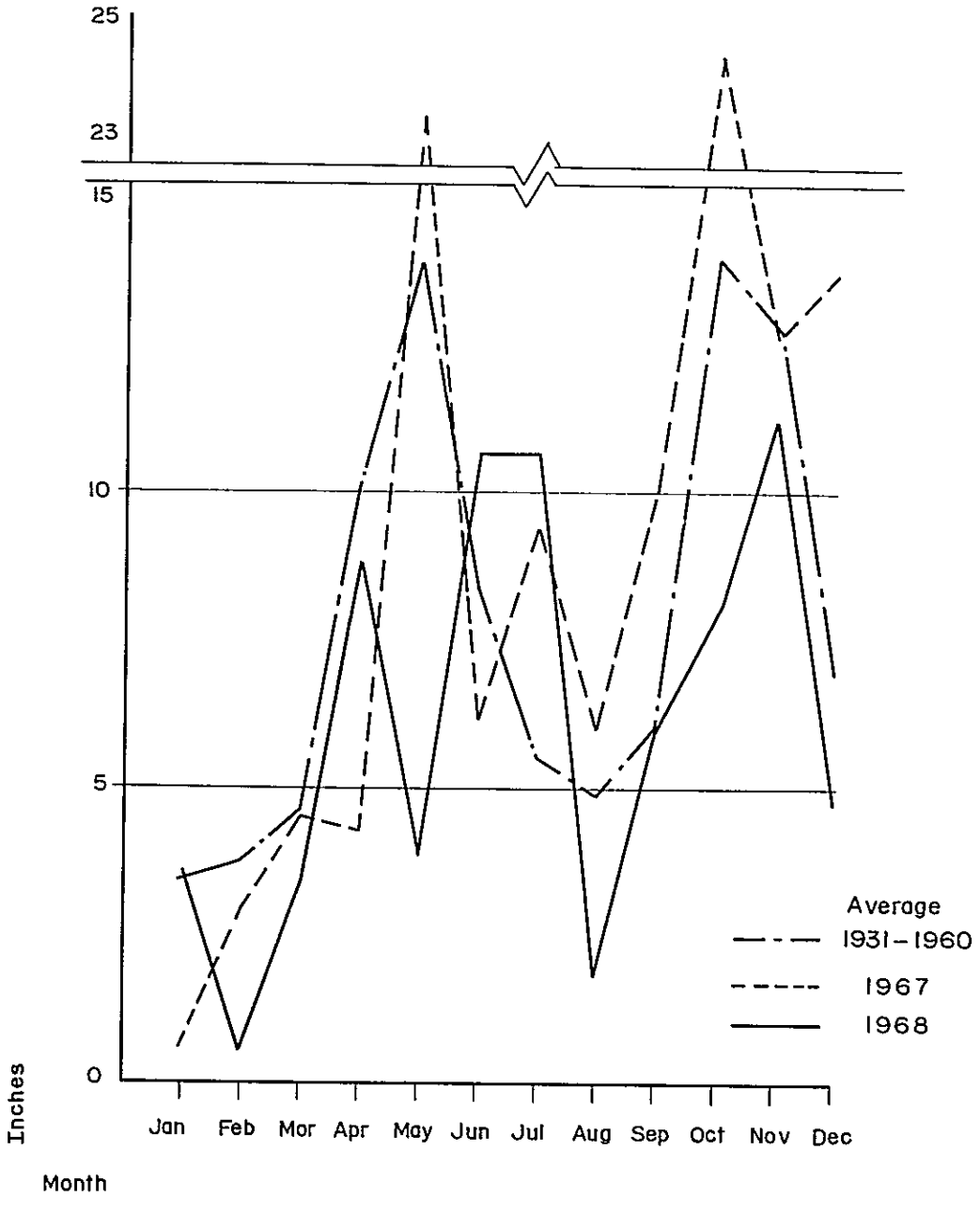


Table III-1-6 Rainfall in Colombo by Months - 1967 and 1968

Month	Rainfall in inches 1968	1967	Standard Average 1931 - 1960
January	3.68	0.62	3.46
February	0.53	2.97	3.78
March	3.40	4.52	4.63
April	8.85	4.27	10.23
May	3.85	23.36	13.88
June	10.66	6.16	8.33
July	10.68	9.41	5.50
August	1.86	5.97	4.87
September	5.95	10.10	6.04
October	7.89	24.39	13.94
November	11.22	12.58	12.77
December	4.76	13.67	6.88
Total	73.33	118.02	94.31

1-2 Social Conditions

1-2-1 Structure of economy

Like other Asian countries, Ceylon is also an agricultural country. However, as the agriculture in this country centers on export crops, the country cannot meet its own demand and relies on imports for more than half of its food supply. Of the total arable land covering an area of about 3.5 million acres, approximately 60% is used for three main export crops-tea, rubber and coconut- and only 20% is used for rice paddy. Cultivation of these exports crops concentrates on the southwestern part where the density of population is very high. Of the three main export crops, tea and rubber are grown in the plantation owned and operated by foreign capital and the requirement for agricultural labor in the plantation is being met by immigrant labor. Therefore, the plantation has no direct impact on Ceylonese small scale agriculture centering on rice production. As for rice paddy which supplies people's staple food, the average acreage per farm household is less than 1.0 acre which is far below the minimum economic requirement. As a result, such phenomena as the chronic unemployment, poverty, heavy debt, and increase in the number of absentee landowner or landless farmers are seen. Such situation keeps farming efficiency and the productivity of agriculture at low level and prevents intoduction of new agricultural techniques. Reflecting such basic structure of agriculture, Ceylon's dependency on foreign trade is very high. Tea, rubber and coconut account for more than 90% of the total exports and such primary consuming items as cereals and textiles account for 2/3 of total imports. 50% of the total foreign trade is with the countries of British Commonwealth of Nations and the British territories. The gross national product in 1963 was 6,644 million Rupee and the per capita gross national product in the same year was such high level as $140 (about twice that of India and Burma). Such accomplishment is also due to the growth of plantation agriculture. Therefore, the state of economy in Ceylon may be said to be that in which "The destiny of a

few primary export crops in the world market is the most important factor in determining the material welfare of Ceylon".

As for the mining industry, exploitation of illuminant is being progressed in addition to the existing graphite and precious stones and accomplishing a satisfactory result. Though the country relied on imports for half of its demand for marine products in the past despite its rich marine resources, the fish catch has doubled in the five year period from 1985 as a result of fishery self-supporting program.

With regard to transportation system, construction of road and railways and improvements of Colombo Port have been pushed forward since the 19th century corresponding to the expansion of agriculture. In 1963 the total length of railways was approx 1,440 km and that offroadway was about 17,000 km. The number of automobiles in the same year was 146,323 but severe restriction on import of automobiles has been in effect since 1961. At present the recently nationalized bus transport network covers the entire island and plays an important role as the main transport facility for the people. Among the commercial ports, the Port of Colombo is the largest and international airports are located in Colombo and Jaffna.

Table III-1-7 Composition of Employment in Ceylon

		No. of employees		Production		Per Capita Production
		No. of employee	Ratio (%)	Rupee (1 mil.)	Ratio (%)	Rupee
I	Agriculture, forestry, fishery	1,681,937	52.5	3,877.1	38.9	2,305
II	Mining	9,412	0.3	69.4	0.7	7,374
	Manufacturing	313,425	9.8	1,086.6	10.9	7,367
	Construction	85,131	2.7	608.2	6.1	7,144
III	Service industry including electricity, gas & water	8,700	0.3			
	Commerce	289,485	9.1			
	Transport & warehousing	137,598	4.3	4,335.4	43.4	3,923
	Public service	494,082	15.5			
	Others	175,355	5.5			
	Total	3,195,125	100.0	9,976.7	100.0	3,123

(Notes) 1. The number of employment is based on the 1963 consus.

2. Per capita GNP including that of dependent is 140 $/person.

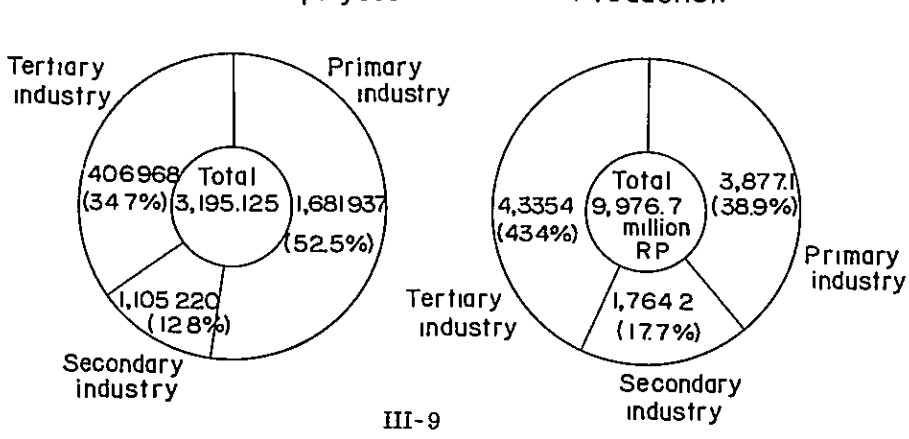


Table III-1-8 Main Trade Items

1963 (In million Rupee

Import		Export	
Foodstuff	567	Tea	1,139
Clothing	67	Rubber	257
Construction materials	35	Coconut	239
Machinery & fuel	213		
Others	608	Others	105
Total	1,490	Total	1,740

1-2-2 Population

1) Changes in population (Nation-wide)

2) Composition of population in Colombo Municipality

While the composition of the total population in Ceylon shows a complete piramid-shape, that in the capital city of Colombo takes the shape of an onion head. This is due to an intensive influx of young labor stratum (mainly 20 ~ 30 years old), that supports production and reproduction functions of the city, into the city of Colombo because of vigorous economic activities in the city.

The total population by age based on the 1953 census is shown in Table III-1-9. Comparison of population in 1953 with that in 1968, 15 years hence, shows that there was an influx of 23,407 in the age group of 20-24 and of 26,003 in the age group of 25-29. It is evident from the above figures that the composition of population of Colombo is strongly supported by young labor stratum.

Table III-1-9 Composition of Population in Colombo

Age group	1953		1968	
	Population	Component ratio	Population	Component ratio
0 4	47,180	11.1	62,406	11.1
5 9	44,621	10.5	59,033	10.5
10 14	38,090	8.9	50,037	8.9
15 .9	36,749	8.6	48,350	8.6
20 24	51,733	12.1	68,028	12.1
25 29	48,614	11.4	64,093	11.4
30 34	35,131	8.2	46,102	8.2
35 39	32,838	7.7	43,291	7.7
40 44	23,722	5.6	31,484	5.6
45 49	21,723	5.1	28,673	5.1
50 54	16,397	3.8	21,364	3.8
55 59	10,465	2.5	14.055	2.5
60 64	7,040	1.7	9,558	1.7
65	11,824	2.8	15,742	2.8
Total	426,127	100.0	562,216	100.0

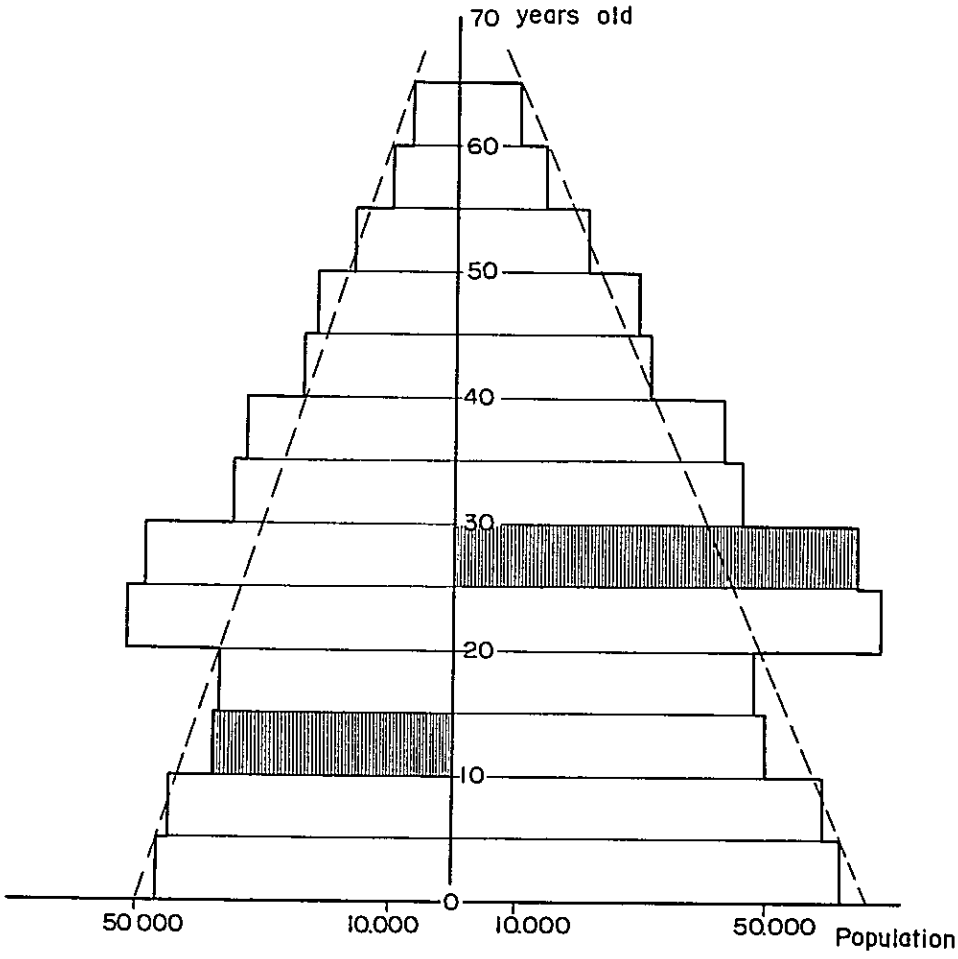
(Notes) 1. The population in 1953 is shown in actual figures obtained by the census.
2. The population in 1958 is shown in forecast figures.

1) Changes in population (Nation-wide)

	Area (km^2)	Population (1,000) 1871	1901	1931	1953	1963	1968
Nation-wide	65,609	2,400.4	3,566.0 (149)	5,306.9 (221)	8,097.9 (337)	10,382.0 (441)	11,964.0 (498)
Colombo	2,093	430.0	690.8 (161)	1,081.2 (251)	1,708.7 (297)	2,207.4 (513)	2,489.0 (579)
Kalutara	1,616	145.7	229.9 (158)	363.8 (250)	523.6 (359)	631.5 (433)	706.0 (522)
Kandy	2,367	232.2	377.6 (163)	587.7 (253)	840.4 (362)	1,043.6 (449)	1,184.0 (510)
Matale	1,995	75.2	92.2 (123)	129.7 (172)	201.0 (267)	255.6 (340)	287.0 (382)
Nuwara Eliya	1,228	58.2	153.0 (263)	235.8 (405)	325.3 (559)	397.7 (683)	443.0 (761)
Galle	1,689	194.4	258.1 (133)	363.6 (187)	524.4 (270)	641.5 (330)	718.0 (369)
Matara	1,246	143.4	203.8 (142)	283.3 (198)	413.4 (288)	514.9 (359)	586.0 (409)
Hambantota	2,623	60.9	104.9 (172)	124.4 (204)	191.5 (314)	274.3 (450)	311.0 (511)
Jaffna	2,586	246.1	300.9 (122)	355.4 (144)	491.8 (200)	612.6 (249)	694.0 (282)
Mannar	2,497	20.3	24.9 (123)	25.1 (124)	43.7 (215)	60.1 (296)	68.0 (335)
Vavuniya	3,799	15.3	15.2 (22)	18.3 (120)	35.1 (229)	68.6 (448)	77.0 (503)
Batticoloa	2,633	93.1	145.2 (156)	174.9 (188)	270.5 (291)	196.1 (211)	227.0 (244)
Amparai	4,598	--	--	--	-	211.7 (-)	239.0 (-)
Trincomalee	2,714	19.4	28.4 (146)	37.5 (193)	83.9 (432)	138.5 (714)	156.0 (804)
Kurunegala	4,776	207.1	249.4 (120)	397.2 (192)	626.3 (320)	852.6 (412)	969.0 (468)
Puttalam	3,036	68,1	29.8 (44)	35.1 (52)	58.8 (86)	302.5 (444)	335.0 (4920
Chilaw		-	74.4 (-)	114.6 (-)	170.1 (-)	-	-
Anurad hapura	7,274	63.7	79.1 (124)	97.4 (153)	229.3 (360)	279.8 (438)	331.0 (488)
Polonnaruwa	3,449	-	-	-	-	113.9 (-)	131.0 (-)
Badulla	2,822	129.0	186.7 (145)	303.2 (235)	466.9 (362)	521.8 (404)	586.0 (454)
Mohehagala	5,666	-	-	-	-	132.2 (-)	155.0 (-)
Ratnapura	3,239	92.2	133.0 (144)	263.8 (286)	421.6 (457)	546.0 (592)	622.0 (675)
Kegalle	1,663	105.3	188.0 (179)	314.6 (299)	471.6 (448)	578.5 (549)	670.0 (636)

(Note) Figures in parentheses represent the ratio with 1871 taken as 100.

Fig. Ⅲ-1-7 Composition of population by age group
(Colombo Municipality)



(1953 Census) (Forcast for 1968)

CHAPTER 2. FUTURE URBAN PICTURE OF COLOMBO

2-1 Establishment of Objectives for Planning

Not only in town or city planning but also in every planning, there must be certain basic objectives determined. A planning is, after all, a process leading to the accomplishment of the objectives so established.

It may not be too much to say that the ultimate goal of a town planning is to attain the amenity of the town. The physical aspects, of course, are the key factor in the urban planning, but the importance of pursuing a spiritual amenity based on the custom, culture, and tradition of the country itself should not be neglected either. It is, therefore, absolutely necessary to attain a complete grasp of the living behavior and the production activities of the people of Colombo of today before making any blue-print of city planning so that a future urban picture of the city, which would satisfy the above-mentioned two different functions, could be drawn out.

In drawing out a blue-print for the system and pattern of the City of Colombo, which is the capital of Ceylon, and its surrounding satellite towns, it is essential for the planners to be well aware of the characteristic features of the local communities which surround the City of Colombo, and to analyze such characteristic features so that the most effective land utilization concept as well as the most suitable population distribution plan could be formulated.

2-1-1 Planning target year

Final planning year 1990
Interim target year 1980

Taking 20 years from now, we will set our final planning year at 1990, while our interim target year will be 1980, 10 years from now. However, it may be difficult to expect that the City of Colombo could be reborn in the most ideal form of a city in 1990. Particularly, when you picture the future immage of the city as enjoying the most desirable density of population after having completed the redevelopment of its slum areas, the 20 years of timing as is targeted may not be long enough, and therefore, in consideration of the possible cases of overdue timing, we have allowed a considerable flexibility in our planning.

2-1-2 Planning area

The planning area is designated as the Colombo metropolitan area covering its administrative zone in a ten mile radius of the center of the city. This area involves not only all the built-up urban areas covering a space of 30,000 acres including the entire Colombo city zone, Wattala, Kolonnawa, Kotte, Mt. Lavinia, and Moratuwa, but also the suburban development area of 50,000 acres extending within a 5 - 10 mile sphere, which encircles the above mentioned urban areas. Thus, a total of 80,000 acre space is designated as forming the proposed metropolitan area.

2-1-3 Estimated future population

The growth and distribution of the future population as estimated in the proposed metropolitan area will be classified as follows according to the following two areas:

Year	Built-up Area	Development Area	Total
1968	900,000	100,000	1,000,000
1980	1,000,000	500,000	1,500,000
1990	1,200,000	1,000,000	2,200,000

a) Built-up urban area (within 5-mile perimeter)
b) Suburban development area (within 10-mile perimeter)

2-2 Land Utilization Plan

At this stage, we have little knowledge about the detailed situation of land utilization or the precise land categories within the proposed planning area. It is, however, known that a space of about 9,200 acres of the Colombo city area and the urban surrounding zones extending about 21,000 acres make up a built-up city area, and further that, in the outer perimeter within the 5-10 mile sphere, there extends a rural zone sporadically located by villages.

Colombo City has adopted a use zoning system as shown in Table III-2-1 hereinunder: A space of 6,500 acres, which is equivalent to more than 2/3 of the total space of the city area extending 9,166 acres, is designated as the residential district and the exclusive residential district. Another space of 1,441 acres, equivalent to 15.7% of the total city area, is designated for use as commercial and business district, while almost none is designated for industrial availability. There are spared open spaces totaling 484 acres, which represent 5.3%, for park and vegetation area.

We will relate in this chapter how should be the future land utilization:

Table III-2-1 Land Use Zoning in Colombo under Present System

Uses	Acregae	Percentage (%)
Residential District	4,996	54.5
Exclusive Residential District	1,493	16.3
Commercial District	1,441	15.7
Industrial District	18	0.2
Parks and Open Spaces	484	5.3
Lakes and Others	734	8.0
Total	9,166 acres	100.0 %

2-2-1 Urban area and urban population

The acreage of the urban area to be required for the estimated population of 2,200,000 after 20 years from now is about 70,000 acres out of the total available space of 80,000 acres of the Colombo metropolitan area. As to the future population in this urban area, we will describe it hereafter in the chapter of "Population Distribution Planning." The land use zoning of the urban area of 70,000 acres to be required for the population in 1990 shall be classified in accordance with the classification as provided in Table III-2-3 hereinabove.

2-2-2 Future industrial picture

As the actual data relating to the status of the industrial distribution in the Colombo metropolitan area have not been available to us, we have assumed the share occupied by each of the planned districts in the national industrial production of Ceylon today based on the ratio of the dwelling population in each district, as then calculated the optimum amount of shares to be taken by the planning districts by measuring macrographically the future growth of industrial production.

According to Arbercrombie Report, Colombo Regional Plan, published in 1948 by Arbercrombie (English), the number of the industrial employments in Colombo in 1947 was about 50,000 which represented about 14% of the total city population of 355,000 in that year. While the national census carried out in 1953 registered to total population of 3,000,000 and the industrial population of 370,000 which was 13% of the total population.

These figures well indicate that the industrial structure in the planning area was along the national average, which, from the regional standpoint, did not necessarily indicate a high industrial concentration. Since then up to the present there has been noticed no indication of any appreciable industrialization either nationalwise or in the planning area alone. Therefore, taking into reference the past records as stated above, we have calculated and deduced the present volume and the future growth of industrial production and industrial population as follows:

Table III-2-2 Present and Future of Industrial Growth

Year	National			Planning Area		
	Ind. population	Pd'tion (mil.) Rupees	Population	Ind. population	Pd'tion (mil.) Rupees	Population
1968	(12.8%) 1,354,500	1,760	10,582,000	(12.8%) 128,000	166	1,000,000
1980	(14.0%) 1,893,200	2,820	13,523,000	(14.0%) 210,000	313	1,500,000
1990	(15.0%) 2,383,200	5,050	15,888,000	(15.0%) 330,000	699	2,200,000

Note: o Industry as herein used includes mineral and construction industries.

o Industrial population as herein used includes the dependant families.

o The ratio of the industrial population against the total population in 1968 was 12.8% (National basis).

o The ratio of the industrial production against the national gross product in 1968 was 17.6%.

o The growth rate of the industrial production is estimated at 4% until 1980, and 6% afterward.

2-2-3 Estimation of Land for Industrial Use

The land for industrial use in the future also is provided in the planning area. The type of industries expected for such land sites are mostly of the type which may concentrate in the urban and suburban areas, and which will be the light chemical industry of consumer goods, such as rubber, ceramics, agricultural and food processing as well as timber and wood processing, and leather products. Provision of land for heavy chemical industry is not recommendable. The suitable land sites for these suburban industries can be expected, as recommended in Arbercrombie Report, in the northern part of Ambatalenpahala, particularly in the outhern coastal area of Kenlani Canga. As calculated in the previous chapter, the production in the planning area in 1990 is estimated at about 700 million rupees while the land requirement for industrial use is calculated at about 1,000 acres.

2-3 Population Distribution Planning

2-3-1 Estimation of Population

The present population in Colombo is estimated at about one million having made a double increase during the past 25 years. Analyzing the population increase factors in the planning area, the nationalwise increase trend of population as well as the population growth arising from the expansion of urban scale can be considered as the key factors for population boom. There are several ways to estimate or measure the pattern of future population. But, in this case, we have taken the method of least squares based on the past records of population movement, and estimated the future population figures.

According to this calculation method, the population in the 20 years future will generally grow two times of the present one. Taking into consideration the accelerated speed of population growth due to the speedy development of urbanization, we can estimate the future population of Colombo metropolitan area in 1990 at about 2,200,000 which is about 2.2 times as big as the present figures.

2-3-2 Method of Population Distribution

In the planning of population distribution, we have divided the planning area into three districts such as, Colombo municipality, urban surrounding zone, and suburban development area. The indexes provided in Table III-2-3 hereinunder have been used as the basis of division.

Table III-2-3 Population Distribution Index

Districts	Present Population Density	Suitable Population Density	Saturate Density
Colombo Municipality	61 (person/A)	70 (person/A)	72 (person/A)
Urban Surrounding Zone	16 (person/A)	25 (person/A)	
Suburban Development Area	2 (person/A)	25 (person/A)	

Note: The urban surrounding zone includes the administrative zones of Wattala, Kolonnawa, Kotte, Mt. Lavinia, and Moratuwa.

2-3-3 Population Distribution Planning

As to the distribution of the future population as estimated at 2,200,000 in the planning area, we have worked on the basis of the index shown in the preceding Table III-2-3.

Table III-2-4 Population Distribution in Planning Area

Districts	1968	1980	1990
Colombo Municipality	560,000	600,000	650,000
Urban Surrounding Zone	340,000	450,000	550,000
Suburban Development Area	100,000	450,000	1,000,000
Total	1,000,000	1,500,000	2,200,000

The development of high density population may be the prerequisite for an effective public investment for the city facilities including highly efficient traffic, supply and disposal facilities in the Colombo municipality zone. It can be expected to accommodate a population of 90,000 by the redevelopment of the slum area, where multistories residential buildings can be built, and also by developing the existing marshy, low land extending some 1,000 acres.

As for the urban surrounding zone and the suburban development area, it is planned to adopt a core development method to develop an urbanization centering around the existing towns and villages, thus preserving the natural environment as much as possible.

2-4 Traffic Planning

2-4-1 Estimation of the Number of Motor Vehicles

Judging from the economic situation of this country at present, it would be difficult to expect that this country would be in a position to engage in a domestic production of motor vehicles at any feasible future, and therefore, it may have to depend on the import of automobiles from abroad for some long years yet. And at the same time, due to the prevailing foreign exchange deficit which shows no indication of improvement in any foreseeable future, this country may have to continue the import restriction of foreign cars for some time yet. Consequently, no sudden increase of automobiles in this country can be expected. The estimation made by Wilbur Smith and Associates, Ceylon Highway Planning & Maintenance Study, Final Report, April 1969, in 1967 on the number of motor vehicles to be owned by this country during the coming 20 years may be the most reasonable figures.

Table III-2-5 Estimation on Number of Automobiles in Ceylon

	Number of Motor Vehicles Owned		
	1967	1977	1987
Passenger automobiles	83,743	84,000	84,000
Buses	8,946	12,500	18,000
Trucks	29,980	40,500	55,000
Total	122,669	137,000	157,000
Number of motor vehicle index	100	110	130
Vehicle miles of travel index	100	120	150

o Metropolitan area

The number of motor vehicles owned in Colombo district in 1968 was:

Privately owned automobiles	28,600
Taxies	2,716
Buses	3,875
Trucks & Commercial cars	10,804
Total	45,995

The number of motor vehicles owned in the Colombo metropolitan area may be about 3/4 of the above figures as judged from the size of the population expected. The figures computed on this basis are as follows:

Table III-2-6 Number of Motor Vehicles in Colombo Metropolitan Area (1968)

Type	Number
Automobiles (Privately owned)	21,500
Taxies	2,000
Buses	2,900
Trucks and commercial vehicles	8,100
Total	34,500

2-4-2 Network of Arterial Roads

The radial roads running from the Central Business District of the City toward the surrounding cities and towns constitute the network of arterial roads for the Colombo metropolitan area. This radial roads consists of a route (1) running from the central district of the City toward north along the coastal line to Negombo, a route (2) toward north-east to Kegalla and Kandy, a west bound route (3) to Avissawella, a south-eastern route connecting with Ratnapura (4), and a south bound route (5) along the coastal line to Kalutara and Galle.

These routes perform the role of national trunk line functioning as an vital arterial line connecting the capital city of Colombo with other cities and towns in this country. These trunk lines, therefore, are expected to play a vital role of transportation for the Colombo metropolitan area in future along with the expansion and growth of the commercial activities and size of the population in said Colombo metropolitan perimeters.

On the other hand, with respect to the arterial roads within the metropolitan area proper, the existing network of roads may have to be improved or expanded, and the construction of new roads, which will be necessarily required to counter the growth of the population and the city activities, may constitute a problem in future.

In this connection, we recommend hereby to build a system of ring roads considering the future size of population at 2.2 million and the functional traffic flow countering to such expanded population. The new ring road system adequate for the future scale of the city shall be, at least, consisting of the following four ring roads:

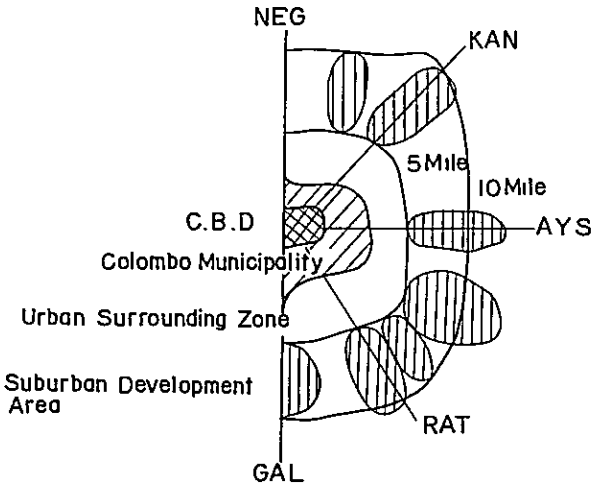
a) A ring road encircling the outer perimeter of the commercial districts such as Fort and Pettah.

b) A ring road immediate outer perimeter of the present city area proper (it may be considered as a by-pass road of the present Base Line road)

c) A ring road connecting the urban surrounding zone including a five mile outer perimeter. (Kolonnawa, Kotte, and Mt. Lavinia)

d) A ring road running along the suburban development area on ten mile outer perimeter where a large scale development is contemplated.

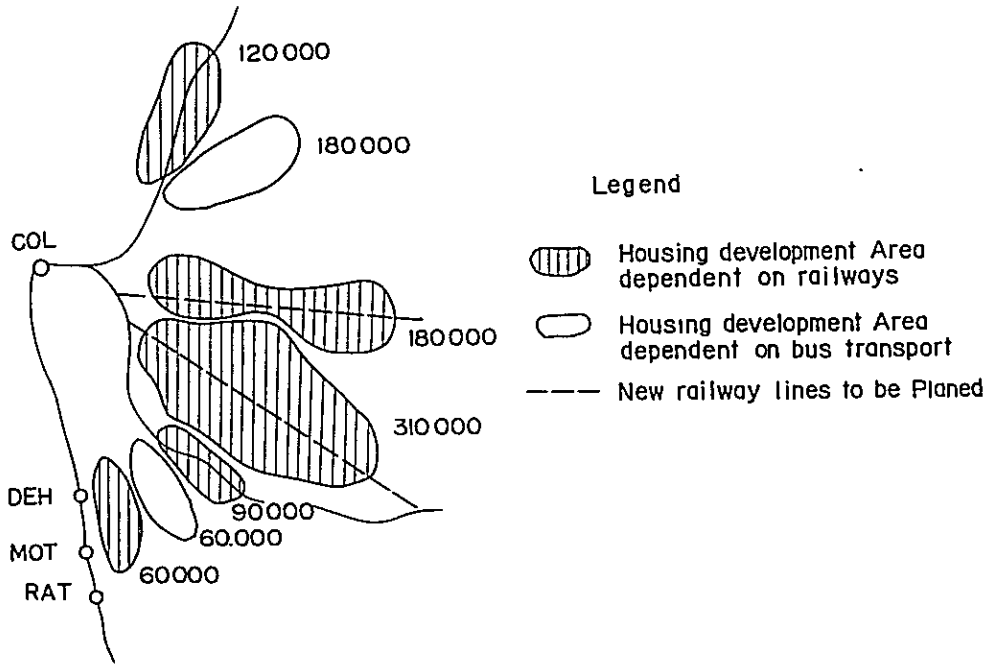
Fig. III-2-1 Concept of Arterial Road Network (Colombo Metropolitan Area)



2-4-3 Concept of Commuter Traffic Lines

For all the commuters including schools within a five mile radius from the center of the city shall be provided, in principle, bus lines, while for the dwellers from five to ten mile outer perimeter, where a large scale city development project for one million population is contemplated in future, shall be, in principle, provided with railroads to commute to the commercial district in the city. As the transportation capacity of the existing railraod lines will be unable to meet the expanding requirement of the future, a study will be made with a purpose to build two additional new lines.

Fig.Ⅲ-2-2 Railway Network Pattern



2-5 Picture of Future Towns

2-5-1 Development of New Urban Areas

Considering the image of the future industrial structure and the size of the population of the City of Colombo of twenty years future (1990), the picture of the future city can be drawn to the size of 2.2 times as large as the present one, having a double expanded population of 2.2 million and a space of 70,000 acres.

In and around the city, there are several low, marshy lands which are easily flooded during the rainy season. The total space of such low, marshy lands reaches up to 2,500 acres. Up until recent days, these marshy lots of land have been left unused as the waste land. But nowadays, a partial reclamation project has been taken up by certain public and governmental agencies. The fact that such project is now being taken up and the land is being reclaimed before the actual formulation of the town planning for the future of Colombo may pose a problem in the future town planning.

Therefore, in order to develop and incorporate these marshy lands into the urban area with comfortable environments, it may be urgently necessary to work up a comprehensive master plan of the City of Colombo. For this purpose, a careful study must be carried out as to the distribution status of the proposed reclamation lands as well as the relationship with the built-up areas so that the whole picture could be well understood. Then, a concrete idea of land utilization of the newly developed area should be established. Particularly, in the residential districts, it would be advisable to establish the neighbourhood units, and at the same time, to determine where to establish the neighbourhood center in the respective neighbourhoods.

The vast area of low, marshy land located in the outer circle of the clustering city areas, for example, Madiwela catchment, should be included into a large scale development project instead of being reclaimed under a partial, small scale development project. For that purpose, therefore, it will become necessary to formulate a schedule program of the development from now up to future. The key point for formulation of this type of development program is to first investigate the status of the land ownership in the proposed area, and to enforce an appropriate measures to restrict land speculation among the real estate dealers to prevent the rise of land price.

2-5-2 Urban Redevelopment

1) Significance of urban redevelopment

It is a general tendency in the recent years that the major cities throughout the world are carrying out redevelopment of their midtown areas. The reason for the necessity of such redevelopment is mainly due to the further effective utilization of land and to facilitate and ease the traffic flow which is coming to an over saturation point.

Viewing from the land utilization standpoint, it is that;

i) Conversion from simple utilization of land to three dime nsional land utilization.

ii) From the conventional utilization of land intermixed with commerce, residence, and industry together to the zoning system use of land.

iii) Eliminate or improve all slum areas to create better residential areas with wholesome environments

Viewing from the traffic facilitation standpoint, it is that;

i) The roads in the midtown area of the city are not adequate for ever increasing traffic volume.

ii) The traffic flow in the midtown area of the city has become so heavy that a mere horizontal solution of traffic problems has become impossible.

iii) The congestion in the rush hours has become uncontrolable.

Also, viewing from other standpoint, it is that the buildings in the city proper area must undergo an extensive reconstruction to meet the re-

quirement of a modern city such as fireproof construction, disaster preventive structure, etc. to improve the function of the city as a whole.

At any rate, in order to carry out a successful redevelopment of the city, it is absolutely necessary to carry out simultaneously both projects of land utilization and traffic facilitation, otherwise, no effective results are obtainable.

2) Redevelopment approach

The inner urban area of the City of Colombo is densely populated, and the present status of land utilization, although a use zoning system has been adopted, is not very satisfactory due to the inter-existence of commerce and residence. The housing situation in the densely populated area is poor in general. The major part of the inner urban area is occupied by the slum area, and in order to get rid of the shunty dwellers, an early redevelopment of these areas is essential.

Even the redevelopment of the inner urban area of the city by improving the environments with the construction of multi-storied buildings to absorb the inhabitants in vertical way so that more open spaces can be allowed and spared, there are still some sections where, having so heavy population, can not afford to have any further increased population.

Taking into consideration the actual status of such problems of the city, we will give a brief description of our basic plans of the redevelopment of the inner urban area of the City of Colombo as follows:

i) It is necessary to carry out a government or public sponsored housing project of large scale in order to clean up the shunty dwellers.

ii) In the redevelopment of the inner urban area of the city, a positive consideration must be given for an effective utilization of the Crown Island.

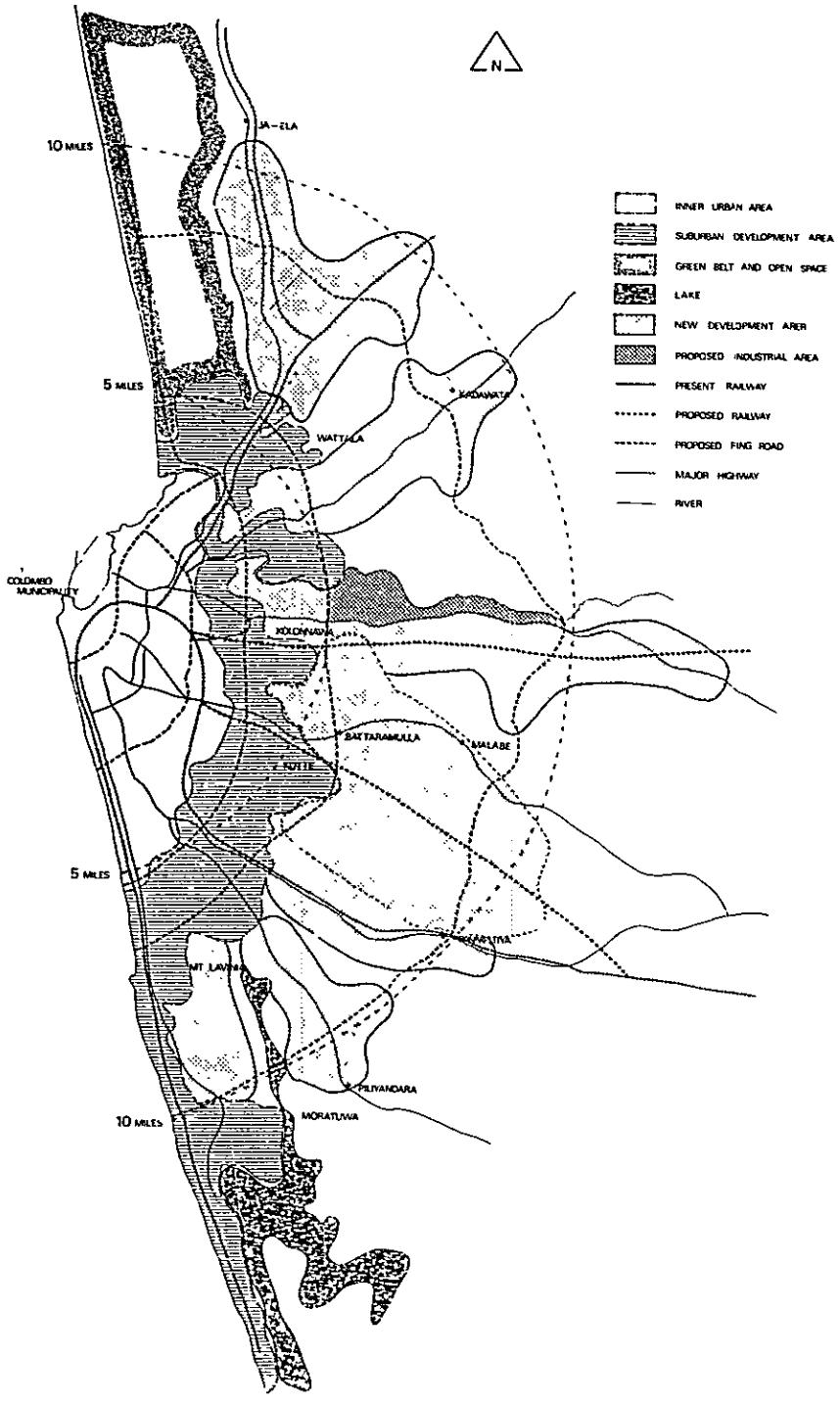
iii) Create and establish a government office zone by integrating all government offices, which currently stand scattered in and around Fort area, into so established government office zone. Also, as pointed out in Arbercrombie Reports, an elaborate study must be made to relocate to the suburban area all the buildings which are not absolutely necessary to be located in the midsection of the city.

iv) Along the border line between Colombo central business district including Fort and Pettah, and the residential zone, build a ring road which may have the dual purposes of serving as the functional separation belt zone between the business and residential zones, and at the same time, to help ease the traffic flow in the midsection of the city.

v) Currently, there is no off-street parking area provided in the midtown area, and most of the cars are parked alongside the streets. This greatly hampers the smooth flow of traffic as well as the business operation in this area. To eliminate such inconveniences, an elaborate study must be made to secure adequate off-street parking spaces in consideration of the future increase of the number of motor vehicles in this area.

Fig.Ⅲ-2-3

THE NATIONAL CAPITAL REGION AND ADJACENT AREA



CHAPTER 3. MASTER PLAN

3-1 Land Use Plan

3-1-1 Concept of land use

As the planning area includes the national capital of Ceylon, which is the center of politics and economy of the nation, high concentration of population in the city has been recorded in the past and this tendency is expected to continue also in the future. The supply of housing to accommodate the increasing population, however, is so small that it will never be able to meet the demand. For this reason, the housing standard in Colombo City is generally low and the supply of housing in large quantity will be required in the future.

In the past few years the number of new housings built annually in Colombo City has been less than 200. One of the reasons for this situation is considered to be the unavailability of housing lots as the city area has already become overcrowded. In recent years, however, the question of reclaiming marshy lands in and around the city limit to convert them to an urban area has come into the limelight. And in some area the project has been under way in efforts to convert these marshy lands into a new urban area. This indicates the fact that these marshy lands are waiting for exploitation as a means of solving a population problem in Colombo Metropolitan Area.

Such a project is also necessary to make reassignment of resident population possible, that will generate as a result of distinct classification of land use into commercial, business and residential districts by clearing slums in and around the CBD.

It is essential to formulate a plan of future land use for Colombo Metropolitan Area after fully grasping the background mentioned above.

In formulating a land use plan, the project area is to be divided largely into three regions.

(1) Present Colombo municipal area situated in the center of the planning area geographically and functionally. (Colombo Municipality)

(2) Urban surrounding zone

(3) New development area located between the 5 mile radius and 10 mile radius from the CBD of Colombo City and where development is expected in the future. (Suburban Development Area)

1) Colombo municipality

The present Colombo municipality covers an area of about 9, 166 acres and consists of 47 administrative wards. The population as of 1968 was 560, 000 with the density of population in the municipality as a whole was such a high ratio as 61 person/acre. Particularly, the area in and around Pettah has been a city area from old times with many old housings which have turned into slums and with an excessive concentration of population. There are not a few places where the density of population exceeds the 200 person/acre level.

In the municipal area there is about 900 acres of marshy lands which are left unexploited but are the object of reclamation. Development of some of these lands is being undertaken by the hand of public agencies to create land for commercial and housing districts.

On the understanding of the present situation of the Municipal area as mentioned above, the future land use in Colombo municipal area may be planned as follows.

- Distinct classification of land use in the district of Fort and Pettah

  These two districts have been playing a role as the central administrative function of the nation and this tendency is expected to continue also in the future. In these districts, however, the commercial, business and government facilities are mixed together and positive efforts should be made to make a distinct classification of land use to form a functionally efficient CBD from a standpoint of city environment, as well as from a standpoint of traffic control.

  For this purpose, the present district of Fort should be designated as a government office district and consolidation and adjustment of government agencies should be contemplated. It is advisable to relocate various government facilities dispersed in the municipal area to the district of Fort and at the same to group and move those facilities, which are not necessarily be located in the CBD, to the Urban Surrounding Zone or to the Suburban Development Area.

  For the district of Pettah, improvements of the district for a commercial and business district should be contemplated and the establishment of height district in land use is desirable.

- Redevelopment of densely populated area

  The districts of MASANGAS WEEDIYA and ALUTKADE adjacent to the east side of Pettah are a built-up area from old times and inspite of simple utilization of land there is a dense population and many of the dwellings have turned to slums. To improve such a deteriorated environment, it is essential to plan redevelopment of these districts to promote three dimensional land utilization and secure open spaces for public use.

  As these districts are designated as commercial districts under the use zoning, it is advisable to provide high story buildings of a combined purpose of commercial building and residence through redevelopment of the districts.

- Utilization of old Race Course

  The use of race course located almost in the center of Colombo municipality has recently been discontinued and the municipal authorities is now working out a plan for the use of the site as a civic center including a public square and town hall. The more important and desirable in this connection is that the municipal office and other related facilities now located adjacent to VIHARA-MAHADEVI PARK are moved to the site of old race course and the lot thus vacated be redeveloped as a core for the citizen.

o Improvement and consolidation of commodities distribution channels

Wholesale markets for fresh vegetables, fruit, fish and meat are now located at 18 different sites in Colombo municipality. All of these markets are small in size and it may be said that none of them is equipped with modern and sanitary facilities for handling perishable foodstuffs.

In order to improve and consolidate these small scale and separately located markets, it is advisable to establish a large scale and modern integrated wholesale market and in this connection, the district of URUGODAWATTA has been chosen as the site of the proposed market.

Besides perishable foodstuffs, the distribution facilities (trucking terminal, warehouse and wholesalers) for general foodstuffs, textiles and ceramic wares, which are moving in and out of Colombo municipality, are also located separately here and there as in the case of the wholesale market. Consequently, distribution of these items is not being carried out in a smooth and efficient manner. To ensure efficient and ideal city functions, it is essential to plan for the improvement of the existing distribution system by all means.

The size of lot for the new commodities distribution facilities is to be 200 ~ 250 acres and for the site suitable for the establishment of such facilities, the area along the ring road scheduled to be built on the boundary of Colombo municipality should be considered.

o Disposition of golf links

The area around the Ridgeway Golf Links located in NARAHENPITA east of the center of Colombo Municipality has been turning to a built-up area under the influence of the recent urbanization trend. It is considered advisable, therefore, to plan the conversion of the golf links to other purpose adaptable to the environments of the surrounding area instead of maintaining it as a golf links in the future. In such an event, it is advisable to relocate the golf links to a certain area out of the 5 mile zone of Colombo Metropolitan Area and to convert the site of golf links to the central park for the city people. In view of the fact that this is a country of everlasting summer, the establishment of the central park should aim primarily at providing a place of repose for the town people by planting many trees and vegetations so that the people may rest and stroll in the shade, and the park should be characterized as a forest park at the final stage.

2) Urban surrounding zone

The five cities - Wattala, Kolonawa, Kotte, Mt. Lavinia and Moratura - which may be called as local towns of Colombo municipality, are situated within a radius of 5 miles from the CBD of Colombo City and have their own administrative entity but are closely related with Colombo municipality in industrial and living activities. This indicates the fact that the concentration of population in the city area, a world-wide tendency, is also seen in the Colombo Metropolitan Area. The present Colombo municipality is suffering from overpopulation and the phenomenon of excessive concentration of population is shifting from Colombo municipality to urban surrounding zone. It may be said, therefore, that urban surrounding zone,

in view of the city function, are destined to form a great metropplitan area together with Colombo municipality. Though the present population of urban surrounding zone is approximately 340,000, a rapid increase of population and vigorous city activities are also expected in the future in conjunction with such factors as the expansion of city area and urban renewal. As stated previously, the future population in urban surrounding zone is estimated at 550,000, the optimum density of population, and an increase of 200,000 is expected in the next 20 years. The future role of urban surrounding zone and the direction of their expansion within Colombo Metropolitan Area are discussed below.

(1) In contrast with the past when each of these outlying cities has had its own course in forming a city, the cities are expected to further strengthen their city function as part of Colombo Metropolitan Area with Colombo municipality being the nucleus of the area.

(2) As for production activities required to maintain daily life in the urban area, manufacturing industry including such sundry goods as porcelain, furniture and industrial art products is conceivable. It is advisable that these manufacturing industries are located in the urban surrounding zone from the standpoint of transportation and the convenience in gathering necessary information. It is expected, therefore, that light industries such as mentioned above will become more active in these cities in the future following the expansion of the city area.

(3) Colombo municipality is expected to see more distinct classification of land use as the CBD of the greater metropolitan area. Particularly, the districts of Fort and Pettah will further demonstrate their characteristics as commercial districts. In such a case, the shift of night population of the local town is expected and there will be need for providing land for construction of housing to receive the night population.

(4) In implementing a housing development project in urban surrounding zone, emphasis should be placed on better living environments favored by the beauties of nature. Therefore, the density of population in the development area should be kept at 40 person/acre at the maximum and the housing provided must be of detached type in principle.

(5) A total of about 5,000 acres of land is expected to be required as housing development ot accommodate an expected increase of 200,000 people in the next 20 years.

3) Suburban development area

This area is located within 5 - 10 mile sphere from the center of Colombo Metropolitan Area and agriculture is the only production activity in the area at present. The population is estimated at about 100,000 and there has been no special relationship between this area and the city of Colombo. However, from a long-range point of view with the next 20 years or more kept in mind, the area is expected to see a rapid increase of population shifting from the urban area. It is important, therefore, to make a full study on the role of the area in the proposed greater Colombo Metropolitan Area at this stage.

(1) The population in this area will increase steadily in proportion to the intensity of city activity in greater Colombo Metropolitan Area. It is essential, therefore, to set up a systematic structure to receive the population shifting to this area from the urban area.

(2) Because of the characteristics as being an agricultural land from the outset, the complete urbanization of the area is not conceivable even with the progress of urbanization. Instead, its characteristics as a supply source of vegetables, which are indispensable to the daily life, will also be preserved.

(3) To meet an expected increase of 900,000 in population in the next 20 years, approximately 26,000 acres of land is expected to be required. For the development of land for urban area, It is essential to make a full study on topography, soil conditions and land use in the present area and make a clear distinction between the land to be used as urban area and the land to be retained as agricultural land.

(4) For the area to be developed into an urban area, the method and the timing of development work must be determined in details and the project should be carried out on large scale in principle. In such an even, however, dependency only on the street traffic for communication with the CBD of Colombo Municipality will be physically impossible and the need for the means of mass transportation will be felt strongly. To meet this requirement, construction of an urban rapid transit railway will be most advisable.

(5) In the implementation of a large scale development project for urban area, emphasis should be placed on the formation of neighbourhood unit and communities. In the center of the neighbourhood unit there should be a neighbourhood center where daily necessities may be purchased and in the center of the housing development area a community center should be provided for the benefit of the residents and at the same time, an effort should be made for centralization of city functions.

(6) A place for industrial activity should be secured in addition to that for agriculture. For that purpose, approximately 1,000 acres of land should be secured on the southern shore of the Kelani Ganga north of Ambatalenpahala as industrial area as previously mentioned. The type of industry expected in this area will be the urban and suburban type industries which make the best use of the geographical conditions. The main type of such industries will be light industries as lumbering, wooden works manufacturing in addition to rubber, porcelain and agricultural processing industries.

3-1-2 Use zoning

1) Colombo Metropolitan Area

For Colombo municipality and urban surrounding zone, it is advisable to adopt complete use zoning system and plan for the growth of these areas as a well-balanced urban area. For the suburban development area, a clear distinction must be made between the area to be developed as an urban district and the area to be retained for agricultural production by

taking into consideration the convenience of traffic and geographical conditions. In planning the future urban area a large scale intensive development program must be worked out. Though the majority of the development area are expected to become residential quarters, it is advisable to take such restrictive measures as bulk zoning or open district system in order to prevent disorderly development.

2) Use zoning in Colombo Municipality

Though the use zoning system is already in effect in Colombo municipality where there are some districts suffering from overpopulation, the increase of population is still expected, and it is advisable to make a partial revision to the present use zoning so that reasonable and efficient land use may be ensured while improving city functions and maintaining better environment in the residential area.

As far as the residential district is concerned, restrictive measures on the building lot (building is not permitted on the lot less than 15 purches) are being enforced for the belt-shaped area 100 m in width on both sides of trunk streets.

However, in the proposed provisional residential area other than these belt-shaped areas, no building controls are enforced and therefore, there are many residences which have turned to slums. To improve this situation, it is essential at least to enforce restrictive measures on building floor space in the proposed provisional residential area to prevent the area from becoming a slum.

As for commercial district, Fort and Pettah are now designated as a commercial district and as they are expected to continue their role as the CBD acting as the administrative and business center of Colombo City in the future, the present status is considered appropriate and should be maintained. For local center (shopping center) which serves daily life of the city people, it is advisable to make a further study on the location and size of the establishment.

3) Three dimensional use of land and urban redevelopment

The majority of the land in Colombo municipality is used for commercial district and residential district and the population of the municipality as of 1968 was 560,000 with the density of population being 61 persons/acre. The population 20 years hence is estimated at 650,000 and the density of population is expected to be 72 persons/acre. In order to secure better environment for the life of the people, therefore, it is essential to plan for the improvement of various public facilities and at the same time, to provide as much open space as possible and avoid overpopulation in the area. In other words, efforts should be made to convert the present housing district to a high story building district as much as possible. In doing this, various plans should be worked out for the design of structures such as the arrangement of commercial facilities in the lower story (1st and 2nd floors) of multistoried buildings and the use of the basement of a building as a parking facility to meet the expected increase in the number of motor vehicles in the future. Particularly for the districts of Fort and Pettah where the city functions concentrate, an utmost effort should be made to materialize three dimensional use of land. For that purpose, it is essential to plan a large scale urban renewal project.

As for the local center which is the core of the daily life of the city people,

the present form is a mere consolidation of detached stores. It is desirable, therefore, to reorganize the center and make it as the functional core of commercial district. For that purpose, it is desirable to attempt an urban renewal and provide commerce buildings and at the same, secure adequate space for public facilities (road and parks).

3-1-3 Direction in the Use of Reclaimed Land

1) Distribution of the proposed reclaimed land

In and around Colombo municipality there are many marshy lands totaling 2,500 acres and the distribution of these lands is shown in Fig. III-3-1.

Of the above mentioned total area, about 1,000 acres is within Colombo municipality and the remainder is in Kotte urban council. The marshy land within Colombo municipality may be divided largely into the following three categories from the standpoint of geographical characteristics. They are: (1) Crow Island (approximately 50 acres in area) situated near the estuary of the Kelani Ganga at the north end of the municipality, (2) area adjacent to the east side of an old urban area in the vicinity of the port of Colombo. In this area there are three marshes, each having a total area of about 100 ~ 200 acres. These are Mutwal, Urugodawatta and Maligawatta. (3) area adjacent to the east side of Base Line road in southeast of the municipality, consisting of Nawala Heen Ela and Kotte. Though the hill land in these districts includes part of the present city area, the total area of these marshes falling under the above three categories is close to 2,000 acres.

Besides, there are tow marshy lands - Kirillapone and Thimbrigasyaya - in the southern part of the municipality but both of them are small in size.

All of these marshy lands are considered to be converted to urban area in the future. In practicing project of these areas, however, the priority in the order of implementation will be the question to be answered at first.

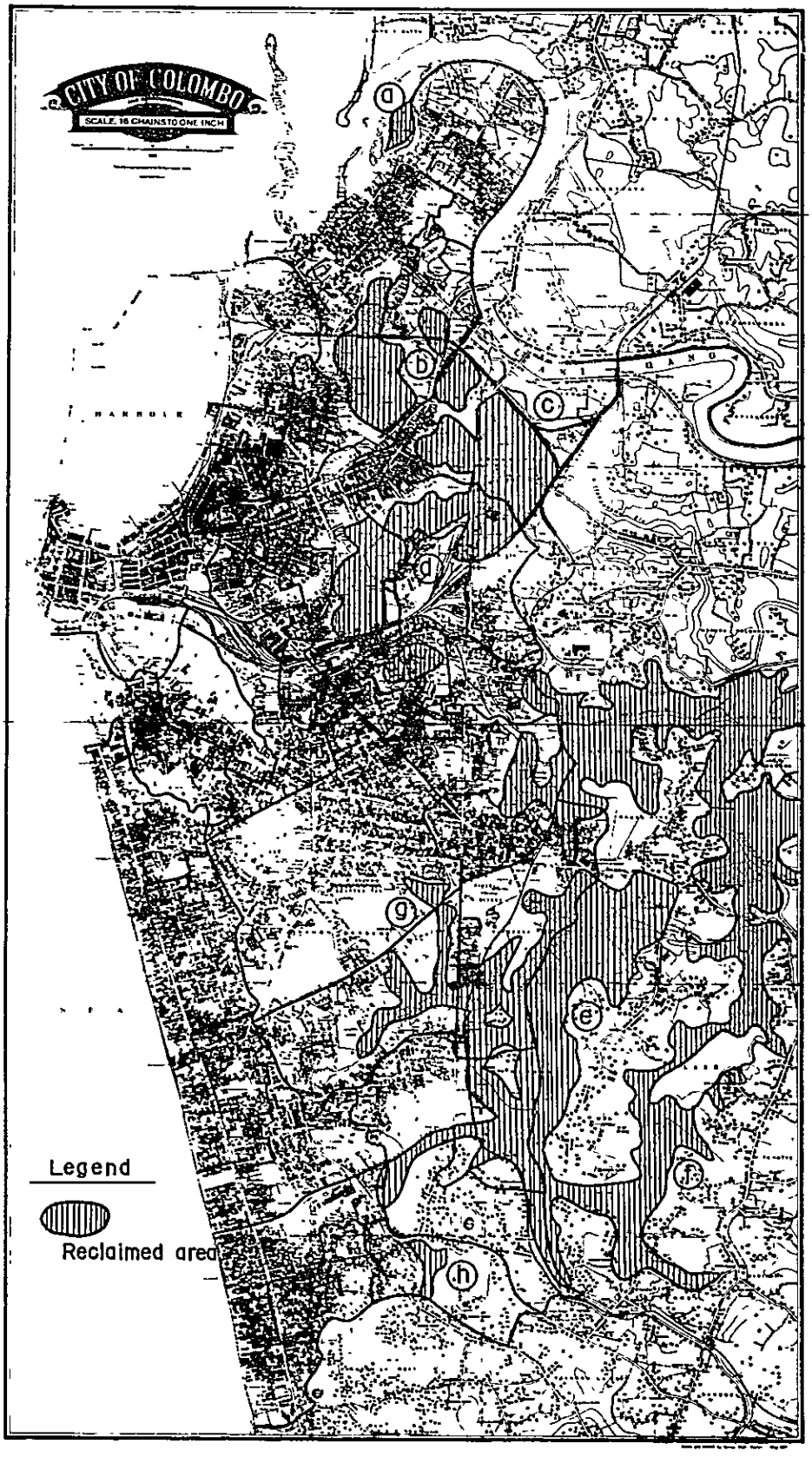
The districts where the concrete development project is being shaped up are Crow Island, Urugodawatta, and Kirillapone.

2) Direction in use of reclaimed land

The characteristics of the distribution of population in Colombo municipality are that there has been a dense population in the urban area around the Port of Fort from old times and that the majority of the residents in the area are either the workers in the Port of Colombo and related facilities or workers engaged in commerce in the district of Fort with low income level in general and deteriorated living condition. In the south of the center of the municipality, on the other hand, there are fairly many open spaces and the living environment is quite satisfactory. This part of the municipality forms a high-class residential area with a comparatively low density of population.

As no major changes are conceivable in the above-mentioned regional characteristics of housing situation in the future, the land use of reclaimed land with the consideration of this point will be taken up at first.

Fig.Ⅲ-3-1 Distribution of proposed reclaimed area



In other words, the proposed site around the Port of Fort (Crow Island, Mutwal Urugodawatta, Maligawatta) for housing district in the future it is advisable to place emphasis on the low income level when selecting the people for accommodation. In designing structures, therefore, emphasis should be placed on the centralized flats instead of providing detached houses with a garden to ensure three dimensional use of land.

As for the districts of Nawala-Heen-Ela and Kotte in the southern part of the municipality, consideration must be given to the fact that these districts are located close to the high class residential quarter and that they require a large scale development project. It is essential, therefore, that the development of these districts does not end up in the establishment of a residential quarter for the relief of a housing shortage but requires a development for functional town.

For that purpose, the planning should not be limited to the pursuance of the function as the bed-town of Colombo municipality but aim at the town planning positively incorporating such facilities as required for well balanced function of Colombo municipality. In concrete, the effective land use of this vast marshy land would be such that makes the land play a part in the comprehensive city improvement project such as the relocation of central government offices now located in the district of Fort and the establishment of such commodities distribution centers as wholesale markets, warehouse and truck terminals for smooth operation of distribution channel.

The above is an outline of land use plan for the proposed reclaimed land in and around Colombo municipality and the classification of the proposed reclaimed land by district is shown in Table III-3-1.

Table III-3-1 Direction of Development by Districts

Direction of development	Districts							
	a	b	c	d	e	f	g	h
Development on large scale					o	o		
Development on medium scale		o	o	o				
Development on small scale	o						o	o
Residential district (Above middle-class)					o	o	o	o
Residential district (Low-income level)	o	o	o	o				
Distribution facilities			o		o			
General commercial area	o	o	o	o	o	o		
Gentral government office					o			
Large parks					o	o		

(Notes) Districts shown alphabetically are as follows.

(a) Crow Island (b) Mutwall
(c) Urugodawatta (d) Maligawatta
(e) Nawala Heen Ela (f) Kotte
(g) Thimbrigasyaya (h) Kirillapone

3) Problems related with the use of reclaimed land

Concentration of population in major cities is the tendency not only in Ceylon but in every country of the world. The role of these reclaimed lands in the elimination of various evils caused by the concentration of population is tremendous. On the other hand, however, these marshy lands which have remained in their natural form have been playing a vital role as the regulator in the natural world and the conversion of them to the urban area will bring not only advantages but also disadvantages as a matter of course. The fact that the central area of Colombo municipality or the area around Fort is overpopulated, the mixed land use for commerce and residence has brought many evils and that the area is potentially the slum under deteriorated living condition has already been mentioned. Effective land use of these reclaimed land to improve deteriorated city environment and provide healthy and cultured urban life is very significant.

The disadvantageous aspect of the project, however, are the destruction of natural environment, decrease of greens and agricultural land in the sub-urban area of the city, and such adverse effects in the present urban area as the lowering of ground-water level and the sinking of fundation. It is evident that these disadvantageous factors will entail tremendous expenditure of public funds as urban disaster control expense and flood control expense in the implementation of the project. The question of the future is not to admit these disadvantageous factor as they are but rather to work out a comprehensive urban improvement plan in the direction of eliminating these adverse factors.

3-2 Population

3-2-1 Present Population

The population of Colombo Metropolitan Area in 1968 was about one million. Of this, 560,000 people live in Colombo municipality, about 340,000 people in such urban surrounding zone as Kolonawa, Kotte, Mt. Laminia, Wattala and Moratuwa and 100,000 people in the suburban development area within 5 - 10 mile sphere from the center of Colombo City.

As evident from the distribution of population in Colombo municipality shown in Fig. III-3-2, the density of population is particularly high in the district of Kochikade, Masangasweedia and Aluthade adjacent to the Port of Colombo. The density of population in some parts of these districts is over 200 persons/acre. Moreover, the living condition in these densely populated districts is deteriorating and the districts have turned to slums.

Meanwhile, Cinamen Garden situated south of the center of municipality is a high-class residential district. Accordingly, the density of population in the district is such low level as 20 persons/acre, which is thelowest in the 47 wards of Colombo municipality.

The highest density of population is seen in Alutkade West where the density is 295 persons/acre. The ratio of the highest and lowest density of population by ward is such an extremity as 15:1.

Table III-3-2 Population of Colombo City by Wards (1968)

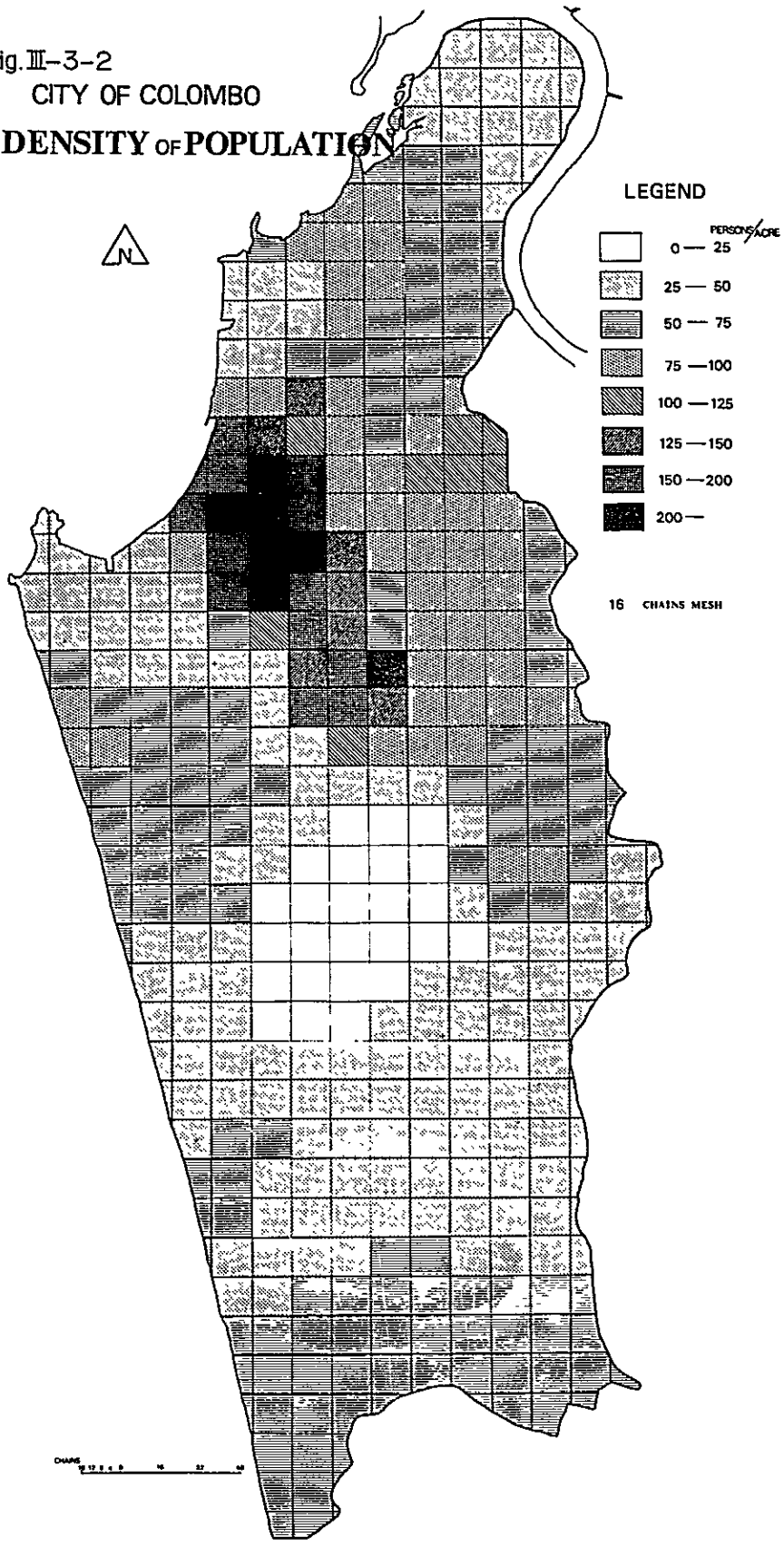
District	Population	Area		Density of population persons/acre
		Acre	Hectare	
Mattakkulia	12,570	412.56	166.96	30
Modera	12,246	168.94	68.37	72
Makawatte	14,275	205.03	82.97	70
Aluthmawatha	13,476	152.75	61.82	88
Lunupakuna	11,247	251.21	101.66	45
Bloemendhal	14,429	246.51	99.76	59
Kotahena East	9,37,	80.74	32.67	116
Kotahena West	12,805	88.45	35.79	145
Kochchikade North	13,463	68.61	27.77	196
Gintupitiya	12,334	49.18	19.90	251
Masangasweediya	11,014	58.11	23.52	190
New Bazaar	10,702	122.00	49.37	88
Grandpass North	11,536	106.27	43.01	109
Grandpass South	13,895	139.92	56.62	99
Maligawatte West	8,186	121.19	49.04	68
Aluthkade East	13,478	62.50	25.29	216
Aluthkade West	9,265	31.36	12.69	*295
Kehelwatte	9,347	70.61	28.57	132
Kochchikade South	12,243	52.15	21.10	235
Fort	19,590	441.01	178.47	44
Kompannaweediya	12,671	161.26	65.26	79
Wekande	9,830	138.93	56.22	71
Hunupitiya	9,688	188.76	76.39	51
Suduwella	10,678	267.84	108.39	40
Panchikawatte	11,255	63.71	25.78	177

District	Population	Area		Density of population persons/acre
		Acre	Hectare	
Maradana	10,235	64.11	25.94	160
Maligakande	10,112	42.34	17.13	239
Maligawatte East	12,251	142.44	57.64	86
Dematagoda	12,330	168.09	68.02	73
Wanathamulla	11,637	137.42	55.61	85
Kuppiawatte East	10,373	134.92	54.60	77
Kuppiawatte West	8,981	89.64	36.28	100
Borella North	12,277	232.69	94.17	53
Narahenpita	11,052	435.90	176.40	25
Borella South	11,907	151.85	61.45	78
Cinnamon Garden	16,732	846.21	342.45	*20
Kollupitiya	13,339	230.08	93.11	58
Bambalapitiya	12,369	338.75	137.09	37
Milagiriya	12,866	250.20	101.25	51
Timbirigasyaya	14,288	438.35	177.39	33
Kirula	13,083	425.26	172.10	31
Havelock Town	11,733	286.64	116.00	41
Wellawatte North	13,123	218.68	88.50	60
Kirillapone	11,035	241.46	97.72	46
Pamankade East	11,414	219.74	88.93	52
Pamankade West	10,584	154.54	62.54	68
Wellawatte South	10,895	167.16	67.65	65
Total	562,216	9,166.07	3,709.36	61

Fig.Ⅲ-3-2

CITY OF COLOMBO

DENSITY OF POPULATION



3-2-2 Future Population

1) Method of estimation

To provide and improve public facilities in the urban area, it is essential to estimate the future population of the city, which must be used as the basis of the planning.

Though there are various ways to estimate the future population and the following methods are in general use, a study is to be made to determine the most appropriate method.

a. The method with which the estimate is made on the extension of the past trend. (Trend method, method of least squares)

b. The method with which an estimate is made on the floor space and then on the optimum population.

Of the above two methods, the method given in paragraph b. is suitable for the estimation of population in a limited district such as a housing development or a new town but is not always appropriate for the estimation of population in the built-up area or large cities where the urban area is tend to expand following the expansion of economic activities in the future.

On this point, the method given in paragraph a. is considered more appropriate unless there is a sudden change in social condition of the city.

(1) Estimate on the nation-wide scale

- Data to be used: Population indicators obtained from the nine censuses taken between 1881 and 1963 (Almost once in every 10 years).
- Method of estimation: Method of least squares
- Calculation formula:

$$Y = 4,445,902 + 83,170\ t + 1198\ t^2$$

where: t = Base year which is 1921 (Future year)

Y = Future population

Therefore, with the replacement of t by 59, the population in 1980, 10 years hence, is estimated at 13,523,170 and that in 1990, 20 years hence, is estimated at 15,888,310 by replacing t with 69.

(2) Estimate on the future population in Colombo municipality

- Data to be used: Population indicators obtained from the past nine censuses taken between 1881 and 1963 in the same manner as for the country.
- Method of estimation: Quadratic equation of the method of least squares.

Calculation method:

$$Y = 237,933 + 4.691\,t + 38\,t^2$$

where: t = Future year (Base year is to be 1921)

Y = Future population

With the use of the above calculation method, the future population is estimated as follows:

Year	Population
1980	646,980
1990	742,530

The population of 560,000 in Colombo Municipality in 1968 is expected to increase to about 650,000 in 1980 and to about 740,000 in 1990. However, as the optimum population density in Colombo Municipality is said to be 72 persons/acre the upper limit of the population that can be accommodated is 650,000. Therefore, it will be necessary to accommodate the excess of the population by the urban surrounding zone and the suburban development area.

(3) Estimate of the future population in Colombo Metropolitan Area including the surrounding cities
(Colombo, Mt. Lavinia, Kotte, Moratuwa)

- o Data to be used: Population obtained by the five censuses taken between 1921 and 1963.
- o Method of estimation: Quadratic equation of the method of least squares
- o Calculation formula:

$$Y = 517,851 + 12,367\,t + 166\,t^2$$

where: t = Future year (Base year is to be 1946)

Y = Future population

From the above formula the following values are obtained

1980	1,130,000
1990	1,413,255

2) Distribution of population

As stated previously, the future population of greater Colombo Metropolitan Area is estimated at 2.2 million or about 2.2. times the present population.

Distribution of an expected increase of 1.2 million is made as follows from the standpoint of optimum population density.

Table III-3-3 Rate of Population Increase (Major cities)

	1881	1891	1901	1911	1921	1931	1946	1953	1963	1966	1967	1968
1 Ceylon	41.5	45.2	53.6	61.7	67.6	79 7	100	121.5	159.0	171.8	175.8	179.7
2 Colonbo	30.5	35.0	42.7	58.4	67.4	78.5	100	117.7	141.3	149.7	152.2	154.9
3 Dehiwala–Mt La	—	—	—	32.5	44 6	60.3	100	137.5	195.0	205.7	211.0	21 4.5
4 Negombo	28.1	58.3	61.0	39.9	66 5	77.9	100	118.9	1444	153.9	160 1	163.2
5 Moratuwa	—	—	58.4	53.8	56.4	63.9	100	118.8	153.5	163 7	106.5	169.6
6 Kotte	—	—	—	25.2	36.1	48 2	100	135.2	183 6	196.4	201.4	206.4
7 Kalutaia	53.8	57.3	60.6	68.6	71.7	75.3	100	107.2	133.2	137.1	137.1	142.4
8 Kandy	43.0	39.7	51.5	58.4	63.5	72.5	100	111.6	133.0	144.3	148 2	152.1
9 Matale	28 6	29.8	35.1	41.1	55.8	73.9	100	122.4	181.8	191.6	198.7	198.7
10 Nuwara Eliya	16.5	25.2	46.4	68.4	69 5	72 2	100	133.0	140.0	147.8	147.8	147.8
11 Galle	64.8	68.5	75.8	81.5	79 7	78 4	100	114.0	133.1	142.8	146.9	149.0
12 Matara	32.8	37.6	51.7	60 5	73.2	82.5	100	120.7	142.1	148.4	152.8	157.2
13 Hambantota	51.5	64.9	71.6	77.9	71.8	78.9	100	108.3	1343	151.1	151.1	151.1
14 Jaffna	63.7	69.0	54.2	64.7	67.9	73 1	100	124.4	151.4	158.3	159.9	161.5
15 Mannar	—	—	130.6	92.5	90.7	100	—	—	220.2	244.9	244.9	244.9
16 Vavuniya	—	—	44 0	62.8	72.7	100	—	—	5563	621.6	621.6	621.6
17 Batticaloa	46.1	55.7	76.5	81.8	81.0	88.9	100	133.8	176.3	184.1	184.1	184.1
18 Trincomalee	29.9	35.7	34.7	27.2	29.0	31.3	100	81.1	107.1	116.9	120.0	120.0
19 Kurunegala	31.6	35.5	48.5	61.0	76.2	78.3	100	130.9	158.4	172.0	172.0	172.0
20 Puttalam	65.3	64.6	65.6	769	88.6	86.1	100	131.3	169.3	192.5	192.5	192.5
21 Chilaw	37.7	41.0	45.8	55.3	72.9	79.1	100	125.1	154.7	164.7	164.7	1757
22 Anuradhapura	10.6	20.4	29.8	43.5	63.2	72.9	100	1493	239.0	243.6	243.6	243.6
23 Badulla	35.5	37.5	44.3	48.5	60.7	73.6	100	127.3	202.5	216.6	2166	224.1
24 Ratnapura	232	28.3	32.8	44 0	56.4	68.3	100	133.4	1736	184.9	184.9	192.9
25 Kegalle	27.3	64.1	47.7	51.7	71.5	757	100	112.4	233.1	2447	244.7	244.7
2+3+5+6	—	—	—	267.144	312.623	370254	509871	618.936	774.249	821.000	806.000	852.000
				52.4	61.3	72.6	100	1214	151.9	161.0	1581	167.1

Fig. Ⅲ-3-3 Dynamic population graph

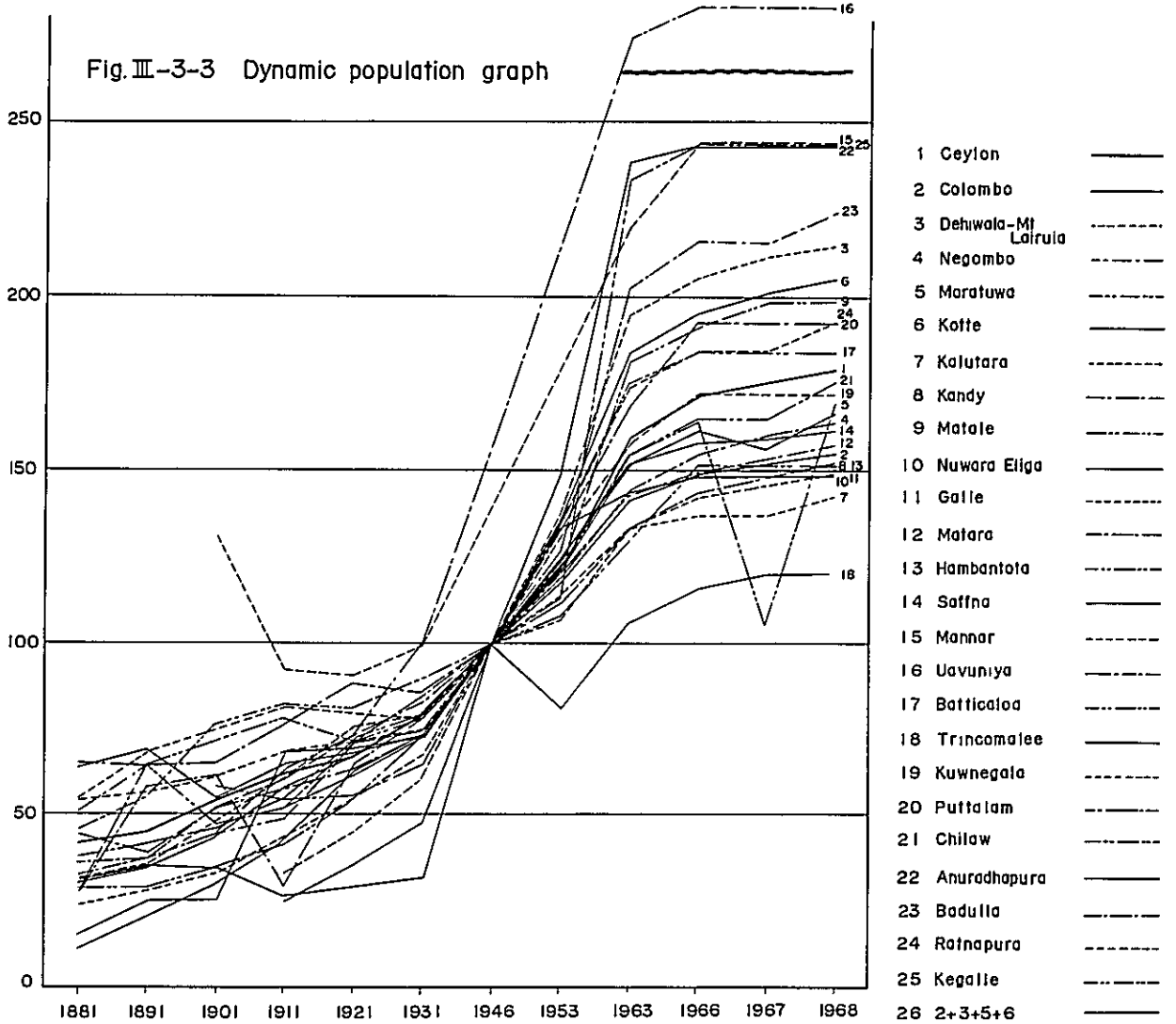
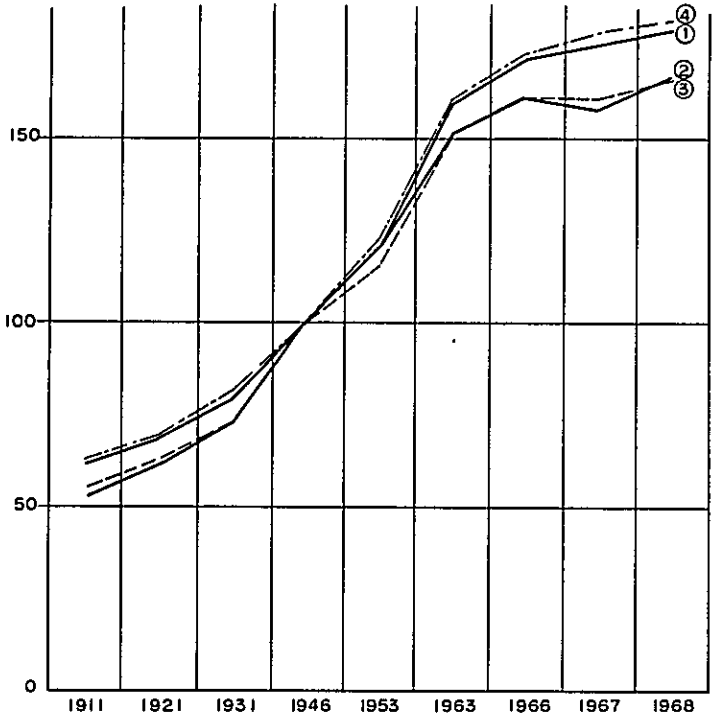


Table Ⅲ-3-4 Changes in population

		1881	1891	1901	1911	1921	1931	1946	1953	1963	1966	1967	1968
① Ceylon	Population	2,760,000	3,008,000	3,566,000	4,106,000	4,498,000	5,307,000	6,657,000	8,091,000	10,582,000	11,439,000	11,703,000	11,964,000
		41.5	45.2	53.6	61.7	67.6	79.7	100	121.5	159.0	171.8	175.8	179.7
② 2+3+5+6	Population	—	—	—	267,144	312,623	370,254	509,871	618,936	774,249	821,000	806,000	852,000
		—	—	—	52.4	61.3	72.6	100	121.4	151.9	161.0	158.1	167.1
③ Urban	Population	—	—	—	496,714	571,352	653,897	900,000	1,050,000	1,365,466	1,450,000	1,445,000	1,501,000
		—	—	—	55.2	63.5	72.7	100	116.6	151.7	161.1	160.5	166.7
		—	—	—	12.1	12.7	12.3	13.5	13.0	12.9	12.7	12.3	12.5
④ Rural	Population	—	—	—	3,609,286	3,926,648	4,653,103	5,757,000	7,041,000	9,216,534	9,989,000	10,258,000	10,463,000
		—	—	—	62.6	68.2	80.8	100	122.3	160.0	173.5	178.2	181.7
		—	—	—	87.9	87.3	87.7	86.5	87.0	87.1	87.3	87.7	87.5



(Note) Figures under column (2) represent the total of values for Colombo, Dehiwala, mt. Lavinia, Moratuwa and Kotte.

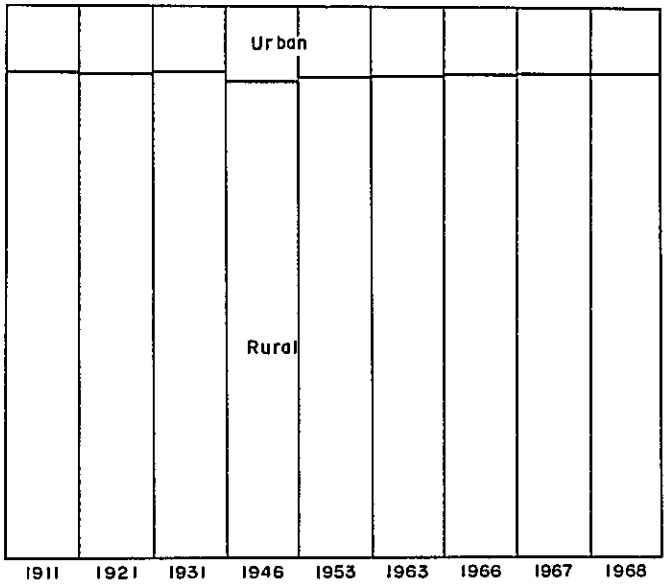
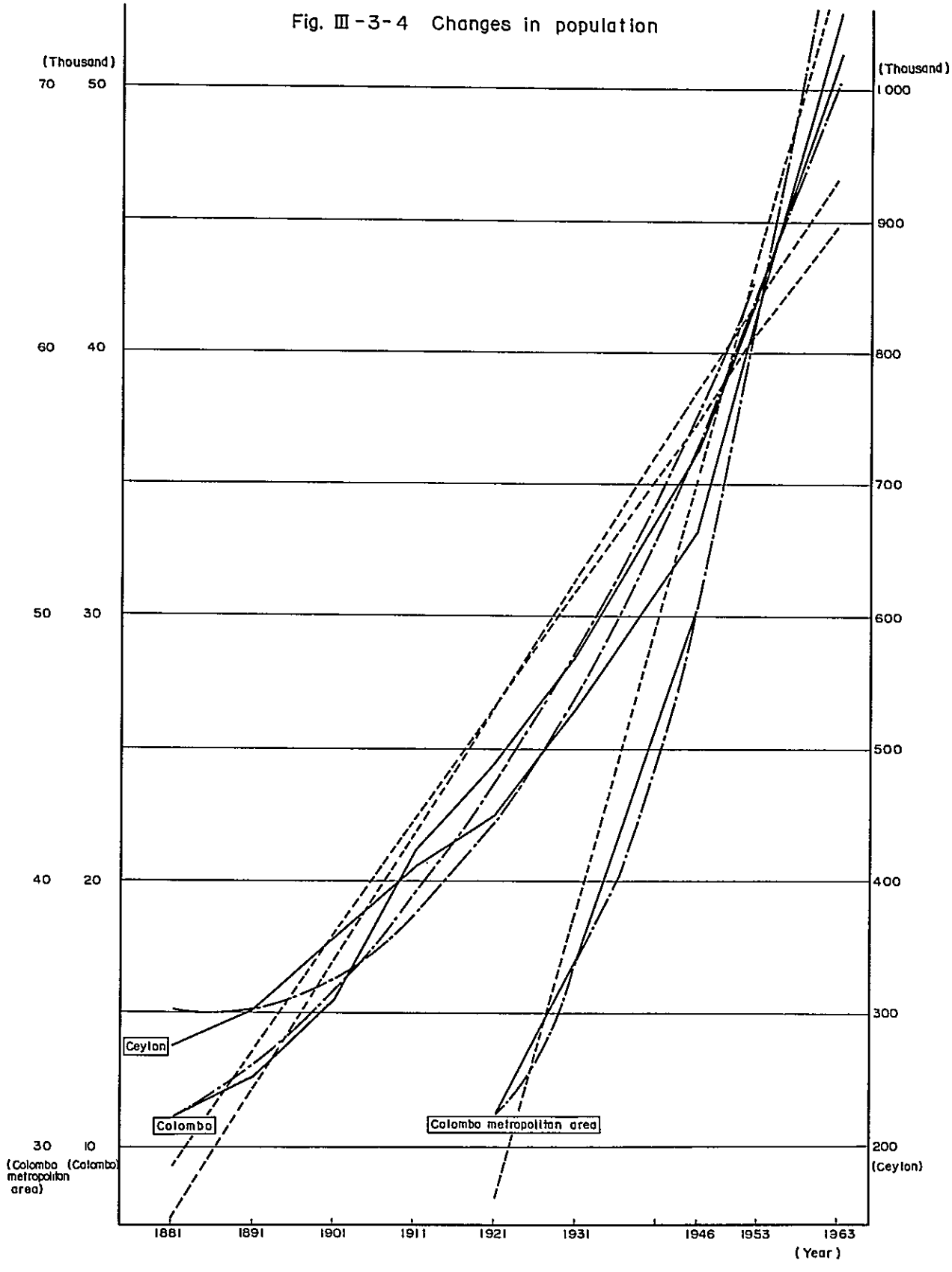


Fig. Ⅲ-3-4 Changes in population



(1) Colombo Municipality

Though the population in 1968 was about 560,000 with the population density of 61 persons/acre, the new urban area to be created by reclamation covering an area of about 1,000 acres is expected to accommodate an increase of about 53,500 people. Also by three dimensional land use through urban renewal, or effective use of waste land which has not been converted to residential district, an increase of about 36,500 people is expected.

Table III-3-5 Future Population of Colombo Municipality

Dist.	Present population (1968)	Increase of population by reclamation	Increase of population by other factors	Future population (1990)	
				Population	Population density (persons/acre)
1	12,570	3,500	6,500	22,570	55
2	65,670	10,000		75,670	74
3	109,270	10,000		119,270	96
4	125,550	10,000		125,550	192
5	65,120			65,120	56
6	24,180	5,000		29,180	76
7	78,200	20,000	20,000	118,200	43
8	81,650	5,000	10,000	96,650	63
	562,210	53,500	36,500	652,210	71

(2) Urban surrounding zone

The present population of such outlying cities as Kolonawa, Kotte, Mt. Lavina, Wattala and Moratuwa is approximately 347,000. These cities are expected to have a sharp increase in population in the future as inner urban zone (Colombo municipality) is not considered capable to accommodate any substantial increase in population.

So far, these outlying cities have had no direct relations with Colombo Municipality in the course of their growth and have been following their own course. In the future, however, when the commercial and business activities in the CBD of a large city become more intensified and the concentration of population in the metropolitan area is accelerated, the urban surrounding zone will be required to play the part of housing district for the commuters travelling to the CBD.

When this tendency is taken into consideration, these outlying cities will no longer be able to maintain their own characteristics in the urban pattern and instead will acquire a strong characteristics of inter-dependence having close relations with Colombo Municipality (CBD). With the consideration given to the above-mentioned points, urban surrounding zone is to be developed mainly as housing districts for commuters travelling to CBD. In selecting the people for the accommodation by the proposed housing district, emphasis is to be

placed on the middle-income class and the type of building is to be detached house (Single unit).

On this precondition the population to be accommodated by urban surrounding zone is estimated at 550,000 with the optimum population density of 25 persons/acre.

Table III-3-6 Future Population of Urban Surrounding Zone

Cities	Present population	Future population
Wattala	30,000	50,000
Kolonawa	20,000	30,000
Kotte	85,000	170,000
Mt. Lavinia	125,000	150,000
Moratuwa	87,000	150,000
Total	347,000	550,000

(3) Suburban development area

This is a rural area totaling about 50,000 acres within 5 - 10 mile sphere from the center of the Metropolitan Area with a population of mere 100,000. From a long-range point of view, however, this area will not be left in the present state of an agricultural area but is expected to be developed vigorously as an urban area in the future.

Though any definite conclusion can not be made until there is a detailed study on the actual state of the area, it is advisable to plan a large scale urban development project to realize efficient new town with better environment.

The population to be accommodated by this area is estimated at about 1,000,000 and the required land space of urban area on the basis of the population density of 25 persons/acre is estimated at about 40,000 acres. The size of population to be allocated to each district of the new development area is shown in the table below.

Table III-3-7 Future Population of New Development Area (1990)

District	Scale of development	Future population
Ragama	4,800 A	120,000 persons
Kadawata	7,200	180,000
Kaduwela	7,200	180,000
Madiwela	12,400	310,000
Galkissa	3,600	90,000
Kesbewa East	2,400	60,000
Kesbewa West	2,400	60,000

Fig. Ⅲ-3-5 Future Distribution of population (1990)

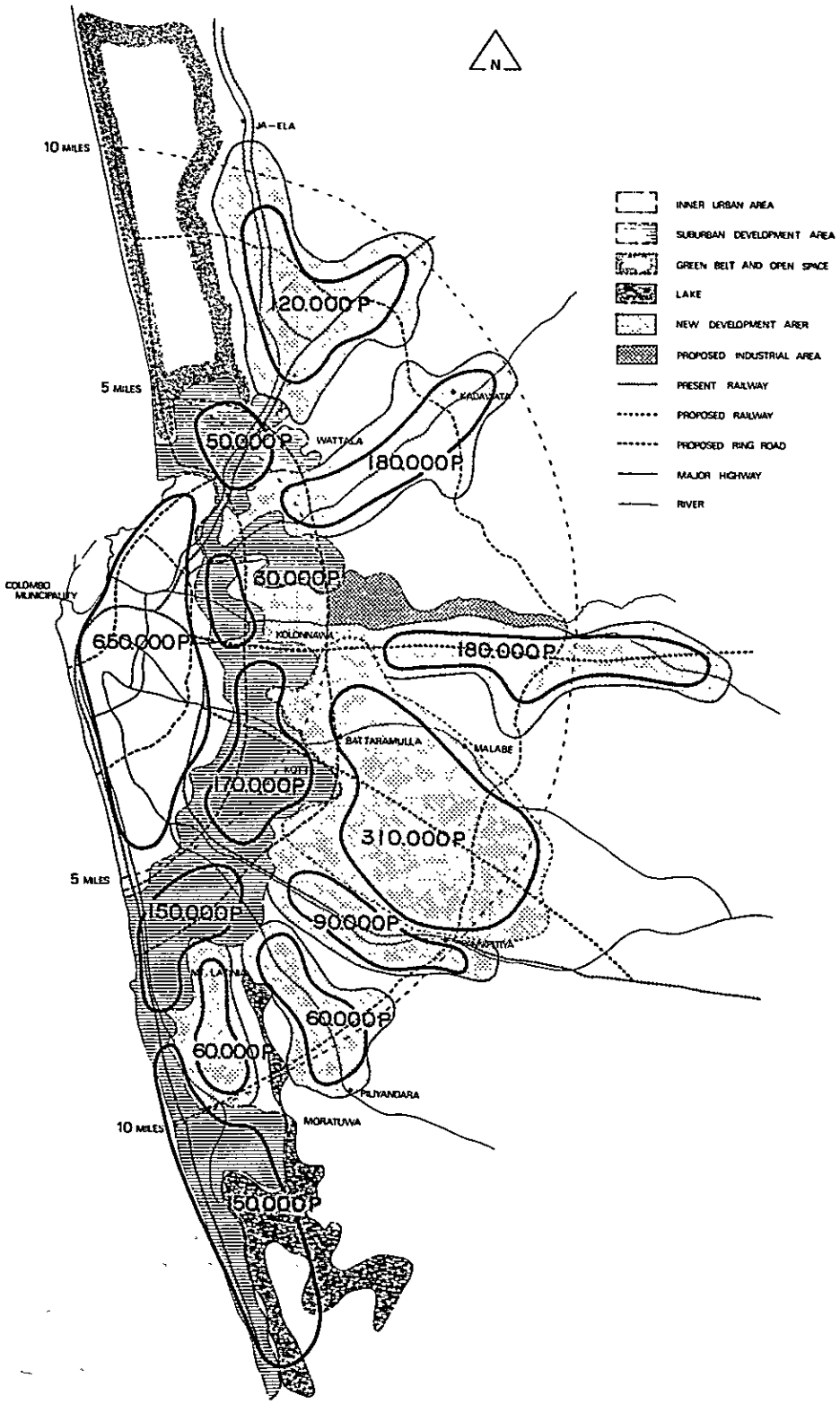


Fig. Ⅲ-3-6

DISTRIBUTION OF POPULATION

: WARD (1990)

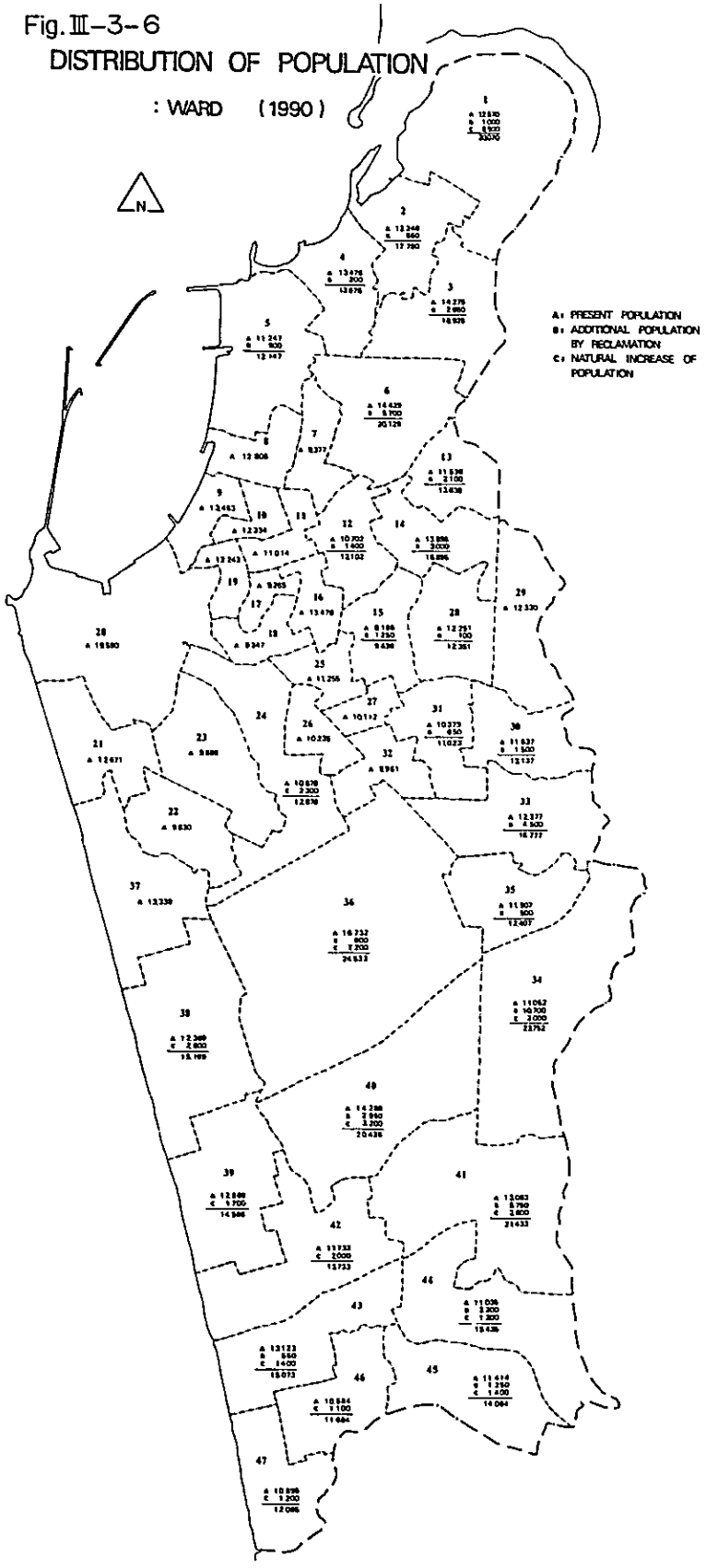
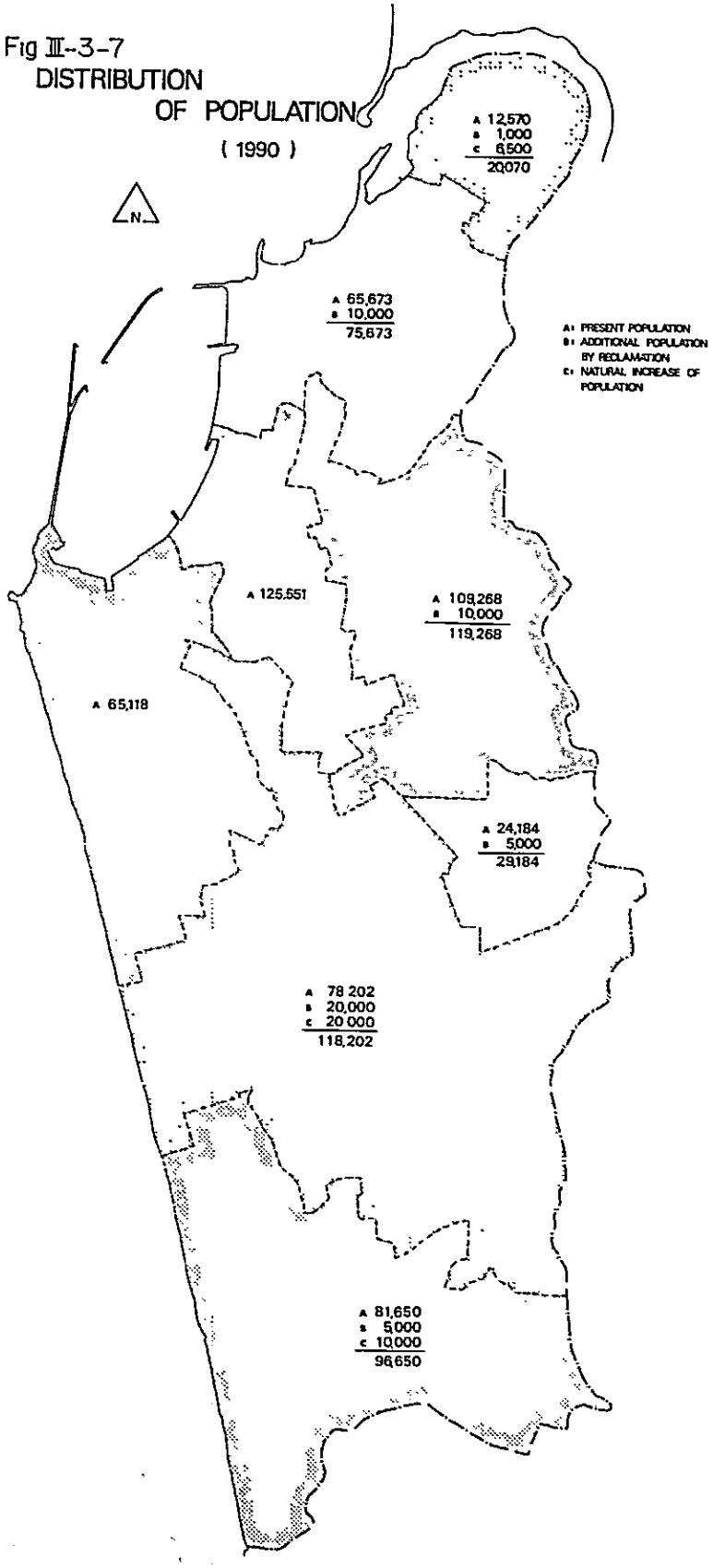


Fig Ⅲ-3-7

DISTRIBUTION OF POPULATION

(1990)



3-3 Traffic Planning

3-3-1 Present Traffic Situation

1) Road

Of the total length of about 30,000 miles of road in Ceylon, the roads under the jurisdiction of the central government (P.W.D.) as of 1968 is 13,315 miles and the remaining 17,000 miles comprise irrigation and land development roads with a total length of about 5000 miles, village, town and urban council roads about 7,000 miles in length and estates roads totaling about 5,000 miles.

The roads under the jurisdiction of P.W.D. are classified into five classes- A-class roads, the trunk road, B-class roads, the main road, and C, D, E-class roads, the auxiliary road.

Table III-3-8 Road Condition by Road Classification in 1962

Road classification	Length (miles)	Condition
A	2,186	All lutumen surfaced
B	2,994	"
C	4,160	Almost "
D	3,062	" metalled
E	608	
Total	13,015	

Source: P.W.D.

Accordingly, 35% of the total length of road in Ceylon or about 10,000 miles are passable by motor vehicles and 25% of the total length are paved roads. However, about 40% of the total length of 30,000 miles are in the state of near natural road.

About 21 miles among the road in Colombo under the jurisdiction of P.W.D. are placed in the hand of Colombo municipality. Of all the roads in Colombo City having a total length of about 200 miles, the road passable by motor vehicles is estimated to be about half judging from the road map.

Recent transition in the number of registered motor vehicle is shown in Table III-3-9. The table shows a very small increase in the number since 1961 when the restriction was imposed on the import of new foreign cars by the government on January 25 of the same year. However, there was a considerable increase in 1967 and 1968 and the annual increase was within the range of 3,000 to 4,000 units. The share of passenger car is the largest in the total number of motor vehicles, followed by bus. Import of motor vehicles is shown in Table III-3-10. A sharp decrease in the number of imported cars since 1961 was due to the reasons previously explained. It is known from the table that emphasis is placed on buses and trucks in the import of foreign motor vehicles in recent years.

The exact number of registered motor vehicles in Colombo City is not known due to lack of statistical data. However, the number of revenue licenses in Colombo district is already known as shown in Table III-3-11. Omni buses shwon in Table III-3-11 are owned by Ceylon Transport Board and all Omni buses in Ceylon are registered in Colomber district. By separating motorcyles from the number shown in Table III-3-11 at the rate of registered cars in 1968 shown in Table III-3-9 and assuming that 3/4 of 4,982 buses owned by Ceylon Transport Board in 1968 are in operation in Colombo district, the number of motor vehicles calculated are 28,600 for passenger car, 2,716 for taxi, 3,875 for bus and 10,804 for truck and van, in the total of 45,995.

Assuming that 3/4 of the above total number are owned in greater Colombo Metropolitan a rea (population of about 900,000), the number of motor vehicles in the greater Colombo Metropolitan Area is estimated as shown in Table III-3-12 below.

Table III-3-9 Vehicle Registration from 1961 ~ 1969
(Exclusive of land vehicles trailers and motorcycles (1))

Year	Cars & Cabs		Buses		Lorries, Vans & Tractors		Total		Remarks
	No.	%	No.	%	No.	%	No.	%	
1961	83,799	71.2	6,506	5.5	27,365	23.3	117,670	100	Motorcycles 17,418
1962	83,161	70.4	6,883	5.8	28,070	23.8	118,114	100	
1963	82,715	70.1	7,237	6.1	28,135	23.8	118,087	100	
1964	82,575	69.7	7,634	6.4	28,290	23.9	118,499	100	
1965	83,063	69.1	8,270	6.9	28,791	24.0	120,124	100	
1966	82,694	69.0	8,314	6.9	28,890	24.1	119,898	100	
1967	83,743	68.3	8,946	7.3	29,980	24.4	122,669	100	
1968	84,678	66.6	8,151	7.2	33,410	26.2	127,239	100	Motorcycles 18,043

(1) Land vehicles include farm tractors and trailers and other vehicles, not primarily designed for road transport. In 1968 there were 15,872 land vehicles.

Source: Registrar of Motor Vehicles

Table III-3-10 Import of Motor Vehicles 1960 ~ 67

Year	Vehicle Type					
	Motor Cars	Motor Buses	Lorries	Tractors	Other chassis with engines	Total
1960	8,318	26	1,468	1,034	1,876	12,722
1961	1,363	21	436	1,383	1,812	5,017
1962	273	12	196	690	481	1,652
1963	270	20	77	882	767	2,016
1964	290	46	109	377	505	1,327
1965	315	244	58	374	482	1,473
1966	425	188	332	1,117	1,192	3,254
1967	930	218	407	-	498	2,053

Source: Ceylon Customs Return

Table III-3-11 Number of Revenue Licences in Colombo District 1967/8

Vehicle	Private Cars & Motor-cycles	Hire cars	Omni-buses & existing motor wagons	Lorries	Private coaches	Ambulances and hearses	Total
No. of Revenue Licences	35,256	2,716	5,535	10,589	215	110	54,421

Land Vehicles: 1,285

Source: Registrar of Motor Vehicles

Table III-3-12 Estimated Number of Registered Motor Vehicles in Greater Colombo Area in 1968

Vehicle Type	Number
Cars	21,500
Cabs	2,000
Buses	2,900
Lorries & Vans	8,100
Total	34,500

Though there is vigorous demand for vehicular transportation, the increase in the number of motor vehicles is standstill due to the strict restriction on car imports but the latent demand for motor vehicles can be estimated from the number of persons posessing drivers' licenses. The number of persons acquiring drivers' licenses were 11,951 in the 1966/67 period and 15,386 in the 1967/68 period. The total number of persons possessing drivers' licenses as of the end of 1968 was 351,899. The relationship between the increase in the number of persons possessing drivers licenses and that of the motor vehicles is such that about 1/2.5 of the former equals the later in general. Therefore, even under the present circumstances when there are no motor vehicles available, the latent demand for motor vehicle is estimated at about 5,000 ~ 6,000.

The recent omnibus services by Ceylon Transport Board, which play a vital role in the transport of passengers in Ceylon as a means of mass transport, are shown in Table III-3-13. The number of passengers transported by omnibus services has been increasing annually at a rate of 10% 15% and a total of about 3.5 million passengers are transported daily by this service in Ceylon. The Ceylon Transport Board is responsible for the operation and management of the nationalized bus service which took effect on January 1, 1958 by Motor Transport Act, No. 48 of 1957 affecting 3,400 buses, 1,200 bus routes and 15,000 employees of 76 private firms. The board now employs approximately 36,000 workers on the payroll and is divided into four local bureaus with a total of 49 depots.

About 10 years ago a traffic survey was conducted by Wilburn Smith & Associates, a consultants firm in USA, through the courtesy of the US government. From the data obtained by that survey, the cordon traffic in Colombo City limit is shown in Table III-3-14 through Table III-3-17.

Table III-3-14 shows that there are 8 main routes to enter Colombo City and approximately 70,000 motor vehicles enter the city daily. The busiest route is A-2 with the traffic of about 17,700 vehicles/day, followed by A-4 which runs in south-east direction with a daily traffic of about 12,100 vehicles. The traffic volume at the morning peak hours accounts for about 8% of the total daily traffic. Also, by the distance from the center of Colombo City the rate of decrease in traffic volume may be estimated. The traffic decreases to 44% at a point of 10 miles from the city center, to 29% at a 20 mile distance and to 22% at the distance of 20 miles, indicating the fact that traffic decreases sharply with the increase in the distance.

Tabl III-3-13 Omnibus Services by Ceylon Transport Board

Item \ Year, ended 30th Sep.	1965	1966	1967	1968
No. of buses licensed	4,027	4,384	4,824	4,982
Average No. of buses operated per day	2,931	3,256	3,599	3,686
Total No. of passengers carried	1,893,730,912	1,025,243,967	1,144,773,653	1,250,135,182
Increase rate of total No. of pass. carried %	100	115	128	140
Average passenger journey (miles)	5.5	5.4	5.4	5.46

Source: Dept. of Census & Statistics "Statistical Pocket Book of Ceylon 1969"

Table III-3-14 Traffic Volume at Colombo Municipal Limits & Near Colombo in 1961[2)]
(From "Ceylon Traffic &Planning Study" by Wilbur Smith & Associates 1966)

Route No.	Location	At Colombo Municipal Limits Peak hour AM	PM	12 hrs.	24 hrs.	New Colombo Distance from CBD (mile)		
A-3	Victoria Bridge	806	786	8,391	10,650	5,700	3,200	3,100
A-1	Kelani Bridge	740	688	6,956	8,750	4,600	3,500	3,300
	Albion Rd. (one way)	230	254	2,587	3,365			
B-2	Cotta Road	635	647	5,846	8,580			
	Naraken bita-Nawala Road	521	396	4,033	5,003			
A-4	Kinllapcne Bridge	1,020	964	9,308	12,066	5,000	2,900	1,000
	Paman Rada Bridge	328	301	2,712	3,478			
A-2	Dehimela Canal Bridge	1,485	1,441	13,504	17,687	6,500	4,500	3,300
	Total	5,765	5,477	53,337	68,599			
		Sub-total A-1 A-4		40,158		21,800	14,100	10,700
		% Reduction from Colombo M. Limits				0.56	71	78
		% Increases from Traffic at 20 mile Radius			460	204	132	100

Shown in Table III-3-15 is the traffic classification at 8 main traffic points on Colombo Municipal Limits. From the table it is known that passenger cars and buses have a large share in the total traffic compared with the ratio in the number of registered motor vehicles including motorcycles (Table III-3-9). The points where passenger cars have a large share in traffic are considered to be the proof that these points have many high-class residential districts in the hinterland. The points where the rate of bus is high in traffic also indicate the existence of large towns in the hinterland.

Table III-3-16 shows vehicular traffic and the number of persons entering Colombo City. During a 12 hour period there were about 90,500 vehicles entering the city including motorcycles, of which 33,500 were bicycles. The total number of persons entering the city during the same period was 326,500, of which half were the bus passengers. It must be noted, however, that the number of buses accounts for only about 6% of the total number of vehicles. The number of bicycles accounts for 37% of the total vehicles but the number of persons transported by bicycles is only 10.5% of the total number. The number of persons entering the city by passenger car is approximately 93,000. The traffic entering Colombo City is

heaviest at the morning peak hour and the number of vehicles is 9,700, of which 5,300 are bicycles. The number of persons entering the city at the morning peak hours is about 32,300, of which 17,000 people were transported by buses, the number of which is equivalent to 3.3% of the total number of vehicles entering during the morning peak hour.

Table III-3-17 shows the number of persons in motor vehicles on the major roads at Colombo Municipal Limits. The points where the number of persons travelling in motor vehicles is dominant are the Victoria Bridge in north, the Kirillapone Bridge and Dehimela Bridge in south. The points where the share of bus passengers is high are the Victoria Bridge and the Pamankada Bridge and the number of persons entering the city in passenger cars is the largest at the Dehiwela Bridge on Route A-2 in south and totals about 40,000.

Table III-3-18 shows the average trip length in miles for each vehicle type. The average trip length for all vehicle types is 4.5 miles but this is considered rather short in view of the fact that the number of vehicles not in operation is not included.

Table III-3-15 Traffic Classification at Colombo Municipal Limits in 1961[2] (%)
(From "Ceylon Traffic & Planning Study" by Wilbur Smith & Associates 1966)

Location	Actual No.	% of Vehicles on Each Route 24 hrs. weekly					
		Pass. cars	Heavy lorries	Light lorries	Buses	Motor-cycles	Total
Victoria Bridge (A-3)	10,650	54.4	17.3	6.1	17.6	4.6	100
Kelani Bridge (A-1)	8,750	69.7	15.8	6.4	1.0	7.1	100
Kolonnawa Road[1]	6,900	55.4	18.4	6.9	12.0	7.3	100
Cotta Road	7,600	68.5	5.7	3.9	14.0	7.8	100
Narahenpita Rd.[2]	5,000	78.4	5.0	5.7	0.8	10.1	100
Kirillapone Bridge (A-4)	12,050	68,1	9.5	5.8	9.6	7.0	100
Pamankada Bridge	3,500	71.1	3.0	4.7	14.3	6.9	100
Dehiwela Cannal Bridge (A-2)	17,700	73.1	6.2	4.6	8.9	7.2	100
Total	72,150	67.2	10.4	5.5	9.9	7.0	100

1) Includes Albion Road east bound
2) Includes Nawala Road

Table III-3-16 All Vehicles & Persons Entering Colombo in 1961[2)]

Time	Vehicle type	Traffic (Vehicle) No.	Traffic (Vehicle) %	Persons No.	Persons %	Remarks
Both ways during 12 hours 7:00 am 7:00 pm	Pass cars		42.2		28.5	
	Heavy lorries		6.6		4.7	
	Light lorries		3.4		3.2	
	Motor cycles		4.4		1.6	
	Sub-total	51,200	56.6	124,200	38.0	
	Bicycles		37.2		19.5	
	Buses		6.2		51.5	
	Total	90,500	100.0	326,500	100.0	
Entering Colombo in morning peak hour	Motor vehicles		42.2		29.6	
	Bicycles		54.5		16.7	
	Buses		3.3		53.7	
	Total	9,678	100.0	32,274	100.0	
Leaving Colombo in afternoon peak hour	Motor vehicles		44.3		28.3	
	Bicycles		51.5		14.0	
	Buses		4.2		57.7	
	Total	7,866	100.0	29,445	100.0	

Table III-3-17 Number of Persons on Motor Vehicles by Location at Colombo Municipal Limits in 1961[2)]

Location	No. of persons by cars, lorries motor cycles	No. of persons by buses(ii)	Total	Remarks
Victoria Bridge	21,867	54,146	54,146	(1) Estimated
Kolani Bridge	21,368	519	21,887	by the average
Kolonnawa Road	14,870	16,506	31,376	
Cotta Road	15,730	21,666	37,396	
Narahenpita Road	10,812	333	11,145	(ii) Counted
Kirillapine Bridge	26,772	28,911	55,683	
Panan Kada Bridge	7,357	12,752	20,109	
Dehiwela Bridge	39,588	33,179	72,767	
Total	158,364	168,012	326,376	

Table III-3-18 Average Trip Length in Miles at Four Adjacent Surburb to Colombo in 1961[2)]

Vehicle type	Pass. cars	Heavy lorries	Light lorries	Total
ATL	4.6	1.6	4.2	45

Table III-3-19 below shows the average occupancy of motor vehicles. It should be noted that lorries, particularly light lorries are being used for the transport of passengers. The average occupancy of passenger cars (buses not included) and lorries is 2.58 persons.

Table III-3-19 Average Occupancy of Passenger Cars and Lorries at 8 Colombo City Limit Stations in 1961[2)]

Vehicle type	Pass. cars.	Heavy lorries	Light lorries	Pass. cars & lorries
Average occupancy	2.51	2.66	3.25	2.58

Recently, the Ceylon Transport Board has conducted a survey on the number of bus passengers entering Colombo City. Fig. III-3-8 shows the number of trips by bus and passengers entering Colombo City during a 15 hour period from 5 am to 10 pm of the same day. From the figure it is known that the main routes of bus transport are Route A-3 in north, Cotta Road in the center, and Route A-4 and A-2 in south. Fig. III-3-9 shows the number of trips by bus at the morning peak hours. It is known that the peak traffic is particularly conspicuous on Cotta Road and at the Kirillapone Bridge (High Level Road) on Route A-4. Though the number of buses at the peak hours is not so large, the congestion in the bus is such that the average number of passengers per bus is estimated at 70 ~ 80. For this reason, further improvement of services is desirable.

Fig. III-3-10.1 and Fig. III-3-10.2 show the distribution of bus trips and passengers at the city limits by hour. The figures show that the morning peak hours at the Victoria Bridge are not the 7 8 o'clock zone but are the 8-9 o'clock zone. The points where there are two peak hour zones are the Victoria Bridge, the New Kelani Bridge and the Pamankada Bridge. This indicates a wide distribution of place of employment for the passengers entering the city. Also from the relationship between the number of buses and the number of passengers shown in the figures, the points where further improvement of bus services is required are readily known. That is, where the line showing the number of buses in service swerves greatly to the right from the line indicating the number of passengers, there is low riding efficiency and better bus services is obtained. On the contrary, the bus routes in the direction of the New Kelani Bridge and the Pamankoda Bridge, which are indicated in the figures by the line showing the

number of buses swerved to the left or excessively gone near the line showing the number of passengers, need more buses in their routes. Fig. III-3-10.3 shows that the number of bus passengers entering Colombo City daily has reached the 238,000 level and that the number of bus trips was 5,216. At the morning peak hours of the 7 ~ 8 o'clock zone, a total of 565 buses transported about 42,000 passengers (17.6% of the total daily passengers). When compared with the results of the traffic survey conducted by Wilbur Smith & Associates in 1961, the number of buses obtained at about 1.5 times the number 9 years ago and that of the all vehicles is estimated at about 1.15 times. (From Table III-3-9). From Table III-3-15 the number of buses crossing Colombo City Limits daily is estimated at about 7,200 and the number of buses entering the city is estimated at 3,600, about half of the number crossing the city limits. From Table III-3-16, the number of buses crossing the city limits during a 12 hour period is estimated at 5,600 and the number of bus passengers crossing the city limits is estimated at about 170,000. Also from Table III-3-16, the number of buses entering the city at the morning peak hours is estimated at 320 and the number of bus passengers entering the city is estimated at about 17,000.

A comparison of the above results with the corresponding portions in Table III-3-17 and Fig. III-3-10.3 is shown in Table III-3-20. In this case, the rate of inflow was considered to be half of the total inflow and outflow. As evident from Table III-3-20, the number of buses entering Colombo City has increased about 1.5 times in the past 9 years but the number of passengers has increased 2.8 times in the same period. The number of buses in operation at the morning peak hours in 1970 is about twofolds of the number in 1961 but the number of passengers transported is about 2.5 times the number in 1961. The rate of increase is 3.3 times at the Dehiwela Bridge on Route A-2, 3.1 times on Cotta Road and 3.1 times on Kolonnawa Road, indicating the progress of development in the hinterlands of these points. The reason for a very small number of buses and passengers at the Kelani Bridge in 1961 shown in the table is that the most bus routes in 1961 were on the side of the Victoria Bridge.

2) Railways, port and harbours

(1) Railways

The national railways in Ceylon has a total length of 932 miles and employs approximately 25,000 workers. Of the above total milage, the broad gauge track (5' ~ 6') covers 845 miles and the narrow gauge track (2' ~ 6') covers 87 miles. Table III-3-21 below shows the number of passengers transported, passenger miles, goods tonnage and goods tonnage miles. While the number of passengers and passenger miles increase annually at a rate of about 3%, the goods tonnage has remained almost unchanged. The business has been in the red (About 2.5 million Rp recently) every year as customary with most of railways in the world but the operation is maintained with the subsidies from the central government. A survey team from the World Bank has recommended the policy calling for discontinuance of deficit laden lines, reduction of personnel and adoption of cost-of-service principle.

Fig. Ⅲ-3-8 Bus traffic entering colombo municipality

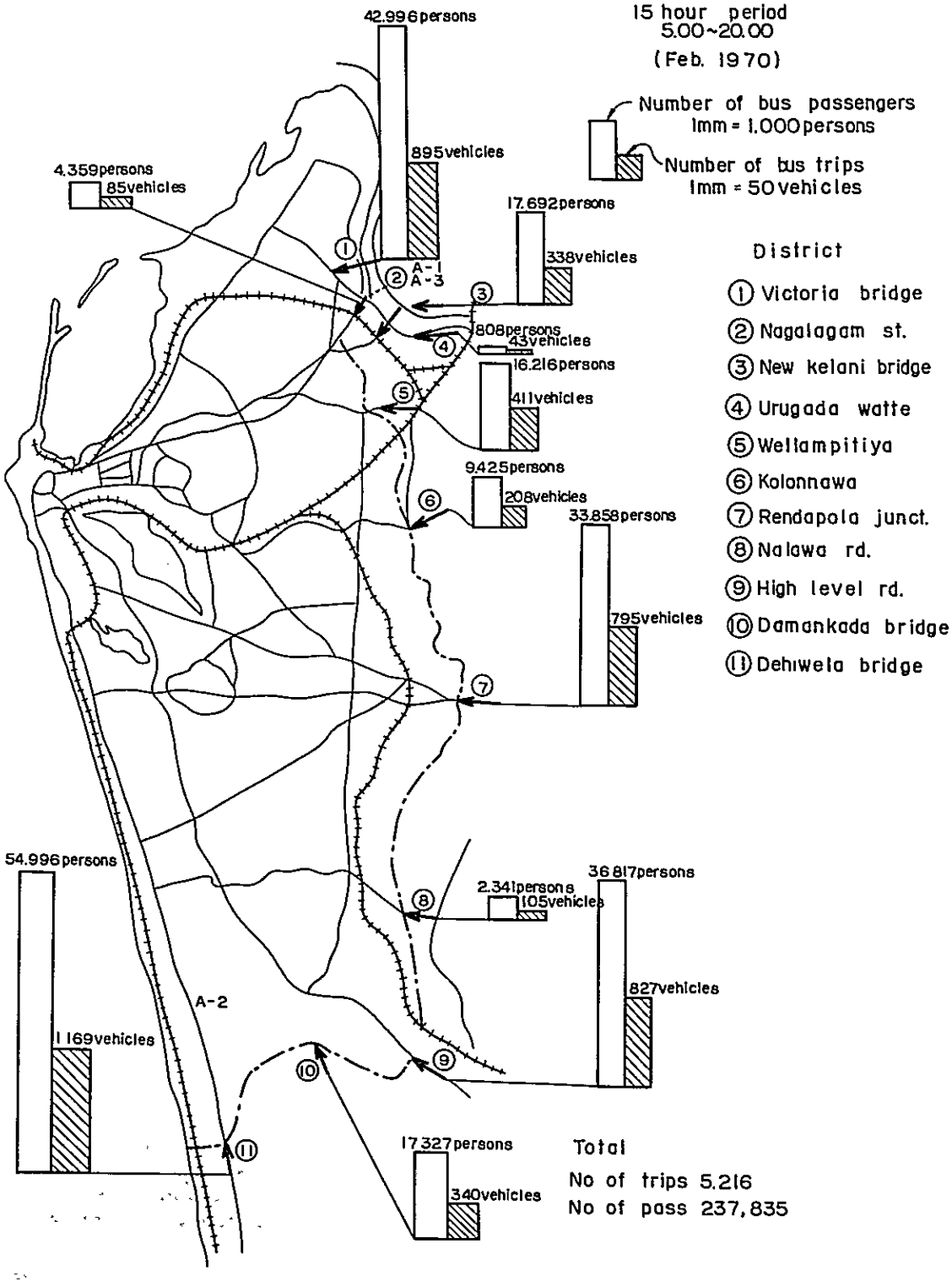


Fig. Ⅲ-3-9 Bus traffic entering colombo municipality during the morning peak hours

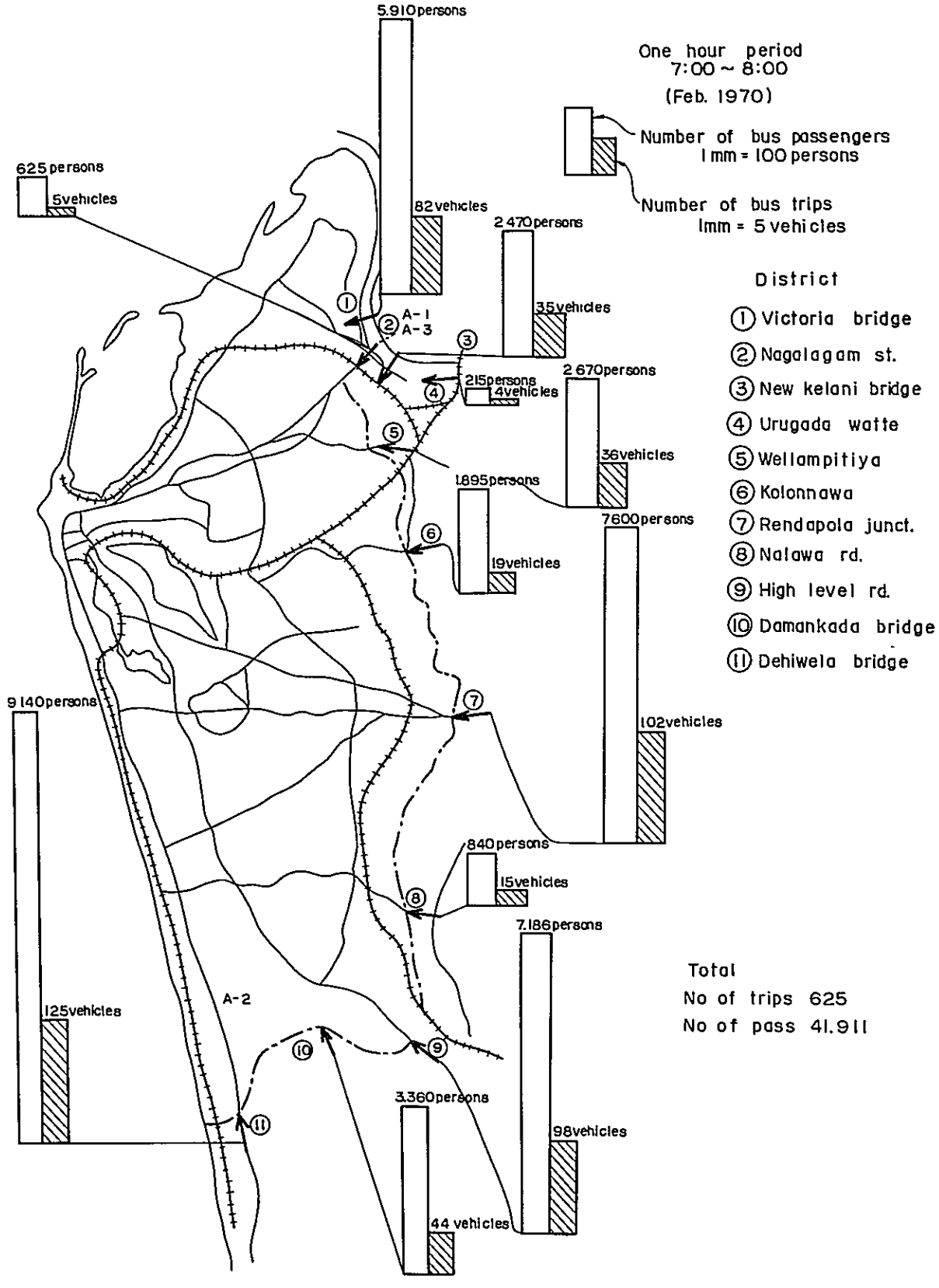


Fig. Ⅲ-3-10[(1)] Bus traffic entering colombo municipality by hour: (Feb. 1970)

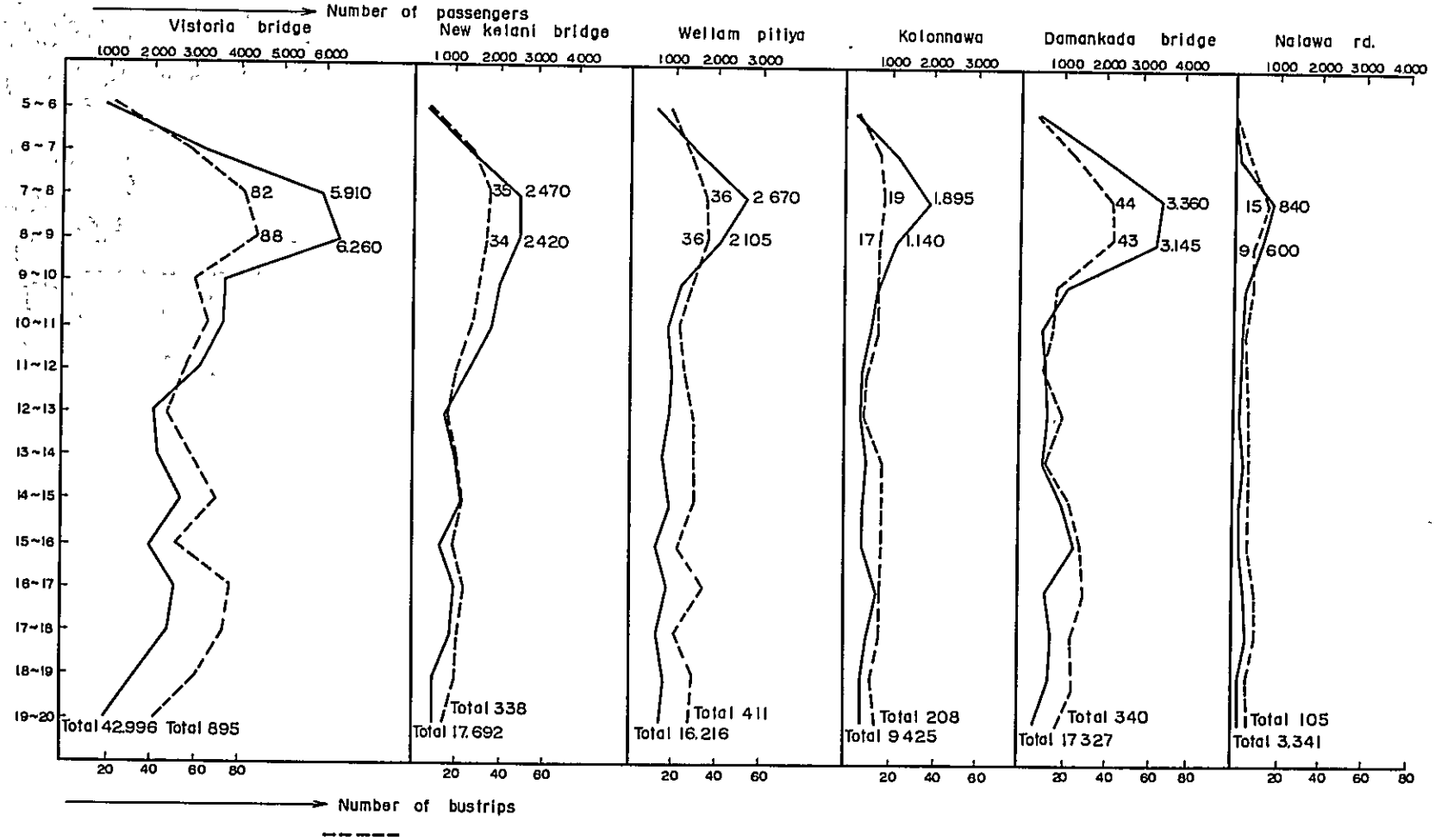


Fig. III-3-10[2] Bus traffic entering colombo municipality by hour:

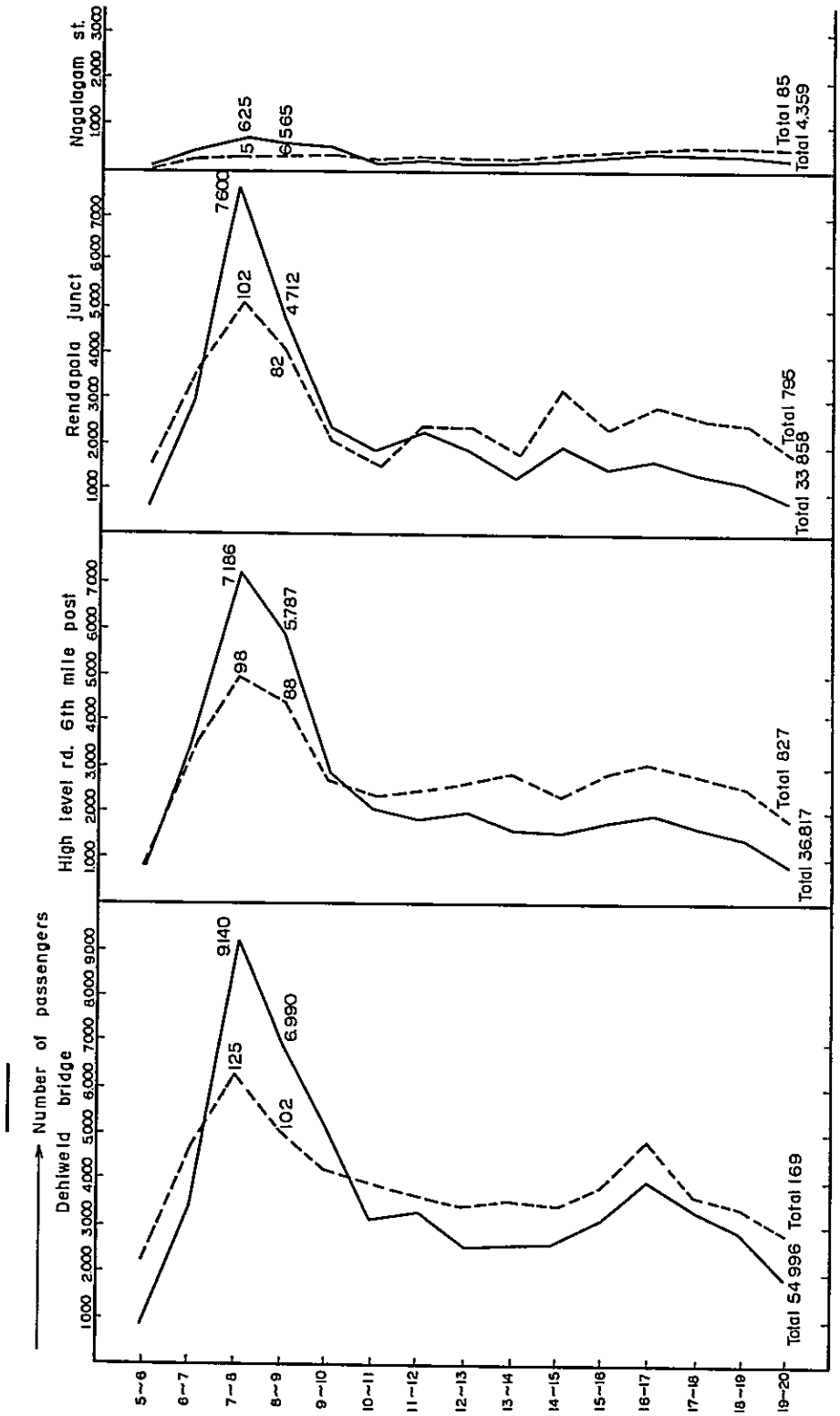


Fig. III-3-10[3] Bus traffic entering colombo municipality by hour :

Total of the traffic for the points of the city limit shown Fig. III-3-10[1] ~ -10[2] and those at urugodawatte (Not shown in the figures' as very small)

Surveyed in Feb. 1970

Urugodawatte

Time zone	Number of passengers	Number of bustrips
7~8	215	4
8~9	60	2
5~20	Total 808	43

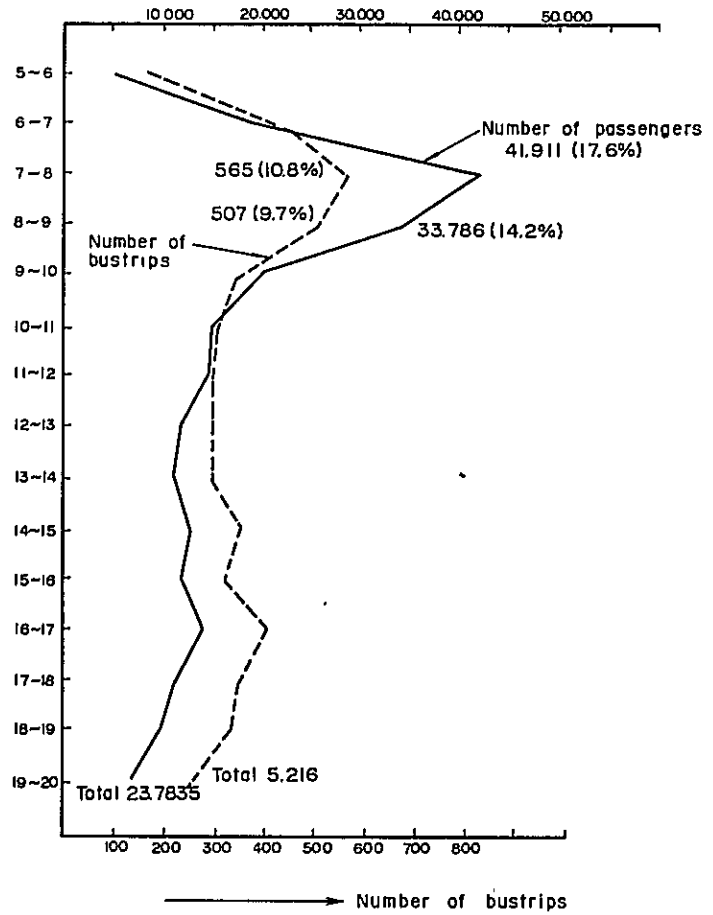


Table III-3-20 A Comparison of Bus Trips Entering Colombo City in 1961 and 1970

Time	Location	No. of Buses Entering Colombo		No. of Persons by Buses Entering Colombo		Remarks
		1961	1970	1961	1970	
Per day (15 hrs)	Victoria Bridge		895	27,070	42,996	
	Kelani Bridge		338	250	17,692	
	Kolonnawa Road		619	8,250	25,641	Includes Wellampitiya
	Cotta Road		795	10,830	33,858	
	Narahenpita Road		105	170	3,341	
	Kirillapone Bridge		827	14,460	36,817	
	Pamankara Bridge		340	6,380	17,327	
	Dehiwela Bridge		1,169	16,590	54,996	
	Total	3,600	5,216	84,000	,835	
Morning peak hrs. (1 hr.)	Total	320	625	17,000	41,911	

Table III-3-21 Railway Transport

Item	Year				
	1964	1965	1966	1967	1968
Route Miles	922	925	935	930	932
Passengers carried	73,355,894	73,520,040	74,714,967	73,731,522	82,026,844
Passengers carried Increase Rate %	100	100.2	102	107	112
Passengers Miles	1,453,459,005	1,498,408,071	1,536,902,239	1,584,919,939	1,678,338,463
Passengers Miles Increase Rate %	100	103	106	109	115
Goods tonnage	1,866,377	1,557,367	1,649,516	1,802,618	1,820,540
Goods tonnage Increase Rate %	100	83	88	97	90
Ton Miles	217,652,635	196,406,692	212,067,280	211,944,568	221,483,744
Ton Miles Increase Rate %	100	90	97	97	102

Source: Dept of Census & Statistics, "Statistical Pocket Book of Ceylon 1969"

Table III-3-22 Number of Passengers Arriving and Departing from Railway Stations in Colombo City

Arrival & Departure / Station	Departure			Number in one month of Sept. '69	Arrival Number in one month of Sept. '69	Total Arrival & Departure Number of passengers in one month of Sept. '69	Daily Average (one month 25)		
	Total Number during one year 1968/69	Month of maximum number	Maximum monthly number				Departure	Arrival	Total
Fort	3,678,825	Aug.	371,821	292,439	255,879	548,318	11,698	10,235	21,933
Moradana	2,269,873	Aug.	208,054	188,139	170,307	358,446	7,526	6,812	14,338
Slave Island	365,675	May	34,799	30,833	14,907	45,740	1,233	596	1,829
Kollupitiya	265,135	Oct.	24,373	22,163	19,588	41,751	886	783	1,670
Rambalapitiya	283,731	Aug.	27,109	24,879	17,047	41,926	995	682	1,677
Wellawatta	256,123	Oct.	24,493	19,801	9,958	29,759	792	398	1,190
Base Line	119,901	Mar.	12,170	10,700	3,116	13,816	428	125	553
Kotta Road	83,670	Mar.	8,069	6,986	2,889	9,875	279	116	395
Navahanpita	43,296	Nov.	4,241	3,316	2,964	6,280	133	119	252
Total	7,365,629			599,256	496,655	1,095,911	23,970	19,866	43,837

Source: Ceylon Government Railway

Fig. III-3-11 Number of passengers arriving & departing daily from railway station in Colombo Municipality

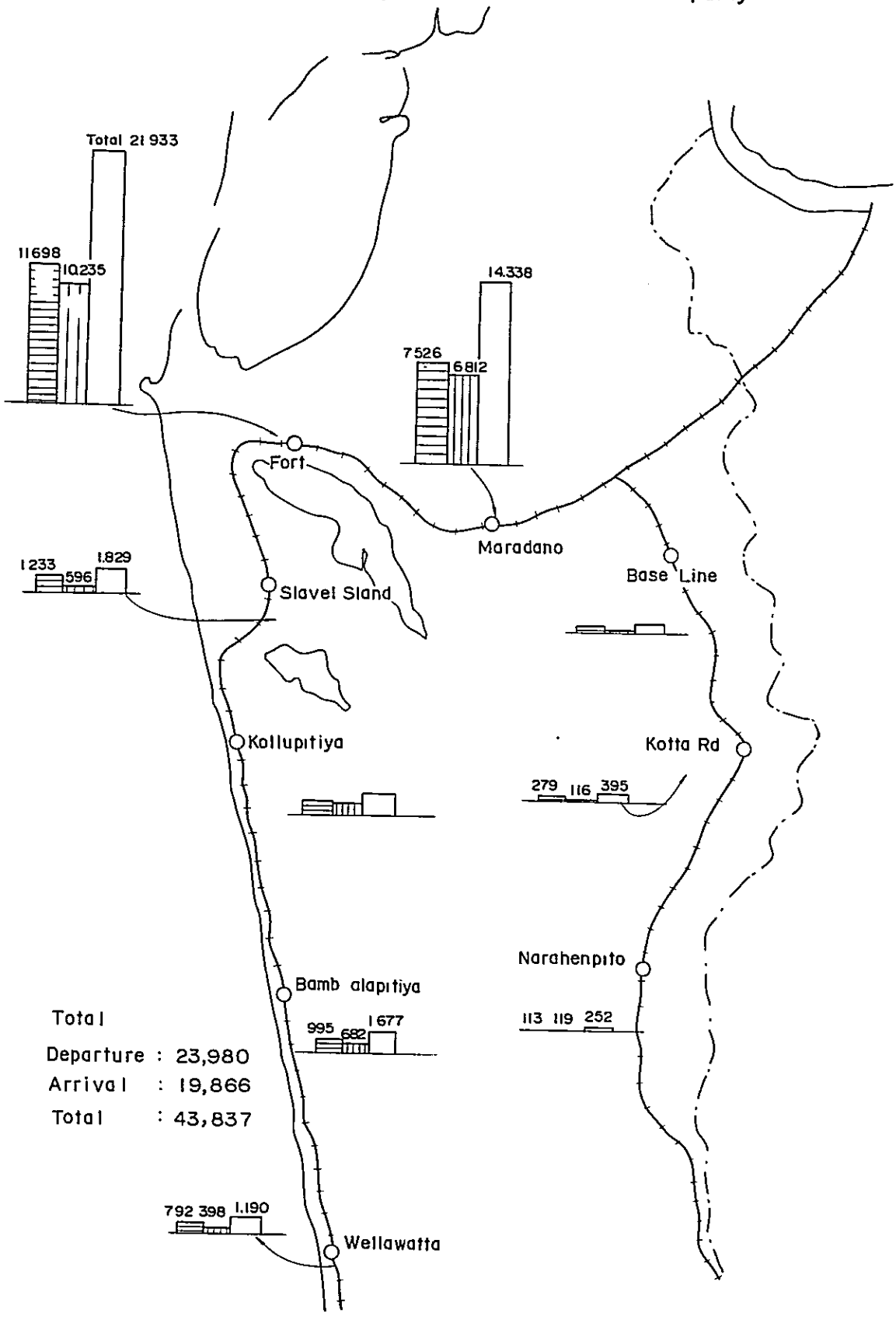
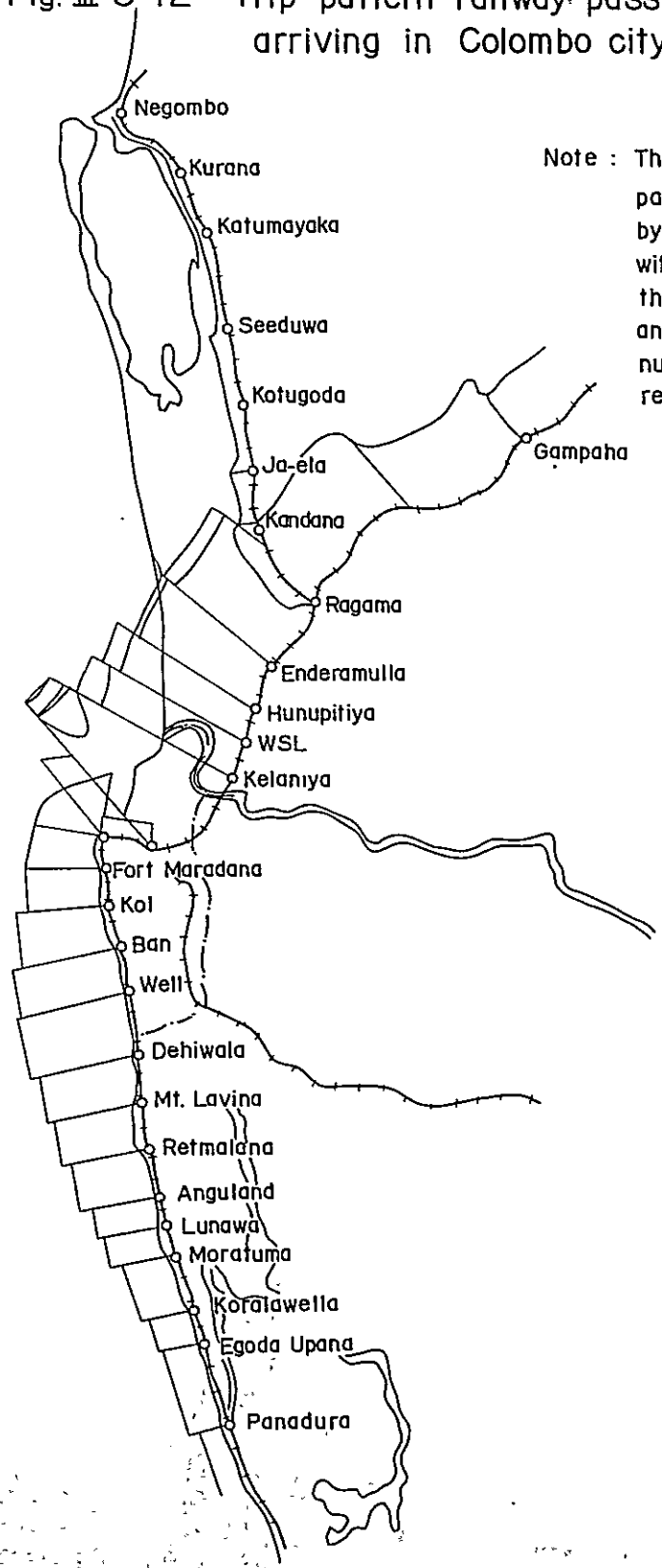


Fig. Ⅲ-3-12 Trip pattern railway passengers arriving in Colombo city



Note : This chart shows only the trip pattern of passengers arriving by railways at stations within the city limits during the month of september 1969 and does not represent the total number of passengers of respective lines.

1 mm = 10,000 passengers

As for the movement of railway cargo, no statistics on the total volume of cargo arriving at the freight stations in Colombo City are available. However, through the courtesy of the Ceylon Government Railways the data on the volume of cargo shipped from each station was obtained as shown in Table III-3-23. From this table the average volume of cargo shipped daily from the stations within city limits is estimated at about 2,400 tons, of which 900 tons are considered to be shipped from Colombo Harbour Station and Kolonnawa Station respectively.

Of the total number of motor vehicles crossing the city limits, the number of lorries and vans is estimated at about 11,500 from Table III-3-15. Assuming that each of these lorries transports one ton of cargo on the average, the total volume of cargo transported by lorries in the city amounts to about 5,800 tons. This shows clearly that the volume of cargo transported over the road is 2 to 4 times that of cargo by railways. The months in which the largest shipment is made by the freight stations in Colombo City are September and December and an average of 2,800 tons of cargo is shipped daily in these two months, of which 58% are accounted for by Colombo Harbour Station and Kolonnawa Station.

Table III-3-23 shows the tonnage of railway cargo by item and station. The table shows that agricultural products and mineral products (petroleum, etc) account for about 70% of the total volume. Fort Station handles mainly agricultural products, construction materials and industrial products, Colombo Harbour Station agricultural products and construction materials, Kolonnawa Station mineral products and industrial products and Maradana Station mostly agricultural products.

The stations which have any impact on road traffic for booking cargo will be only Fort Station and Maradana Station. As Colombo Harbour Station receives and ship cargo directly to Colombo Harbour and Colonnawa Station has its own siding, their influence on road traffic is not too great. Judging from the volume of cargo shipped from Fort Station, which is 300 ~ 500 tons/day and that from Maradana Station, 100 ~ 250 tons/day, the traffic of lorries generating at Fort Station for both shipment and arrivals of cargo is estimated at less than 1,000 daily on the average and that for Maradana Station is estimated at less than 500 daily.

Table III-3-23 Volume of Cargo Shipped by Railways in Colombo by Station and Item (ton)

1967/68

Item \ Station	Fort	Colombo Harbour	Kolonna (includes side track)	Maradana	Total
Agricultural products	40,277	230,478	-	60,113	330,868
Forest products	69	-	-	-	69
Mineral products	1,105	-	258,476	-	259,581
Construction materials	32,288	63,200	1,021	595	97,104
Industrial products	32,778	23,064	55,711	2,506	114,059
Livestock products	5,576	21,600	852	197	28,225
Others	7,951	4,949	24,850	597	38,347
Total	120,044	343,291	340,910	64,008	868,253
Highest monthly shipment	14,457	43,876	26,648	8,071	84,445
Month of highest shipment	9	12	7	1	12

Table III-3-24 Volume of Cargo Shipped by Railways in Colombo by Month (ton)

1967/68

Month \ Station	Fort	Colombo Harbour	Kolonnawa (includes side track)	Maradana	Total
October	9,183	26,444	30,619	5,027	71,273
November	8,809	25,094	31,307	4,725	69,935
December	7,407	43,876	27,088	6,074	84,445
January	10,037	27,058	27,853	8,071	73,019
February	9,683	25,022	25,306	3,682	63,693
March	10,179	34,548	26,305	4,710	75,742
April	8,598	28,954	26,288	5,427	69,257
May	9,034	24,564	27,815	5,250	66,663
June	9,753	20,788	28,426	5,190	64,157
July	11,068	26,475	31,972	5,963	75,478
August	11,836	25,557	29,098	4,491	70,982
September	14,457	34,911	28,843	5,398	83,609
Total	120,044	343,291	340,910	64,008	868,253

(2) Ports and harbours and others

a) Ports and harbours

Annual transition in the volume of cargo excluding petroleum products handled in Port of Colombo, where a total of 5, 750 vessels enter annually or 15 vessels daily, are shown in Table III-3-25. It is noted from the table that the rate of increase in the volume of cargo is extremely low. Besides, exports and imports of petroleum products amount to about one million to one and half million tons, making the total volume of exports and imports to about 5 million tons/year. Of this, more than 80% are imports. After deducting the tonnage of petroleum products and the volume of cargo transported by railway from Colombo Harbour Station amounting to about 340, 000 tons/year, the remaining 2. 1 million tons/year (Approximately 6, 000 tons/day) are the volume of truck cargo generated at the port. This tonnage is almost equivalent to that of cargo shipped out of Colombo City limits previously mentioned. The Port of Colombo is in a very favourable position geographically with 75% of the total population of Ceylon living in the area within a radius of 80 miles from the port. Until November 1965 a 20% special surcharge rate had been applied to all port cargo handled in the Port of Colombo. However, through year's of continuous efforts of the Port Cargo Commission this special surcharge rate was discontinued except the 10% surcharge fare of Japanese shipping companies. Abolition of this system is considered to have helped a saving of 40 million Rp in foreign currency annually.

For the improvement of the Port of Colombo, the following projects are now under way.

i) Removal of fence barriers at the Queen Elizabeth Quay and extension of transit cargo storage yard --- Extension of the quay by 1, 000 ft is now under way. A study is being made on the use of the quay as a container quay in the future.

ii) Construction of multi-story warehouses at Fort --- Not implemented yet. A study is being made as foreign currencies are required for the purchase of machinery and equipment.

iii) Construction of a berth to accommodate 60, 000 ton-class tankers by loans from the Asian Bank--Dredging of navigation channel and purchase of tug boats are under study.

iv) Renewal of cargo handling facilities under way.

v) Extension of coaling jetties and construction of a new barge quay wall.

Extension of barge quay wall at Baghdad and Pethah.

Table III-3-25 Tonnage of Dry Cargo Handled in Port of Colombo 1960/61 ~ 1968/69

Year Aug. 1 ~ July 30	Total Imports	Total Exports	Total Imports & Exports Tonnage	Increase rate %
1960/61	2,105,346	543,412	2,648,758	100
1961/62	2,039,480	481,691	2,521,171	95
1962/63	2,070,769	486,580	2,557,349	97
1963/64	2,044,302	522,341	2,566,643	97
1964/65	2,168,099	680,708	2,848,807	108
1965/66	2,279,134	678,245	2,957,379	112
1966/67	2,315,029	723,628	3,038,657	115
1967/68	2,131,291	733,608	2,864,899	108
1968/69	2,471,498	807,179	3,278,677	124

Source: Port (Cargo) Corporation

b) Airport

The airports related with Colombo City are Katunayake International Airport located 19 miles north of the Port of Colombo and Colombo International Airport at Ratmalana 8 miles south of the Port of Colombo. The number of passengers handled by Katunayake Airport in 1968 was about 53,000 or 150 daily on the average. Assuming that 1/3 of regional services of Air Ceylon and 2/3 of domestic airlines used Ratmalana Airport in 1968, the number of passengers handled by this airport is estimated at about 37,000 or 100 daily on the average. Accordingly, the road traffic generated by the passengers carried by the airlines is very small.

For Katunayake International Airport, a loan amounting to 26 million Rp was extended by the Canadian Government for the improvement and extension of runways, installation of lighting facilities, and construction of apron, turnway and a terminal building. The work on the runways was completed in September 1965 and the terminal building was completed in the beginning of 1968.

The growth of business of Air Ceylon is not so remarkable. To develop tourist industry in the country, direct air routes to Bangkok and Beirut are considered essential. It is said that all the responsibilities for the overseas publicity to attract foreign tourists should be assumed by Air Ceylon like PIA.

3-3-2 Forecast of Future Traffic Volume and Highway Development Plan

1) Forecast of future vehicular traffic

As stated previously, the latent demand for motor vehicles is estimated at about 5,000 judging from the number of persons acquiring drivers'

licenses in recent years. However, in view of the present economic condition of the country, the prospect for early solution of shortage in foreign currency is dim and therefore, the restriction on the imports of foreign motor vehicles is expected to last for some time. In this connection, the future number of registered motor vehicles forecast by Wilbur Smith & Associates in 1967 is considered appropriate. The said forecast is shown in Table III-3-26.

Table III-3-26 Estimated Number of Motor Vehicles & Relation Vehicle-Miles of Travel in 1972, 1977 & 1987 [1)]

Vehicle type	No. of Motor Vehicles			
	1967	1972	1977	1987
Passenger cars	83,743	84,000	84,000	84,000
Buses	8,946	11,000	12,500	18,000
Lorries	29,980	35,000	40,500	55,000
Total	122,669	130,000	137,000	157,000
No. of Motor Vehicles Index	100	105	100	130
Vehicle-Miles of Travel Index	100	110	120	150

According to the forecast shown in Table III-3-26, the number of motor vehicles in Ceylon in 1987 is expected to increase to about 160,000, 1.3 times the number in 1967 (increase rate per annum; 1.3%). As the increase rate of motor vehicles in greater Colombo Region is considered to account for 2% per annum, 50% over the average increase rate for the whole country, the number of motor vehicles in greater Colombo Region in 1980 will be: 34,500 (from Table III-3-12) x $(1 + 0.02)^{12}$ x $(1 + 0.0^{1})$ ≒ 65,000 (1.5 is the adjustment coefficient for more concentration of population and economic activities in Colombo City in 1980), accounting for about 45% of the number for the country.

Judging from the increase rate in the number of bus passengers entering Colombo City in 1961 and 1970 as shown in Table III-3-20, the number of bus passengers entering Colombo City in 1980 is estimated at 600,000/day, about 2.5 times the number in 1970 and the number of passengers during the morning peak hour is estimated at 100,000, if increased with the same annual rate. Consequently, the number of bus trips required to transport the above-mentioned passengers is estimated at about 15,000 trips/day and the number of bus trips required during the morning peak hours is estimated at about 2,200 even at the level of services in 1970. As there were 2,900 buses in Colombo region in 1970, the number of buses required in 1980, in proportion to the number of bus passengers entering the city, is estimated at about 8,400.

The percentage of buses in the total number of motor vehicles in Colombo Region in 1970 was $\frac{2,900}{34,500}$ = 8.4% and that in 1980 is expected to be

$\frac{8,400}{65,000}$ = 13%. According to Table III-3-16, the ratio of bus to passenger car and truck in the volume of transportation per vehicle in 1961 was 16:1. However, as the transport efficiency has increased twofold according to Table III-3-20 $(\frac{237.835}{5,216} \div (\frac{84,000}{3,600}) \fallingdotseq 2.0$ in 1970, the ratio of bus to other types of vehicle in the volume of transport is 32:1. Therefore, the percentage of passengers transported by bus in 1970, calculated on the basis of the above-mentioned percentage of bus and the increased efficiency, is 75% and that in 1980 will be 83%. From this the number of bus passengers crossing the Colombo City Limits in 1970 is estimated at 630,000 per day. In 1980 the number is expected to increase to 600,000 x2/0.83 = 1,450,000. Assuming that the bus riding efficiency is the same as that in 1970 and that the composition of vehicle types is almost the same as that shown in Table III-3-16, the number of motor vehicles crossing the Colombo City Limits in 1980 is estimated as shown in Table III-3-27. In this case, however, the percentage of bicycles is considered to decrease in the ratio equivalent to the increase in the number of buses.

Table III-3-27 Estimated Vehicular Traffic at Colombo City Limits in 1970 and 1980

Time	Vehicle type	Traffic (Vehicles)			
		1980		1970	
		Number	%	Number	%
24 hrs.	Pass. cars	90,000	45	54,000	43
	Heavy lorries	14,000	7	8,800	7
	Light lorries	6,000	3	3,700	3
	Motor cycles	8,000	4	5,000	4
	Sub-total	118,000	59	71,500	57
	Bicycles	56,000	28	43,000	34.6
	Buses	26,000	13	10,500	8.4
	Total	200,000	100.0	125,000	100.0
Entering Colombo in Morning Peak Hour	Motor vehicles	11,900	55	6,950	50
	Bicycles	8,200	38.1	6,325	45.5
	Buses	1,500	6.9	625	4.5
	Total	21,600	100.0	13,900	100.0

Table III-3-28 shows the distribution of all vehicular traffics in 1980 shown in Table III-3-27 to 8 major points on the city limits in proportion to the number of bus passengers in 1970 shown in Table III-3-20 and the number of bus passengers in the morning peak hour shown in Fig. III-3-9. This will serve as the basic data for the trunk road construction project for Colombo City for which target has been set for 1980.

Table III-3-28 Estimated Traffic Volume at Colombo Municipal Limits in 1980

Route No.	Location	Daily Traffic		Morning Peak Traffic		Remarks
A-3	Victoria Bridge	24,700		2,600		Top: Motor vehicles
		1,450	18.1	210	14.2	Middle: Motor cycles
		10,200		1,800		Bottom: Bicycles
A-1	New Kolani	10,200		1,100		Includes Wellanpitiya
		600	7.5	90	5.9	
		4,200		700		
	Kolonnawa Road	14,700		2,000		
		860	10.8	160	10.9	
		6,100		1,300		
B-2	Cotta Road	19,300		3,400		
		1,140	14.2	270	18.1	
		7,900		2,200		
	Narahenpita Road	1,900		350		
		110	1.4	30	2.0	
		800		250		
A-4	Kirillapone Bridge	2,100		3,200		
		1,240	15.5	260	17.1	
		8,700		2,100		
	Pannankada Bridge	9,900		1,500		
		580	7.3	120	8.0	
		4,100		1,000		
A-2	Dehiwela Bridge	31,500		4,100		
		1,860	23.2	330	21.8	
		12,900		2,700		
	Urugoelawata Road	2,700		350		
		160	2.0	30	2.0	
		1,100		250		
	Total	136,000		18,600		
		8,000	100.0	1,500	100.0	
		56,000		12,300		

In Table III-3-28 shown above, the traffic volume in the morning peak hour was set at the value 1.3 times the value shown in Table III-3-27. This was based on the results of the past surveys.

2) Highway development plan

(1) Macroscopical analysis

As stated previously, the number of registered motor vehicles excluding motorcycles in Colombo Region in 1980 is estimated at 65,000. Assuming that all of these vehicles travel in Colombo Region every day, the total daily operating miles may be calculated as follows.

As shown in Table III-3-18, the trip length of vehicles other than bus is 4.5 miles. As the average daily operating miles of a bus, according to the Annual Report 1966/67 of Ceylon Transport Board, is 157 miles and the operating rate is 84%, the average daily operating miles of a bus is 157 x 0.84 = 132 miles. Assuming that the average number of trips of a truck and a passenger car per day is 8 (about 6 in city area of Tokyo), the total daily operating miles will be as follows.

8,400 x 132 + 56,600 x 4.5 x 8 = 3,146,000 vehicle - miles

Assuming that the capacity of a 2-lane road is 16,000 vehicles/day, the required length of 2-lane road will be 3,146/16 ≒ 200 miles. As the total length of 4-lane roads in Colombo Region is estimated at only about 25 miles and that of the 2-lane roads in Colombo City and suburban areas is estimated at 100 miles at the most, the shortage of 2-lane roads is roughly estimated at 40 ~ 50 miles. As the construction of road in city area is expected to require an average of 3 million Rps per mile, the total cost of the project is estimated at 150 million Rps. By comparing the traffic volume with the capacity of road for each destination of the daily traffic volume shown in Table III-3-28, a study was made on the requirement for improvements and construction of additional roads. As the traffic volume in 1980 is estimated at about 1.6 times the volume in 1970 in total from Table III-3-27, the highway development project required will be as follows:

a) Construction of a new road starting from the New Kelani Bridge, running through marshes in Maligawata and along the present St. Sebastian Canal and connecting to Mavata St.

b) Construction of a new road starting from Kokonnawa Road (Albion Road), crossing Base Line Road at a right angle, running to west and crossing over the railway tracks, passing through marshes in Maligawata and reaching the south side of Law Court (Some parts of the route are existing).

c) Widening and improvements of the road starting from Cotta Road, running through Ward Place St., passing through Union Place St. south of Beira Lake and reaching Fort.

d) Construction of a new road connecting the Kirillapone Bridge and Fort in a bee-line.

e) Construction of a new marine driveway running north along the coast and connecting to Fort.

f) Formation of a ring road (No. 1 ring road) by extending Skinners Road Amour St. to south west.

g) Construction of No. 2 ring road which originates in Weragoda at the north end of Base Line Road, runs through Mifotamulla, Welikada, Nugegoda, and south of the zoo and connects to Galle Road.

h) Widening and improvements of Galle Road, Marine Drive, Church St. Reclamation Rd and Kochikada Rd to provide a by-pass to avoid

the passage through city center and residential districts of goods transported from the Port of Colombo to the outlying areas and construction of a new road connecting Alutmawatta Rd., the street along the port, with the crossing point of Prince of Wales Ave. and the road leading to the New Kelani Bridge.

All of the above-mentioned roads should be provided as 4~6 lane roads.

(2) Analysis from the standpoint of cross sectional traffic volume

The estimated traffic volume on each road at Colombo City Limits in 1980 is shown in Table III-3-28. The width of road required is to be determined on the basis of traffic volume in the morning peak hour shown in the table. Conditions for the determination of the road width are:

a) Efficient traffic control by such measures as the prohibition of left turns and passage of oxcarts in the morning peak hour, prohibition of jay-walking and installation of appropriate traffic lights and signs, and the designation of specific lane for bicycles when their number is large. Therefore, the capacity of one lane is to be 600 vehicles/hr.

b) Where the vehicular traffic exceeds 600 units/hr, a special lane of 4 ft in width is to be provided for specific use by bicycles. On the routes where bus traffic in one direction exceeds 100 units/day, the bus bay is to be provided.

c) On the roads of 6 lanes or more, a median of 3 ft or more in width should be provided. On the streets a sidewalk of 5 ft or more in width must always be provided and plantation of trees on the side of street must be considered. However, no consideration is to be given to the space for on-street parking.

On the above-mentioned conditions, the number of lanes and the total width of a road at various locations may be determined as shown in Table III-3-29 below. The total width of each road shown in the table is the minimum requirement and therefore it is needless to say that the width greater than this is desirable. As these streets also collect and distribute local traffics, it is desirable to maintain the width shown all the way to Fort or Pettah.

Table III-3-29 Required Width of Roads to be Improved by 1980

Location	Lane Required		Width required for bicycles (ft)	Median Width (ft)	Sidewalk (ft)		Grand Total (ft)	
	No. of Lanes	Total width (ft)						
Victoria Bridge	6	72	8	3	10	20	95	105
New Kelani Bridge	2	24	8	-	10	20	45	55
Kolonnawa Road	4	48	8	-	10	20	70	80
Cotta Road	6	72	12	3	10	20	100	110
Narahenpita Road	2	24	-	-	10		35	
Kirillapone Bridge	6	72	12	3	10	20	100	110
Pamankada Bridge	4	48	8	-	10	20	70	80
Dehiwela Bridge	8	96	12	3	20	30	135	145

The route originating at the Victoria Bridge and reaching the city center is to be a 4-lane road and instead of widening Barbar St., the route starting from the New Kelani Bridge and reaching the city center is to be made a 4-lane road and construction of a new road which branches off from Base Line Road, runs along St. Sebastian Canal and reaches Mavata Road is desirable. This route is considered to become an important route which will be needed in the future in relation with reclamation of marshes in this district. For the approach to Kolonnawa Road, construction of almost a new road will be required even though the existing road may be widered in part. As for Cotta Road, widening of the entire length will be necessary. For Narahenpitiya Road, construction of a new road which connects directly to Torrington Place St. will be necessary. As for the proposed new straight road development from Fort to the Kirillapone Bridge, the entire length should be a 6-lane road. The road, which is to be widened, extending from the Pamankada Bridge and running along the Dehiwela Canal should be linked directly with a 6-lane road extending from the Kirillapone Bridge. At the same time, construction of a new roads that runs along the Dehiwela Canal and also connects to Marine Drive and Galle Road should be planned to help disperse vehicular traffic. For the improvement of Galle Road extending from the Dehiwela Bridge to Fort, a new expressway is to be constructed along the west coast (Referred to as Marine Driveway).

(3) Highway development plan

a) Highway development plan

As for the highway development plan for Colombo Metropolitan Area, a definite plan was worked out as early as 1955 by the Sub-Committee on Road-Colombo Region established under the Central Planning Commission and headed by the Director of P.W.D. Until today, improvements of roads have been carried out following the guideline set forth in this plan but only part of the plan has been implemented due to limited funds available. There is no need to alter this plan even under the present circumstances and the only question remained unsolved is how fast the plan can be implemented. However, there may be room for reconsideration on the priority order of construction. In other words, situation has changed more or less by the development of Dehiwela - Mt. Lavinia Districts in south and Cotta District into suburban residential districts and by large land formation projects planned by the Colombo District Reclamation & Development Board.

Though the improvements and developments of roads are important, maintenance and repair of roads are equally important as pointed out by the Wilbur Smith Report. For the effective enlargement of traffic capacity, maintenance and repair of the existing roads are more efficient and construction of a new road should be planned only after the existing roads have been given adequate maintenance and repair. It may be said that the maintenance and repair of the existing roads are almost ignored in Colombo City.

As pointed out by Mr. V. Ranasinghe, Superintending Engineer of Colombo Municipal Government, the present traffic problems stem from the concentration of commercial activities and government

offices in one specific location. Relocation and redistribution of government offices through redevelopment of Fort and Pettah Districts is strongly urged.

A highway development plan recommended upon summarization of various studies made so far is shown in Fig. III-3-13. The total length of road recommended for widening or construction by 1980 is approximately 40 ~ 50 miles. Some of the planned roads have already been completed and put in use. The total investment required for this project is estimated at about 150 million Rps. If the implementation of the project is carried over a period of 10 years, the average annual investment required will amount to 15 million Rps., which is equivalent ot 3 times the amount of investment in the present road project undertaken by Colombo Municipal Government. Therefore, the procurement of required funds will be the question which may decide the success or failure of the highway development plan.

b) Development plan of parking facilities

In connection with the question of parking facilities, it is evident that on-street parking in Fort and Pettah Districts during daytime should be prohibited totally except the roadside where parking meters are provided, in view of the traffic congestion in these districts. However, for the effective and smooth discharge of the functions of CBD, it is essential to provide off-street parking facilities in convenient locations to substitute on-street parking.

According to the survey made in 1955, the daily vehicular traffic entering Fort District in weekdays was 35,000 and the number of vehicles parked in Fort District in the peak hour (10 ~ 11 am) was approximately 3,600. Of this, about 1,600 vehicles were found parked on street and about 900 of them were parked for a prolonged time. As the number of motor vehicles in the country at present is estimated at 1.8 times the number in 1955 and if assumption is made that the daily traffic entering Fort District is increasing at that rate, the number of motor vehicles entering the district today is estimated at about 63,000 and the demand for parking facilities at the peak hour is estimated at 6,500 at the maximum. Assuming that 500 vehicles use on-street parking facilities equipped with parking meters (within one hour and daytime only) and about 3,000 vehicles park in the private parking lots, estimated from 2,000 vehicles parked in 1955, off-street parking facilities to be considered are only for the remaining 3,000 vehicles. Assuming that the number of long parked cars increases at the same rate of 1.8 times, the number of vehicles actually requiring parking facilities is about 1,600. It is necessary therefore, to secure about 22 acres of land at Gordon Gardens, Erchelon Square and Chalmers Granaries, all of which were recommended by the previously mentioned Sub-Committee on Road-Colombo Region, to provide off-street parking facilities for 3,000 vehicles after relocating the existing facilities in the districts.

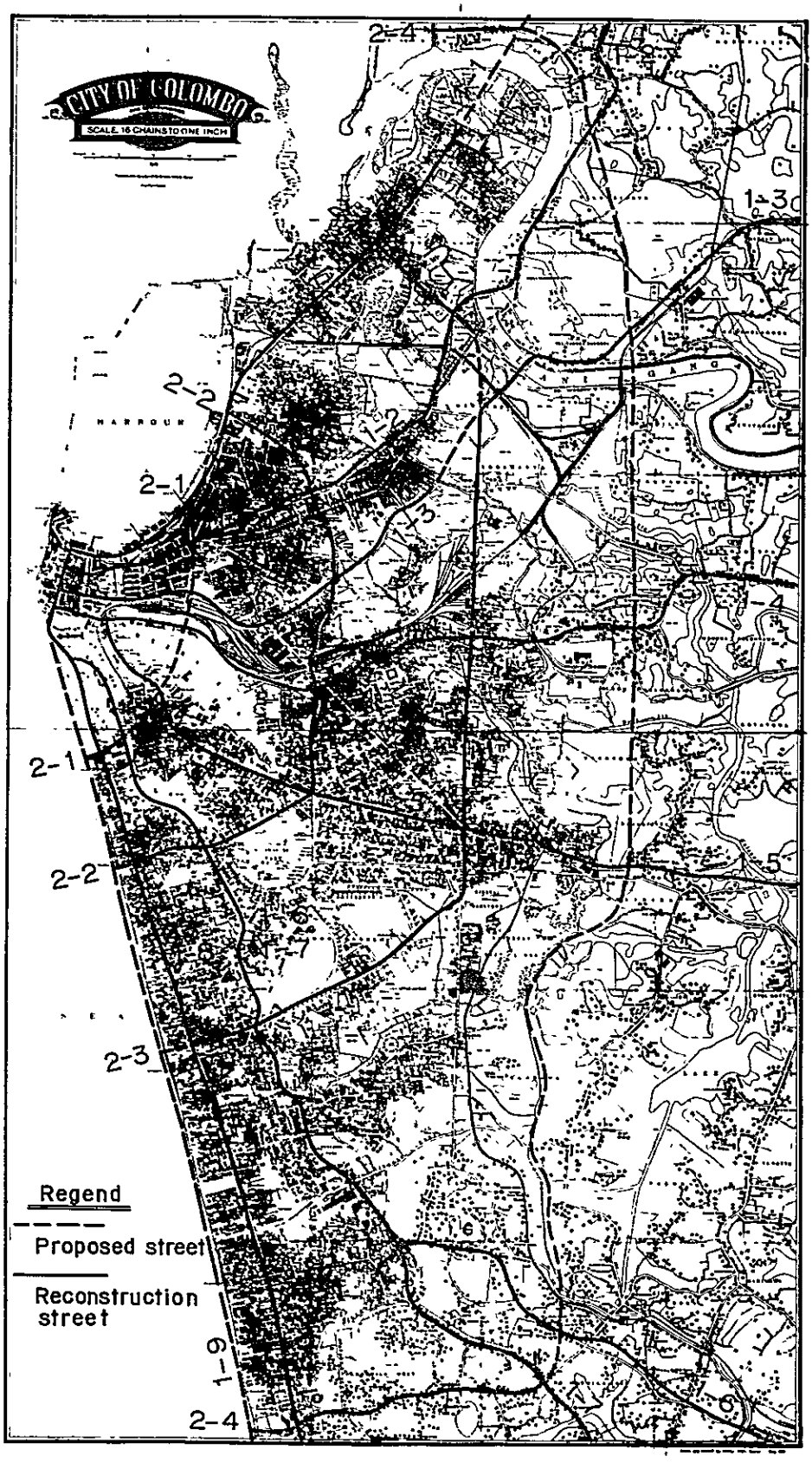
For the district of Pettah where streets are narrow, on-street

Table III-3-30 Street Construction and Improvement Plan

(By 1990)

Symbol	Designation	Major Cities to be linked	Remarks
1-1	No. 1 Radial Road	Negambo	Mainly improvements of the existing road and construction of new roads is only in part.
1-2	No. 2 Radial Road	Negambo	Improvements of the existing road only.
1-3	No. 3 Radial Road	Kandy, Kurunegala	Mainly improvements of the existing road and construction of new roads is only in part.
1-4	No. 4 Radial Road	Kolonnawa, Arissawella	Improvements of the existing road only.
1-5	No. 5 Radial Road	Kotte, Ratnapura	Improvements of the existing road only.
1-6	No. 6 Radial Road	Ratnapura	Improvements of the existing road only.
1-7	No. 7 Radial Road	Ratnapura	Improvements of the existing road only.
1-8	No. 8 Radial Road°	Mt. Lavinia, Galle	Improvements of the existing road only.
1-9	No. 9 Radial Road	Mt. Lavinia, Galle	New seaside road.
2-1	No. 1 Ring Road	-	To be constructed newly for enhancement of functions of CBD.
2-2	No. 2 Ring Road	-	Has a function to separate CBD of Colombo City from surrounding residential quarters.
2-3	No. 3 Ring Road	-	A ring road within residential quarters.
2-4	No. 4 Ring Road	-	A ring road (to be constructed newly) encircling around Colombo City Limits.

Fig.Ⅲ-3-13 Street authorization map (1990)



parking is not conceivable and the problem of parking lot can not be solved unless spaces are secured at Chalmers Granaries, Colombo Kachcheri and Old Dutch Cemetery as recommended by the Sub-Committee. Other points to be taken into consideration in relation to parking problems in the districts of Fort and Pettah are as follows:

i) The convenient part of off-street parking facilities is to be reserved for short time parking and different rate is to be applied according to the degree of convenience. The parking rate for the short time parking is to be only nominal and is to be raised in the future with the increase in the intensity of parking problem. The rate of parking meter is to be set at fairly high level to secure parking space for vehicles of high urgency.

ii) Traffic of ox-carts and pushcarts is to be prohibited during busy hours in the day. On-street parking at the road side except the road equipped with parking meters is to be prohibited totally during the daytime. However, stopping of motor vehicles on the street side for loading and unloading of passengers and cargo is to be permitted. For this purpose, legislation of required measures is to be made.

iii) Legislation is to be made to obligate the buildings with a floor space having more than certain area constructed in these districts in the future to provide a parking space in proportion to their floor space and at the same time, legislation is to be made to prohibit the ownership of a car in these districts unless a parking space is secured within the land owned by the driver.

iv) As the construction of high story parking buildings and underground parking lots requires a large amount of investment and is not only uneconomical but also unpopular because of high rate. As these facilities have proved to be a failure in every country of the world, the Colombo Municipality that has a shortage of fund should not adopt such a plan. Instead, the parking problem should be solved by user's burden through means mentioned in the previous paragraph iii). This was pointed out by Mr. D. W.E. Meegama, a Municipal Engineer of Colombo Municipal Office in Annexure of the previously mentioned Sub-Committee.

v) In order to secure required land space for parking facilities in CBD, relocation of government offices, markets, factories and cemetery in the Pettah and Fort Districts should be accelerated and at the same time, the use of bus should be encouraged through improvement of the bus terminal in front of Fort Railway Station and reorganization of bus route network.

c) Implementation of the plan and traffic control

For the realization of the highway development plan, a 3 year program, which has a good prospect for acquiring required funds, should be drafted and implemented. The highway development plan of the past were not realistic and were not accompanied by concrete method for implementation. Therefore very few of them were actually

carried into practice as Mr. V. Ranasinghe pointed out.

i) As the widening of roads in the city area, particularly in the District of Pettah, not only requires a large amount of investment but is extremely difficult in securing required land space, it is essential to provide necessary land space and cut down cost of construction through adoption of the redevelopment method including both buildings and land (multi-story housing system combined with stores). For this purpose, necessary steps should be taken to legislate required laws and regulations and to arrange special loans.

ii) In order to secure necessary land space for parking facilities and ensure purification and promotion of city functions, it is essential that such facilities as the government offices, Chalmers Granaries, markets and cemetery, which are not necessarily be located in the city center, be relocated to their appropriate places or consolidated so that required public space may be secured for roads and parks. In this connection, the civic center plan proposed by Mr. Damiencki (UN Town Planning Expert, Colombo Municipal Council) is noteworthy.

iii) As the rotaries found in the busiest streets in the major cities of the world are causing a bottleneck in traffic control, occupying a large space and showing inefficiency in handling traffic and moreover, are the spot of most frequent traffic accidents, construction of a new rotary should not be attempted and the existing ones should be altered to the channelization crossing or to the signal type intersection.

iv) As pointed out by Mr. U. Ranasinghe, efforts should be made for the readjustment and consolidation of bus stops, studies and implementation of one-way traffic, improvement of bus terminals, particularly the improvement of entrance and exit for efficient operation of buses, reorganization of bus route network to sim simplify and shorten bus routes to adapt and correspond with the present traffic volume.

v) Jay-walking in the city area must be prohibited and at the same time, guard rails, fences and concrete posts should be provided for the road in city area to prevent jay-walking physically. Use of palm trees for this purpose will contribute to the saving of cost and the painting of such facilities will avoid the injury to amenity of the city.

vi) As pointed out by the Wilbur Smith Report and the survey team of the World Bank, it is essential to provide required funds for the maintenance and repair of the existing roads and to carry out reorganization for the maintenance and repair management system.

CHAPTER 4. MODEL PATTERN OF HOUSING DEVELOPMENT (NAWALA HEEN ELA)

4-1 General

4-1-1 Outline of District

The planning district is situated at the point about 4 miles southeast of the center of Colombo Municipality and is a narrow strip stretching from north to south. The administrative boundary between Colombo Municipality and Kotte U.C. is provided by a river flowing from north to south almost in the center of the district.

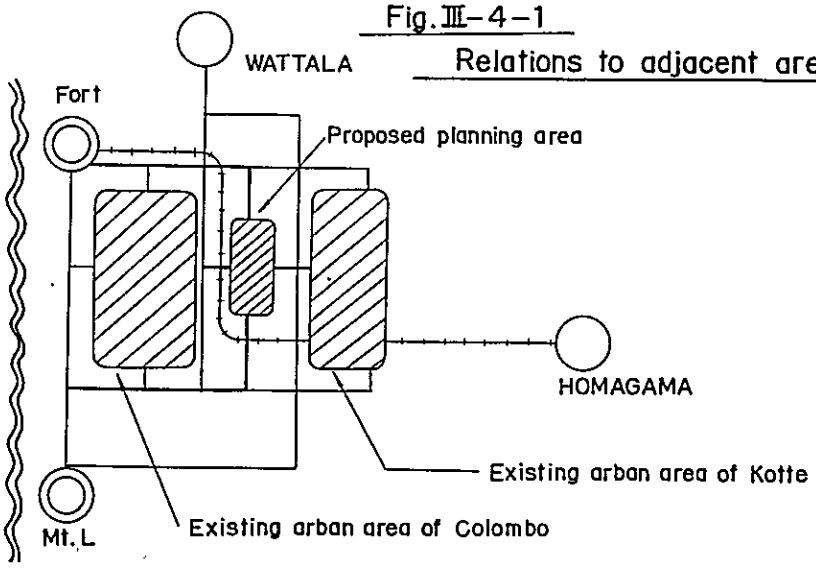
As for the topography of the district, the marshy area along the river flowing from north to south in the center of the district is 2 feet above sea-level and subject to inundation at time of a flood. The present land use is classified as a grass land. On both sides of this marshy land there are hills 2 ~50 feet above sea-level.

These hilly areas are dotted with hamlets where buildings are standing at a considerably high density even to the points with no access roads. The majority of these buildings are dwellings but school buildings and stores are also seen sporadically.

4-1-2 Relations to Adjacent Districts

The planning area is flanked by the existing urban area of Colombo and Kotte U.C. and has close relations with the centers of the cities through railways and roads.

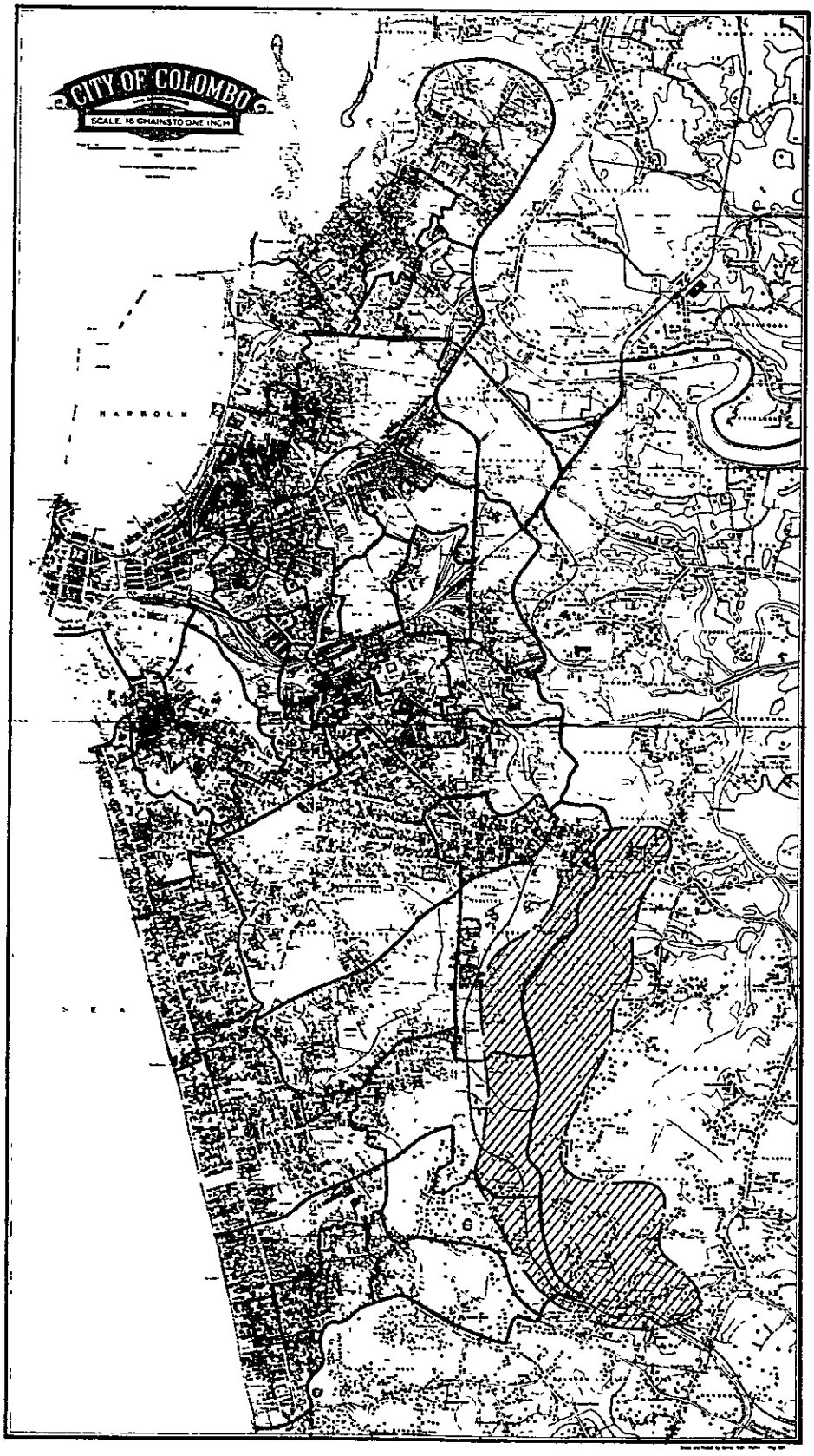
Fig.Ⅲ-4-1
Relations to adjacent area



4-1-3 Total Acreage of Planning Area

The total acreage of the planning area including the low land along the river and the hilly land on both sides of the low land is 1,000 acres. Of this, 350 acres or 35% is low land area.

Fig.Ⅲ-4-2 Geographical location of proposed planning area



Total acreage of planning area:	1,000 acres
Low land area:	350 "
Hilly land:	650 "
Number of building in planning area:	About 1,100

4-2 Pilot Plan

4-2-1 Characteristics of New Development Area

As previously mentioned, the planning area is within a radius of 4 miles from CBD of Colombo Municipality and can be reached in 30 minutes by bus from the CBD. As the topography of the area is featured by plane land and hilly land, an effective land use plan making the best use of the natural topography is desirable.

Though the district is originally a low land and subject to inundation at time of a flood, attention has been focused on this district recently as a prospective housing district in order to meet a growing demand for residential quarter. As the main objectives in developing this district, creation of a residential quarter for commuters travelling to CBD and Mt. Lavinia of Colombo City must be considered first. At the same time, however, efforts should be made to provide public facilities of various types for the residents in the limited district by aiming at establishing an efficient community with good environment, as well as to introduce various facilities for wide inner urban area which may be useful for the promotion of city functions in other districts or the entire Colombo region.

As examples of the facilities for wide inner urban area, administrative facilities, parks, and market facilities may be pointed out. Through introduction of these facilities, the new development area will be able to adapt itself to the existing urban area and promote town making integrated into the existing urban area without causing a friction.

4-2-2 Land Use Plan

In the marshy land in the center of the planning area a river flows from north to south. Consequently, the soils in the low land area are considered to be the accumulation of alluvial. Because of the soft foundation, therefore, construction of multistoried buildings is not advisable. For the marshy land, therefore, a residential quarter comprising ordinary detached houses should be planned.

For the hilly land where the foundation is satisfactory and construction of multistoried buildings is possible, land use making the most of the natural feature of topography should be planned. In the hilly land, however, there is a considerably large number of dwellings already standing. If these existing hamlets are to be maintained as they are, creation of a new urban area with good environment can not be hoped for.

For this reason, development of the district should be planned to include both the low land area and the high land area. As the majority of the existing dwellings in the hilly lands are ordinary detached houses, they should be relocated to the low land area after completion of the development of the low land area.

For this purpose, development of the low land area must be started first and the development of the high land should follow the relocation of the dwellings.

As for the composition of the neighbourhood unit, it is not advisable to draw a unit line between the low land area and the high land area and separate them as a different community. A single community integrating various aspects of topography into a neighbourhood unit should be established. This also essential for balanced land use in planning residential quarter and public facilities.

In this case, careful planning must be made to promote the sense of social solidarity among the residents in the low land area and the high land area as the residents of a single community without friction. While the high land area has been inhabited from old times, the low land area is going to be developed as a new town. In order to create an efficient new town, a comprehensive town development project including the existing hamlets in the high land should be implemented.

In view of the fact that the project area presents such problems as the wide area transport system and inner drainage, the project should aim not only at providing land space to relieve the shortage of housing lots in face of a sharp increase of city population but also securing public facilities which are most needed in the backward region and incorporating in the land use plan for town making various facilities required for the benefit of the people in the adjacent area and for further growth of Colombo City.

1) Composition of neighbourhood unit

Preconditions

(1) The development area is to be 750 acres in area and the future population is to be approximately 40,000.

(2) The size of population of one neighbourhood unit is to be from 8,000 to 12,000.

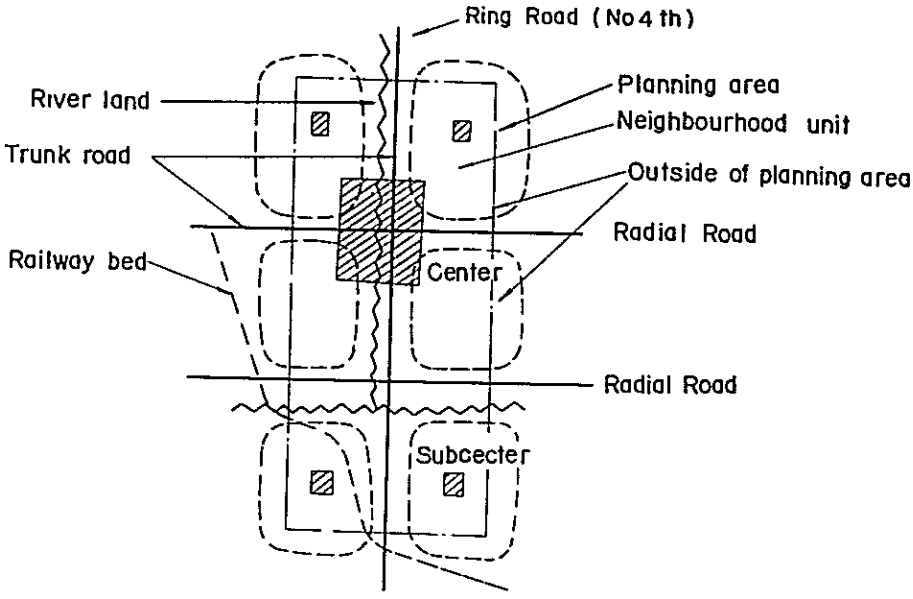
(3) Construction of a trunk road in the neighbourhood unit is to be avoided as much as possible. For this purpose, the composition of neighbourhood unit is to include part of the district not covered by the project.

(4) A neighbourhood center is to be provided in each neighbourhood unit to give the role of the central function in daily life of the residents.

The planning area is rectangular in the shape stretching from north to south with a river and a wide area trunk road running almost at the center from north to south. In planning the composition of neighbourhood unit, therefore, use of these river and trunk road as a separator will make it possible to avoid the inclusion of through traffic in the neighbourhood unit and realize ideal composition of neighbourhood of better environment.

Regarding the area adjacent to the project, the part of the existing urban area and the area which is expected to be developed in the future is to be included in the neighbourhood even when they are located outside the project area, in relation with the trunk road network and the configuration and size of the neighbourhood unit.

Fig. Ⅲ-4-3 Model pattern of neighpourhood units



2) Distribution of detached houses and flats

In order to plan three dimensional land use as a residential town, construction of multistoried buildings of combined use is required in addition to the plane detached houses.

As stated previously, construction of multistoried housings should be planned for the high land where foundation is satisfactory and the assignment of ordinary detached houses to the low land area is considered advisable economically.

On the condition that the total development area is 750 acres and the estimated population is 40,000 and also in consideration of the topography and geology of the project area, the land available for construction of flats is only about 140 acres. Therefore, the distribution of building is to be determined as follows.

Table Ⅲ-4-1 Estimated Number of Buildings and the Forecast of Population

Type of buildings	No. of units	Estimated population	Remarks
Flats	4,500	22,500	5.0 persons/unit
Detached houses	3,000	16,500	5.5 persons/unit
Others (Combination of a dwelling and a store)	200	1,000	5.0 persons/unit

The land space required for the construction of 7,700 units in the project area for the proposed population of 40,000 is estimated as follows.

* Preconditions

(1) The average land space (net) required for each unit of the flats is to be 5 perch (about 125 m^2).

(2) The average land space (net) required for each unit of ordinary detached houses is to be 15 perches (about 375 m^2).

o Total land space required for flats	4,500 units × 5 perches = 22,500 perches 22,500/160 = 140 acres
o Total land space required for ordinary detached houses	3,000 units × 15 perches = 45,000 perches 45,000/160 ≒ 280 acres

From the above calculation it is known that 140 acres of land is required for flats and 280 acres of land for ordinary detached houses, totaling 420 acres for housing construction (net). As the total requirement for housing construction accounts for only 55% of the total project area of 750 acres and the share of public land such as roads, parks and canals is 25 ~ 30% of the total project area, a study should be made on use of the remaining 15 ~ 20% or 110 150 acres in the direction of providing facilities beneficial to the residents of the project area (schools, kindergartens, shopping area) and wide area urban facilities also aimed for the residents of the district other than the project area (shopping center, civic center).

4-2-3 Traffic Planning

In formulating a basic guideline of traffic planning, the points, which are considered to influence the future of this project, are given below.

(1) Mode of trip for commuters and students

- o Commuting routes to CBD of Colombo City
- o Commuting routes to Kotte, Mt. Lavinia
- o Establishment of attendance routes for students

(2) Traffic for Inter-city and inter-planning area

- o Inter-city traffic flow
- o Inter-planning area traffic flow (mainly the linkage of neighbourhood centers)

(3) Through traffic

(1) Mode of trip for commuters and students

For the project area orientated to a residential town as a bed town of CBD of Colombo City, and such outlying cities as,, Kotte and Mt. Lavinia, the determination of the means of commuting transportation for the residents of the project area is a very important question.

As a means of commuting transportation in and around the city, railways and buses are being used mostly but passenger cars are also used though small in share in the total transport volume. As for the passenger car, it is obvious that it will play a vital role as the means of commuting transport in the future corresponding to the growth of national economy. Also with the improvement of road network, door to door transport will be possible and even high speed driving is conceivable. One of the disadvantages of passenger car, however, is that it is not suited for mass transportation.

As the project area has a railway line running around its perimeter and a ring road as a wide area trunk road in Colombo Region running almost in the center of the area from north to south, a means of mass transport to the CBD of Colombo City has been secured and the project area is within the reach of less than 30 minutes from CBD.

Given below are the conceivable commuting routes from the project area.

a) Commuting route to CBD of Colombo City

Though the use of railway is conceivable to commute to Fort at present, the use of buses and privately-owned cars is expected to increase in the future with the completion of ring roads. For the commuters using railways, use of buses will be unavoidable in view of the distance to the nearest railway stations. Also judging from the fact that the project area is within the reach of 30 minutes from the CBD by any means of transport, the bus route which directly connects to the CBD without transfer will become the most important route.

As for the commuting route to the CBD only by means of passenger cars, use of the proposed ring roads and radial roads is conceivable. However, in the event when the parking problems are still unsolved in the CBD, a ride to and from the railway station with wives or "the Kiss and turn" is conceivable.

b) Commuting route to the outlying cities

For long distance commuting, use of mainly the railway is conceivable but for short distance commuting (to Kotte and Mt. Lavinia), an increase in the use of passenger cars is expected following the improvements of road network and the diffusion of passenger cars. As the central districts of these outlying cities are industrial districts or place of employment, it is essential to provide a means of mass transport. In such an event, it will be advisable to rely mainly on bus transport in view of commuting distance. It will be necessary, therefore, to plan a bus route network in and around these outlying cities.

c) Establishment of attendance routes for students

The trunk road within the project area should be provided with a separate roadway and a side walk As for the route to the school within the project area, foot ways for pedestrians is to be provided by linking schools, shopping facilities and residential quarters functionally

(2) Traffic for inter-city and inter-planning area

The traffic generating within the project area has already been discussed in the previous paragraph (1).
A considerably large traffic generating in the outlying cities and only passing through the planning area is also conceivable. As one ring road of Colombo region and two radial roads are scheduled to pass through the planning area in the future, a considerably large traffic volume is expected on the three roads. Moreover, as the three roads are scheduled to cross one another at two points in the planning area, a careful planning must be made in controlling crossings. In such an event, it is advisable to avoid a grade crossing.

4-2-4 Policy for Implementation of Project

Though the main objective of the project is to creat a new town as a residential town to meet growing demands for housings in the major cities, improvements of such public facilities as trunk roads and rivers are also important elements of the project from a broad point of view.

Because of the concentration of these important public facilities in the marshy land of the project area by coincidence, development of the marshy land area will contribute greatly not only to the supply of housing losts but also to the promotion of reorganization of the functional structure of the greater Colombo metropolitan area.

On the other hand, the hilly land surrounding the marshy land area has been urbanized to a considerable extent, the living environments are deteriorating. It is desirable, therefore, that redevelopment of the hilly land area is also taken up simultaneously with the development the marshy land area. In the event of simultaneous development, however, it is considered advisable to start the project with the low land first in view of financial problems accompanying the implementation of a large scale project and the handling of residents in the existing hamlets.

For the development of the hilly land area and for the realization of three dimensional land use, it is essential to redevelop sparsely populated hemlets in the hilly land and the transfer of the residents of the existing hamlets will pose a serious problem. This problem, however, will be readily solved by preceding the development of the marshy land area.

In allocating housing lots, the expense required for providing public facilities should be burdened by the residents of the project area on the principle of beneficiary's burden. However, for wide area public facilities (trunk roads and rivers for example), which benefit not only the residents of the project area but also the residents of the adjacent districts, investment by central government or municipal government is desirable.

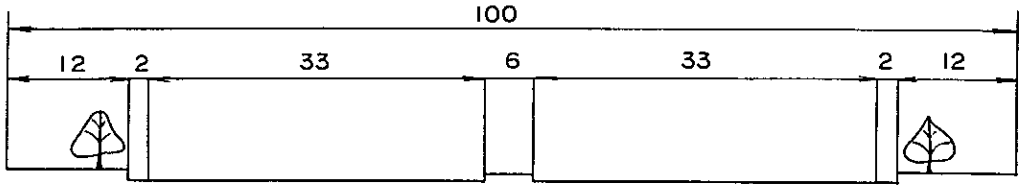
Table III-4-2 Land Use Table (New development area)

Classification	Description	Acreage of develop. area Area (acre)	Ratio (%)	Remarks
I. Public land	Road	123.75	16.5	
	Canal	36.25	4.8	
	Parks	27.50	3.7	
	Sub-total	137.50	25.0	
II. Land for common use	School	27.50	3.7	
	Commercial area	15.00	2.0	
	Government facilities	20.00	2.6	
	Sub-total	62.50	8.3	
III. Housing lot	Land for detached houses	350.00	46.7	
	Land for flats	150.00	20.0	
	Sub-total	500.00	66.7	
Total		750.00	100.0	

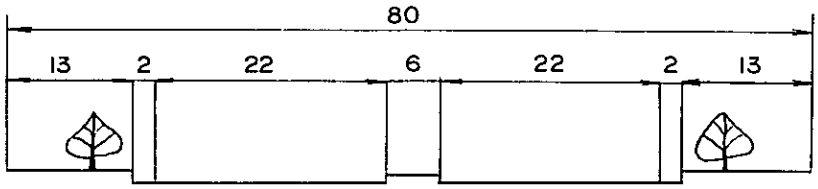
Table III-4-3 Population Distribution by Neighbourhood Unit

Neighbor-hood unit	Multistoried houses		Flats		Detached houses		Total	
	Population	No.	Population	No.	Population	No.	Population	No.
A	-	-	5,500	1,100	3,245	590	8,745	1,690
B	1,000	200	8,500	1,700	2,090	380	11,590	2,280
C	-	-	3,000	600	1,925	350	4,925	950
D	-	-	-	-	3,520	640	3,520	640
E	-	-	5,500	1,100	3,740	680	9,240	1,780
F	-	-	-	-	1,980	360	1,980	360
Total	1,000	200	22,500	4,500	16,500	3,000	40,000	7,200

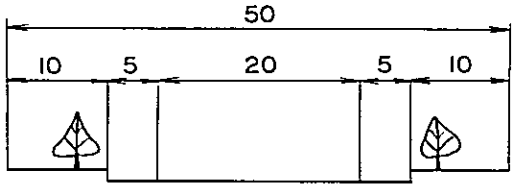
Fig Ⅲ-4-4 Standard section of a street (unit : feet)



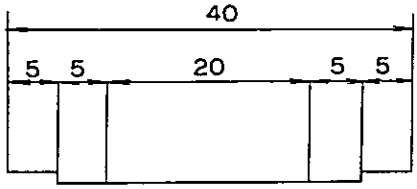
(6 – lane street)



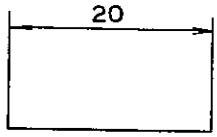
(4– lane street)



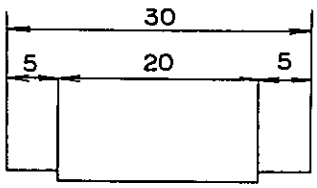
(2–lane street)



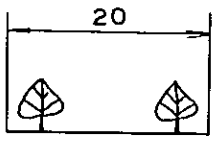
(2-lane street)



(Block street)



(2–lane street)



(foot path)

Fig Ⅲ-4-5 Boundary of planning area

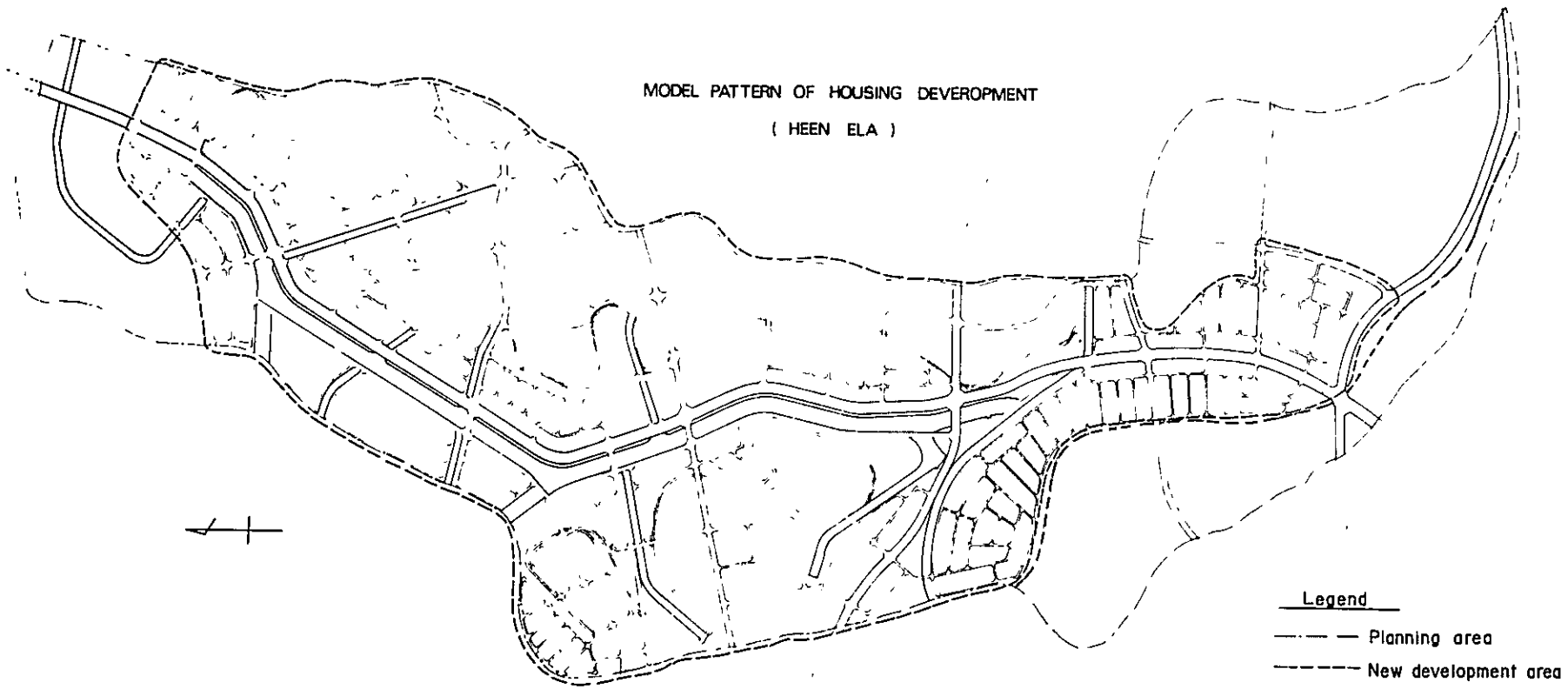


Fig Ⅲ-4-6 Composition of neighbourhood units

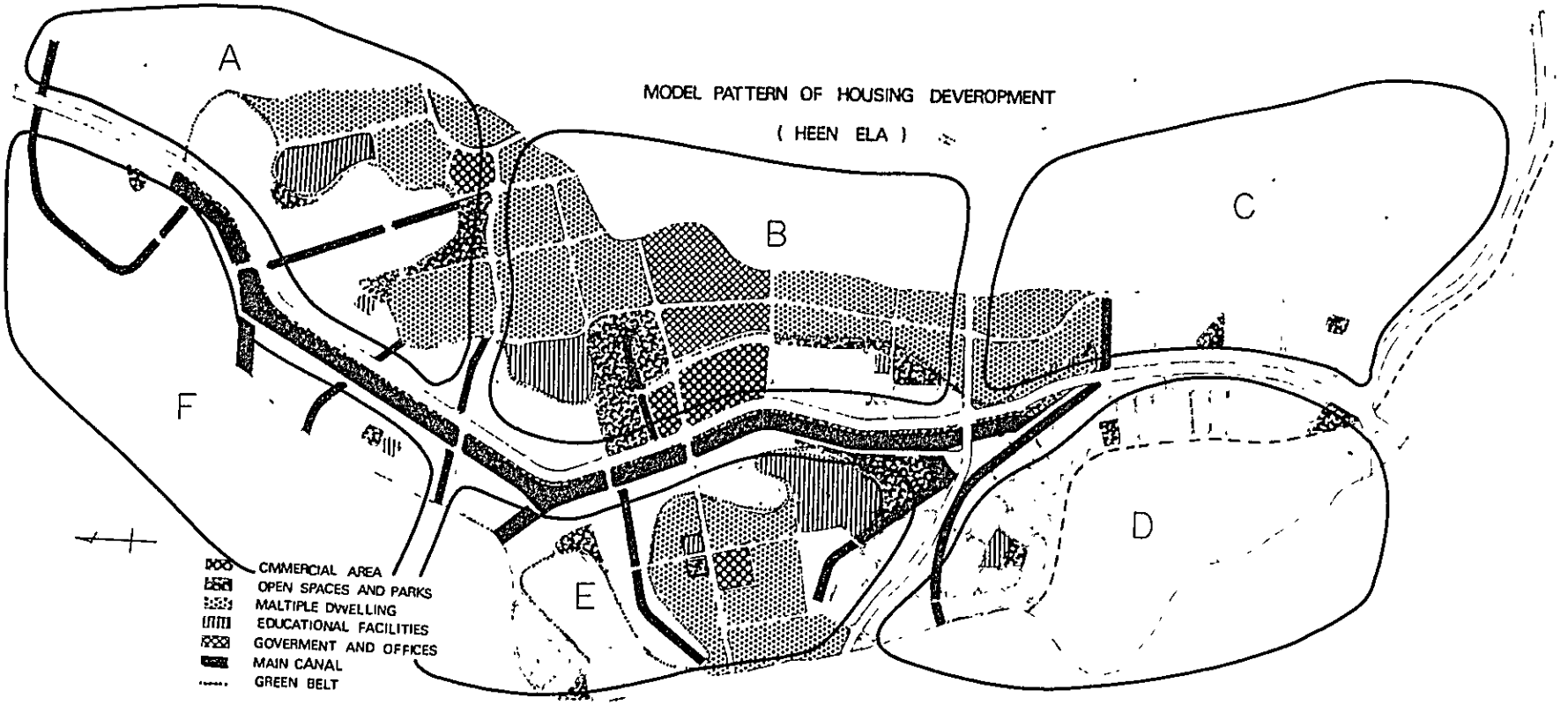


Fig Ⅲ-4-7 Distribution of population

MODEL PATTERN OF HOUSING DEVEROPMENT

(HEEN ELA)

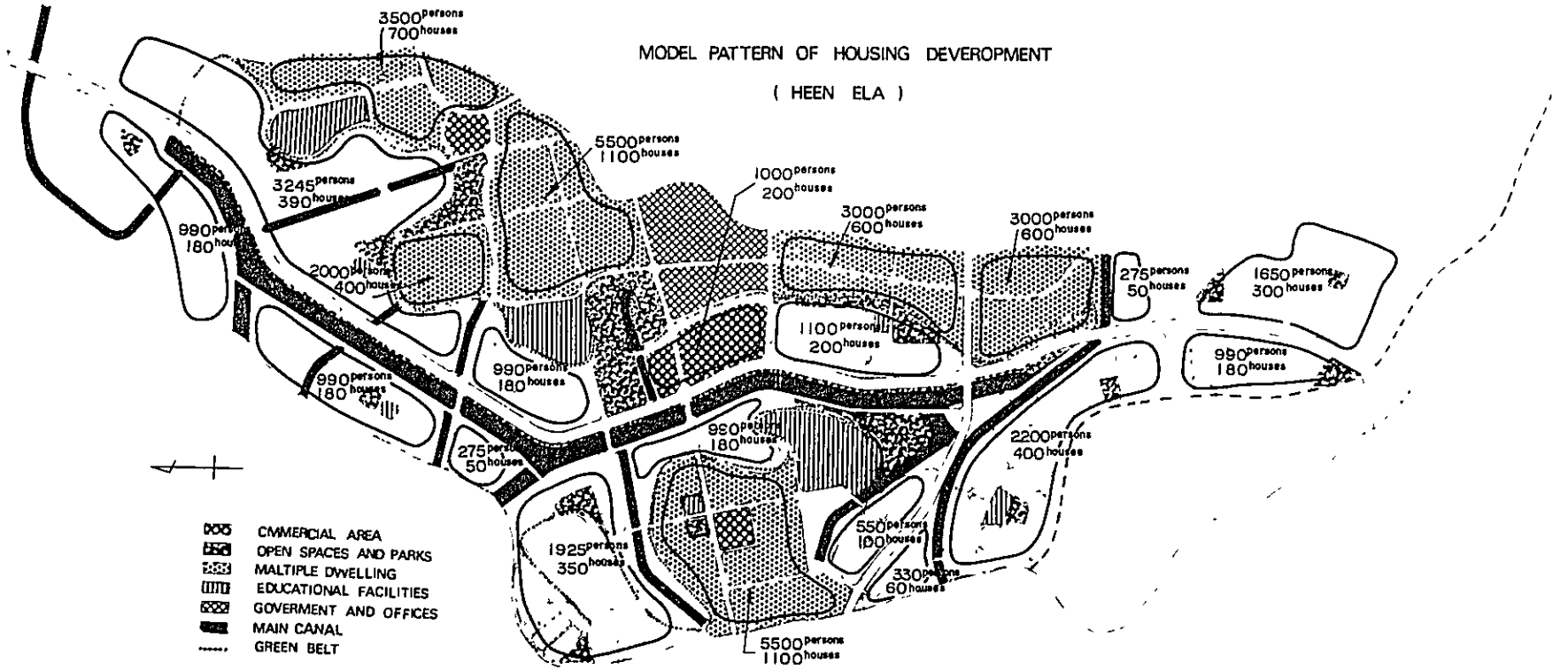
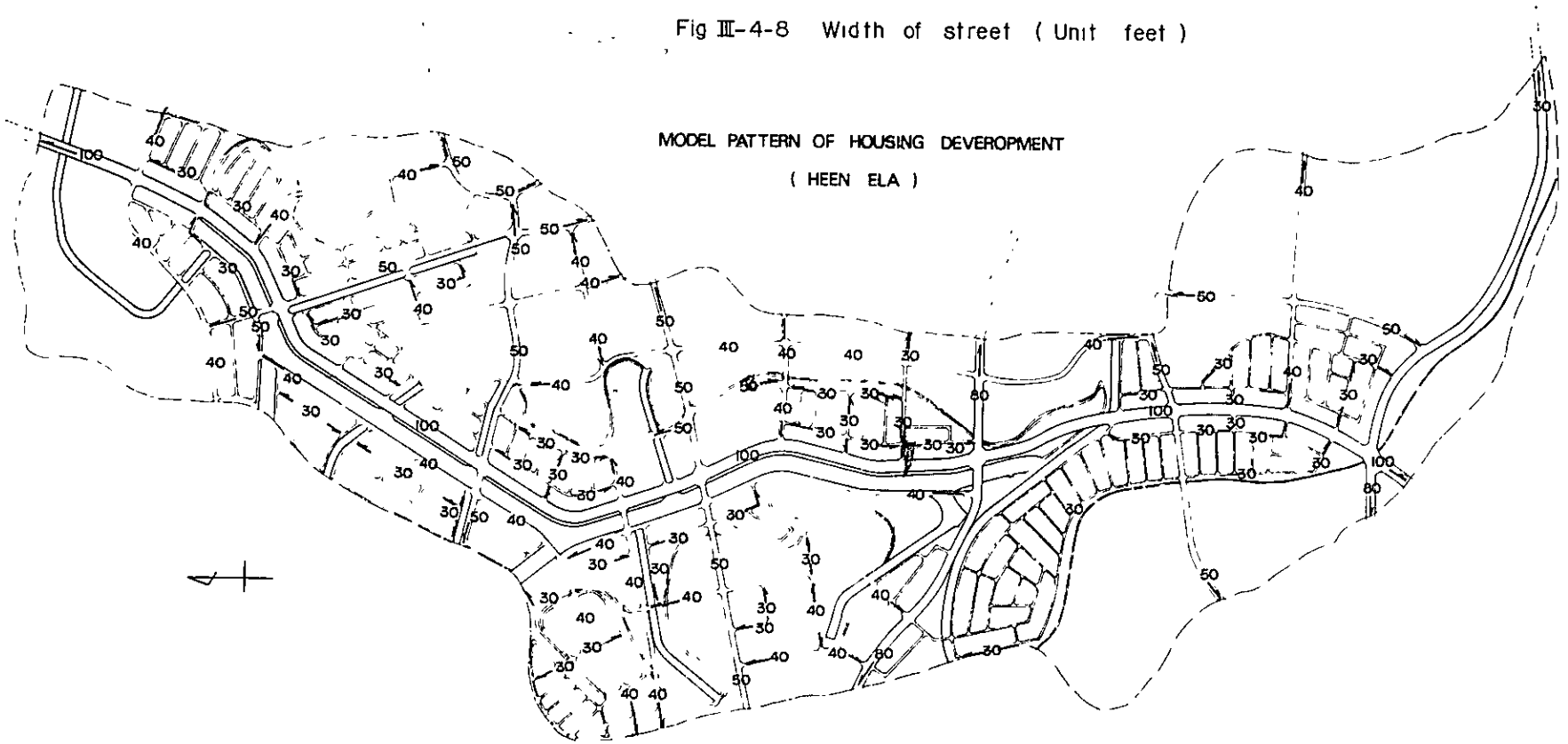


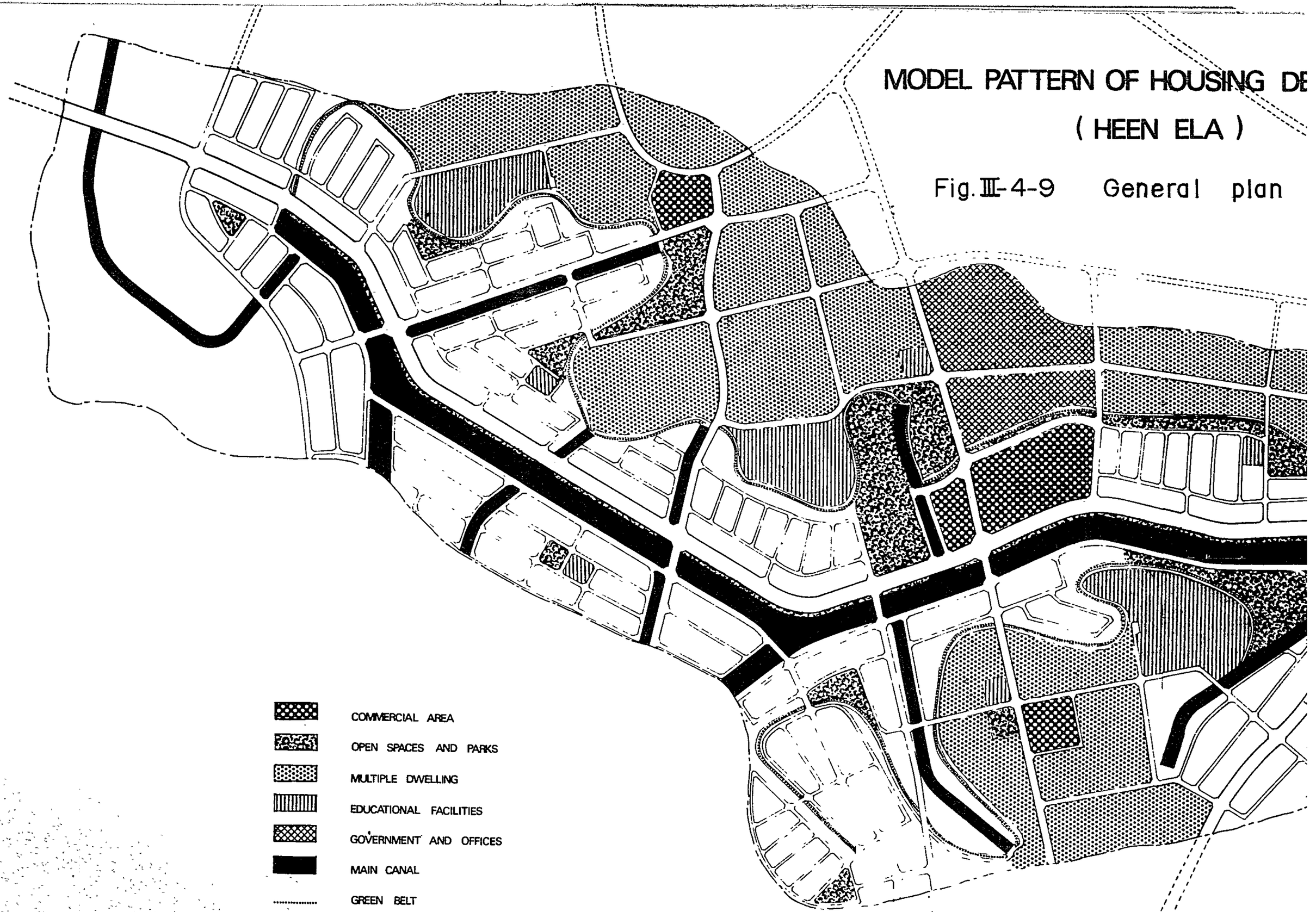
Fig Ⅲ-4-8 Width of street (Unit feet)



MODEL PATTERN OF HOUSING DE

(HEEN ELA)

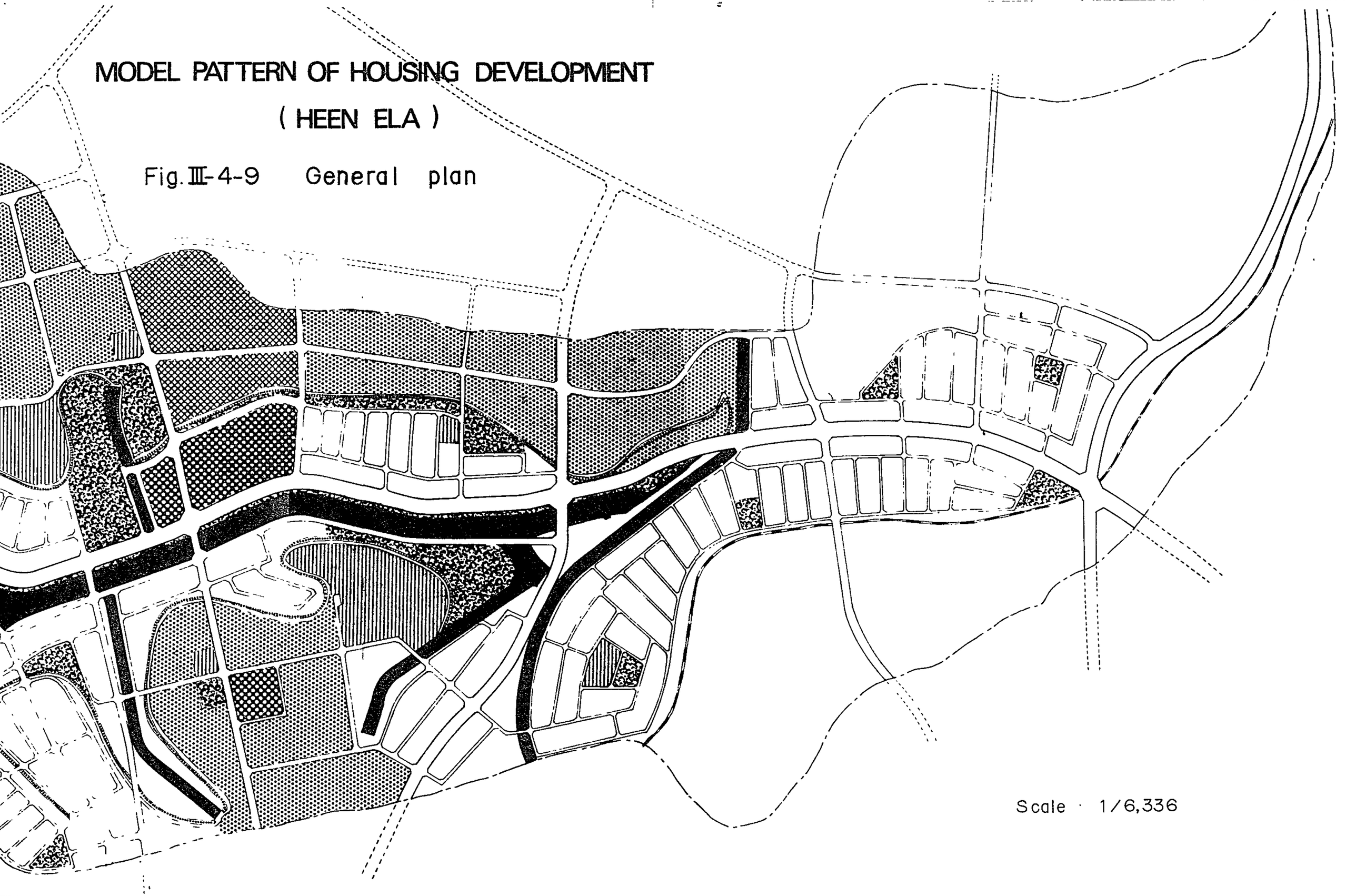
Fig. Ⅲ-4-9 General plan



MODEL PATTERN OF HOUSING DEVELOPMENT

(HEEN ELA)

Fig. Ⅲ-4-9 General plan



Scale · 1/6,336

Fig. Ⅲ-5-1

PRESENT TRAFFIC MAP IN COLOMBO DISTRICT

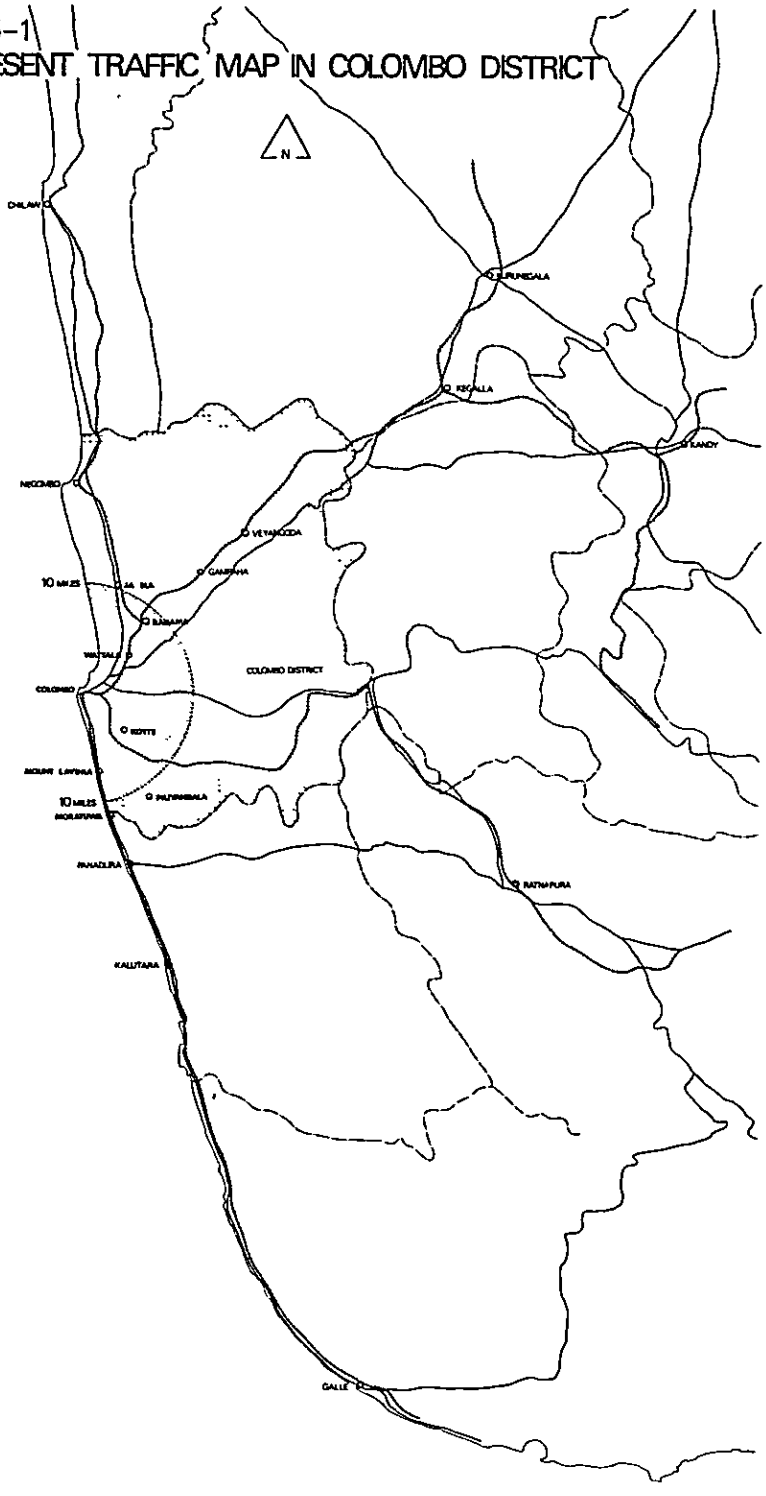


Fig. Ⅲ-5-2

TIME CONTOUR MAP

-BY BUS-

14 MILES/HOUR

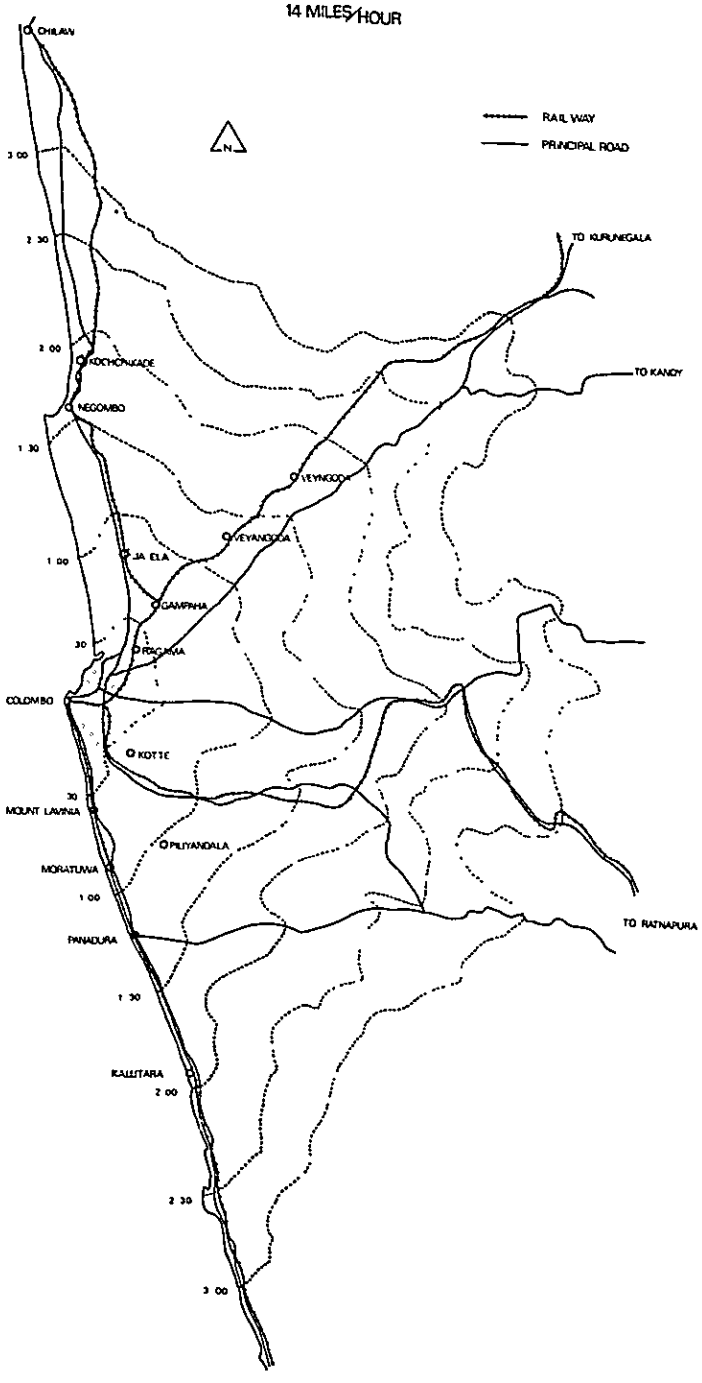


Fig. III-5-3

TIME CONTOUR MAP
BY BUS

COLOMBO MUNICIPALITY

Fig III-5-4 Passengers entering Colombo Municipality by Buses (day)

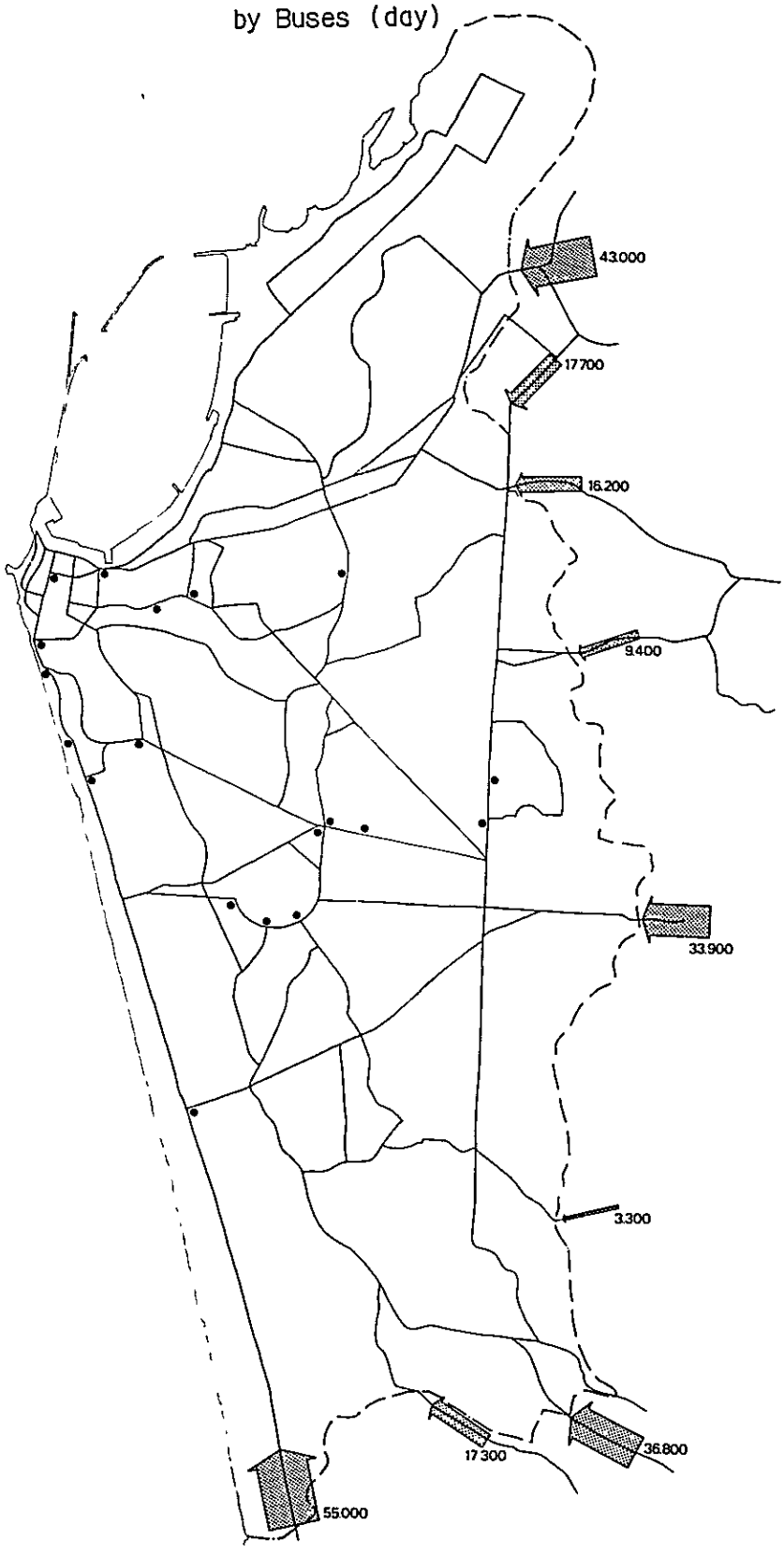


Fig III-5-5

COLOMBO CITY
AND
SUBURBAN

BUS ROUTES

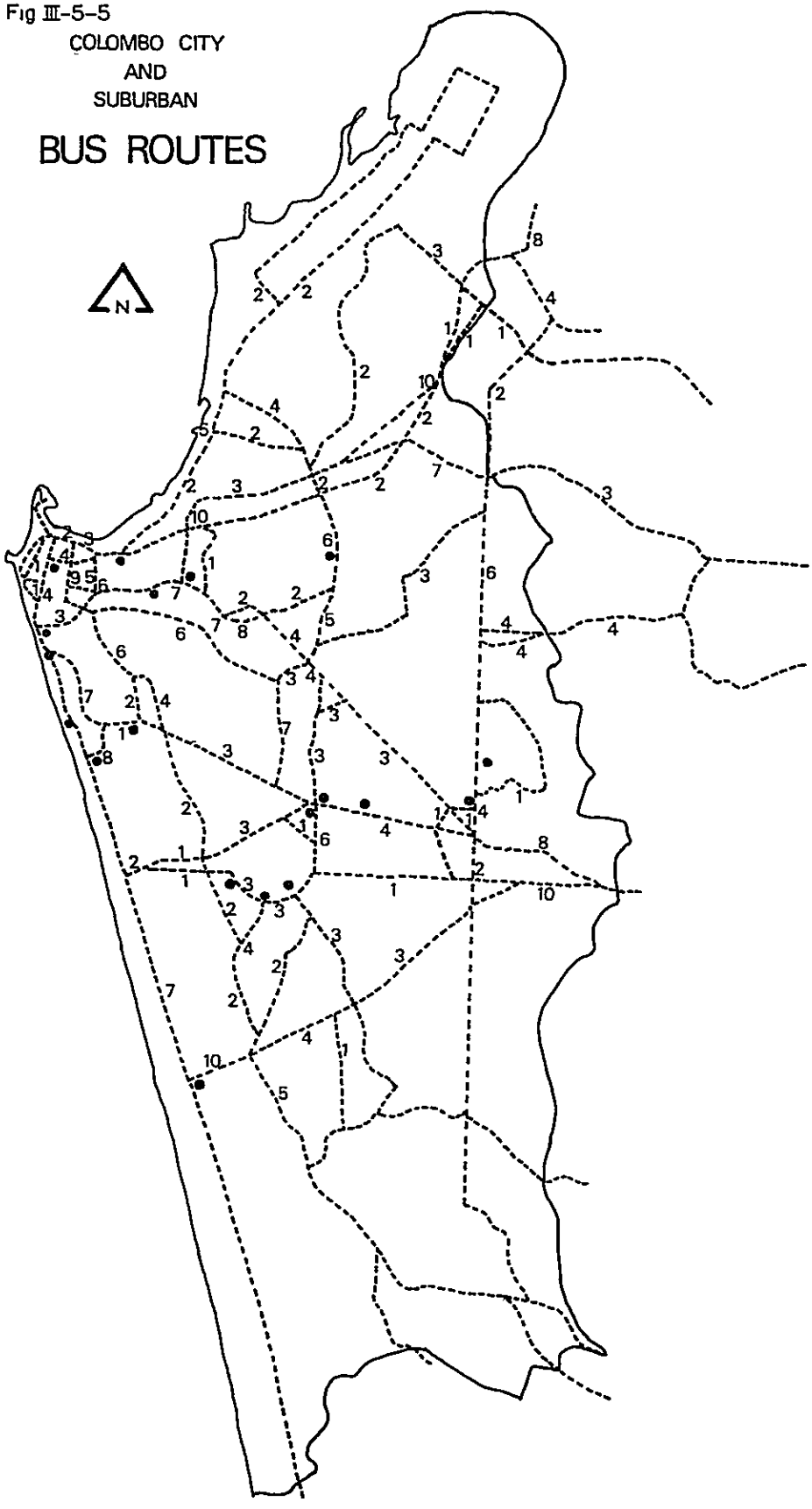


Fig III-5-6

PRESENT USE ZONING BY LAW

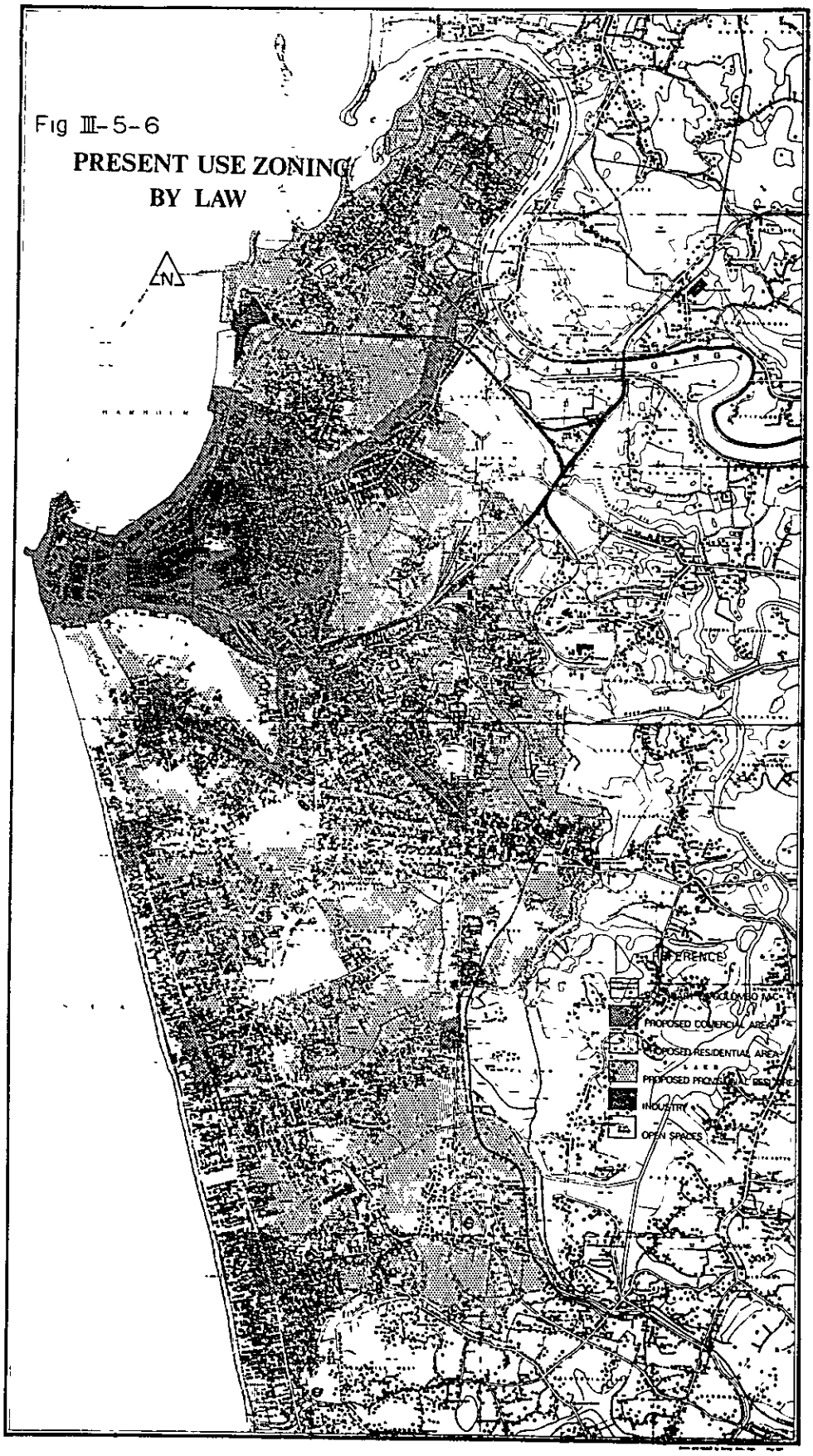


Fig.Ⅲ-5-7 Location of marshes in and around colombo

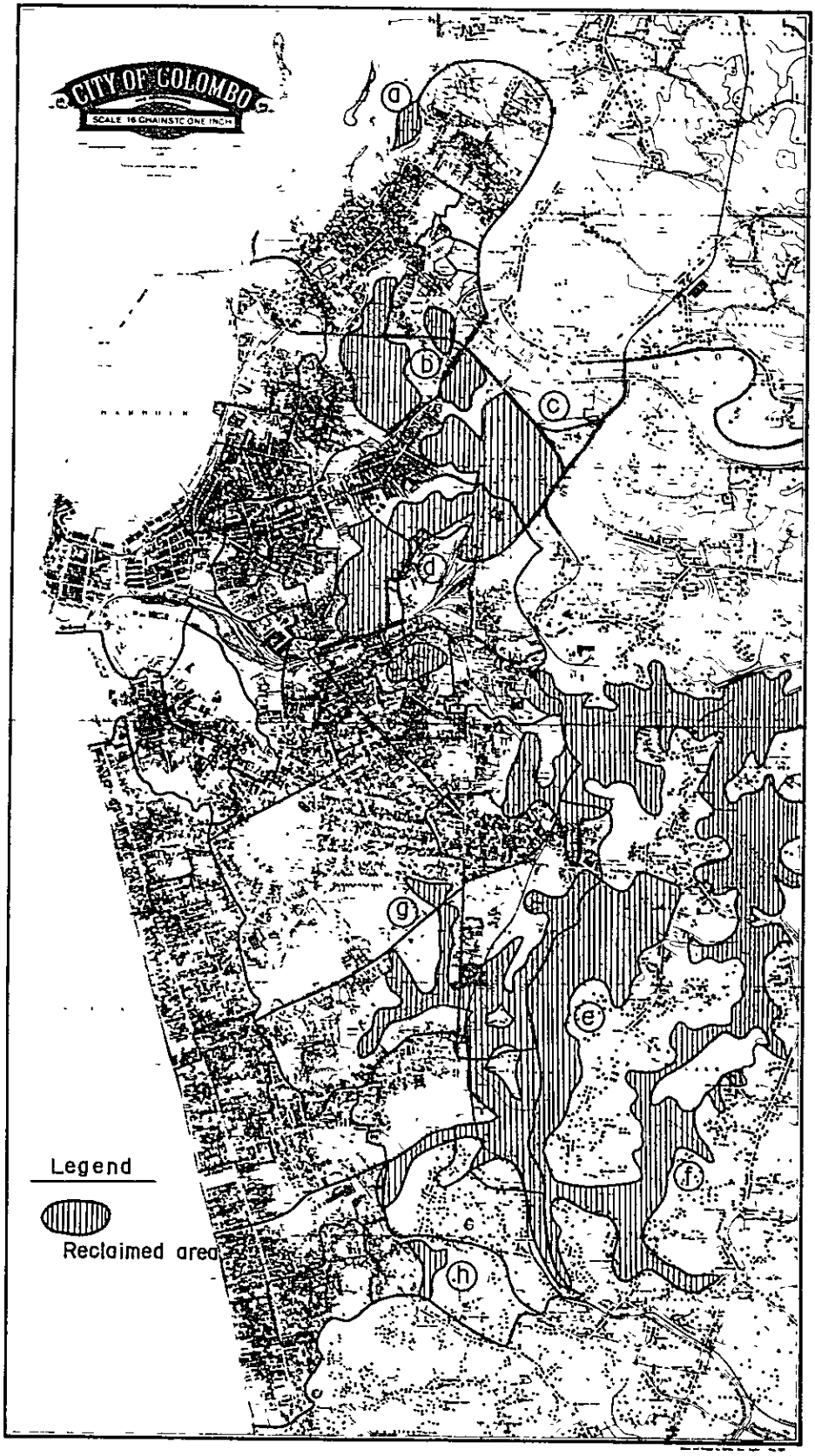


Fig Ⅲ-5-8 Contour Map For Land Valuation

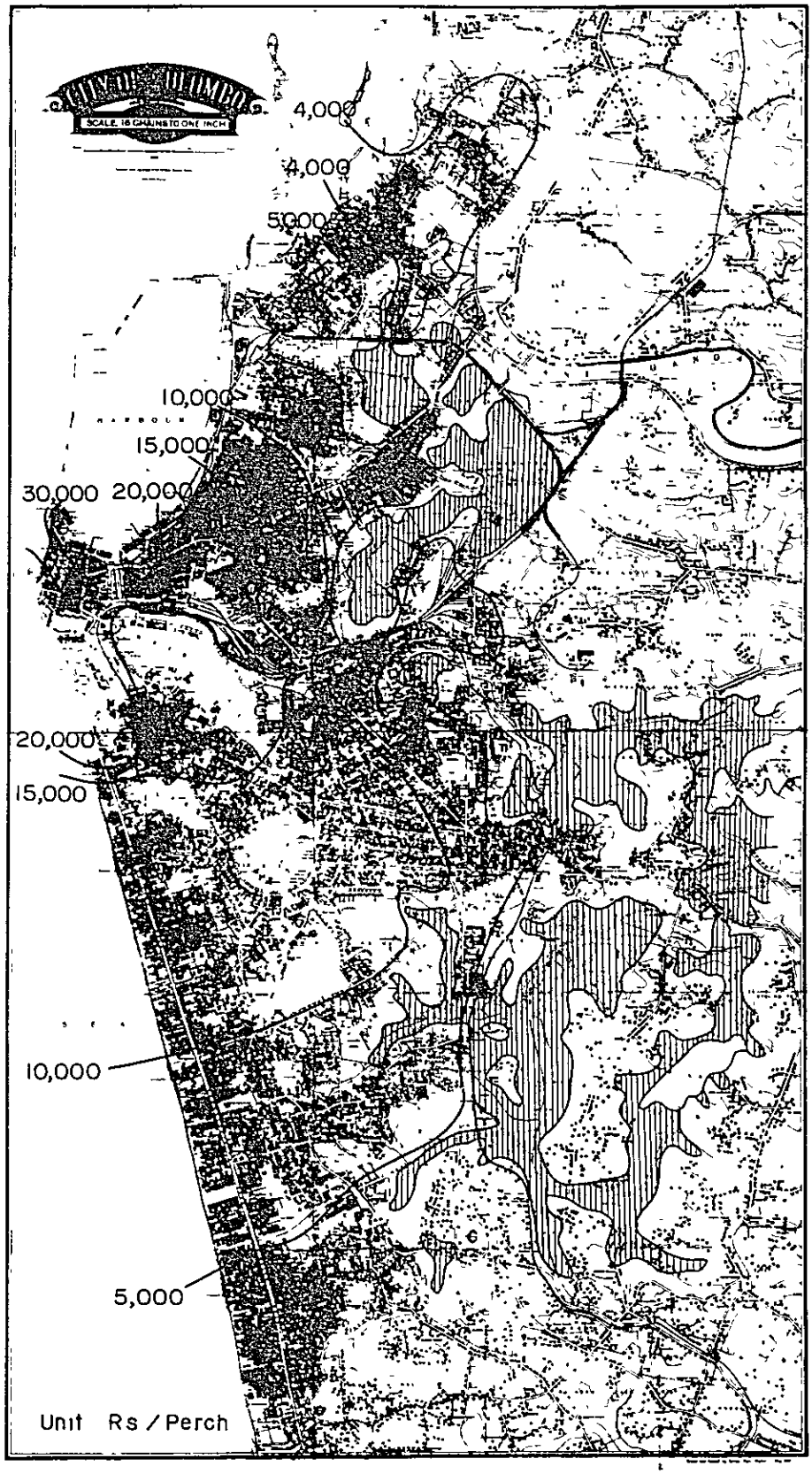


Fig Ⅲ-5-9 Number of Eating Houses by Ward

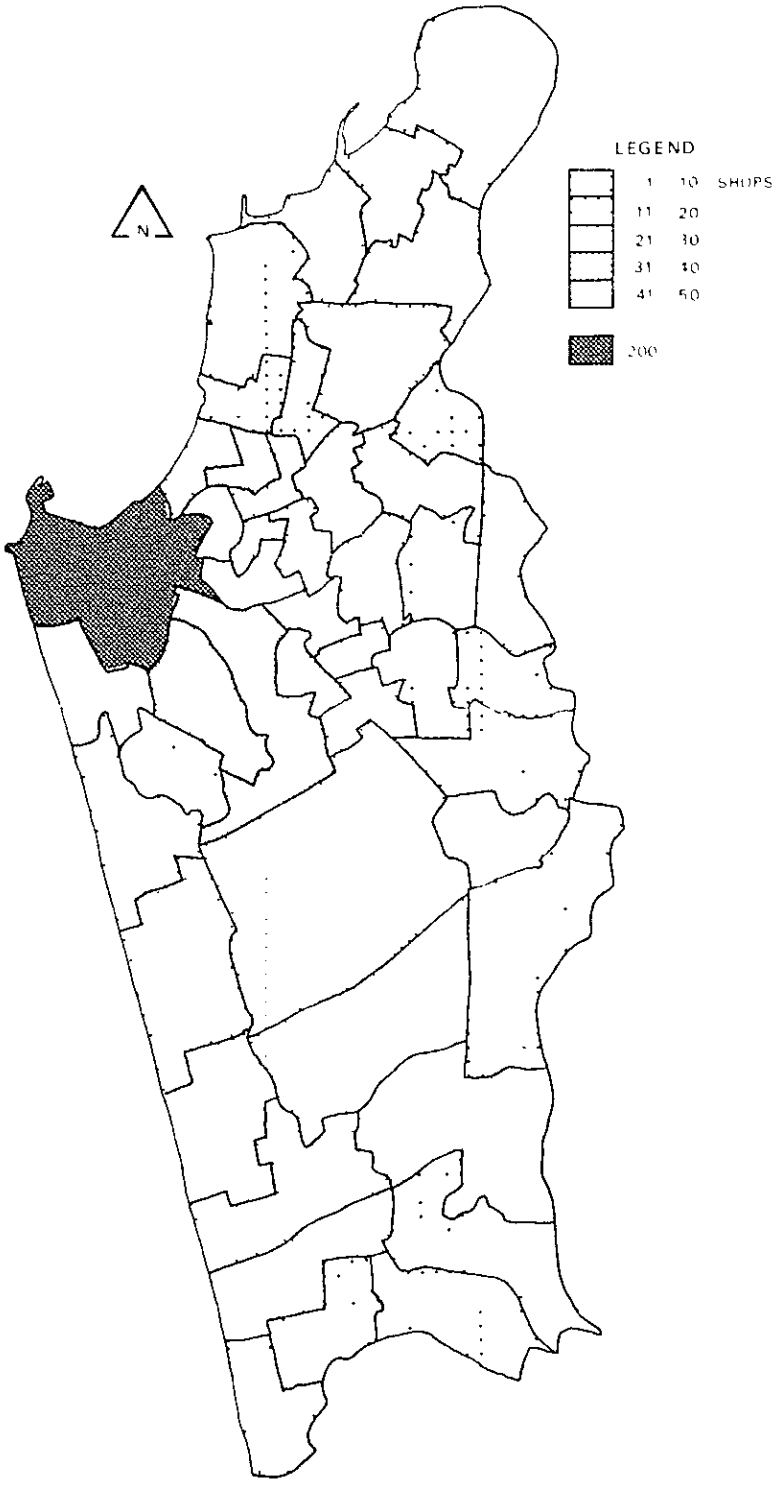


Fig Ⅲ-5-10
SPHERE OF SERVICES

—SCHOOL—

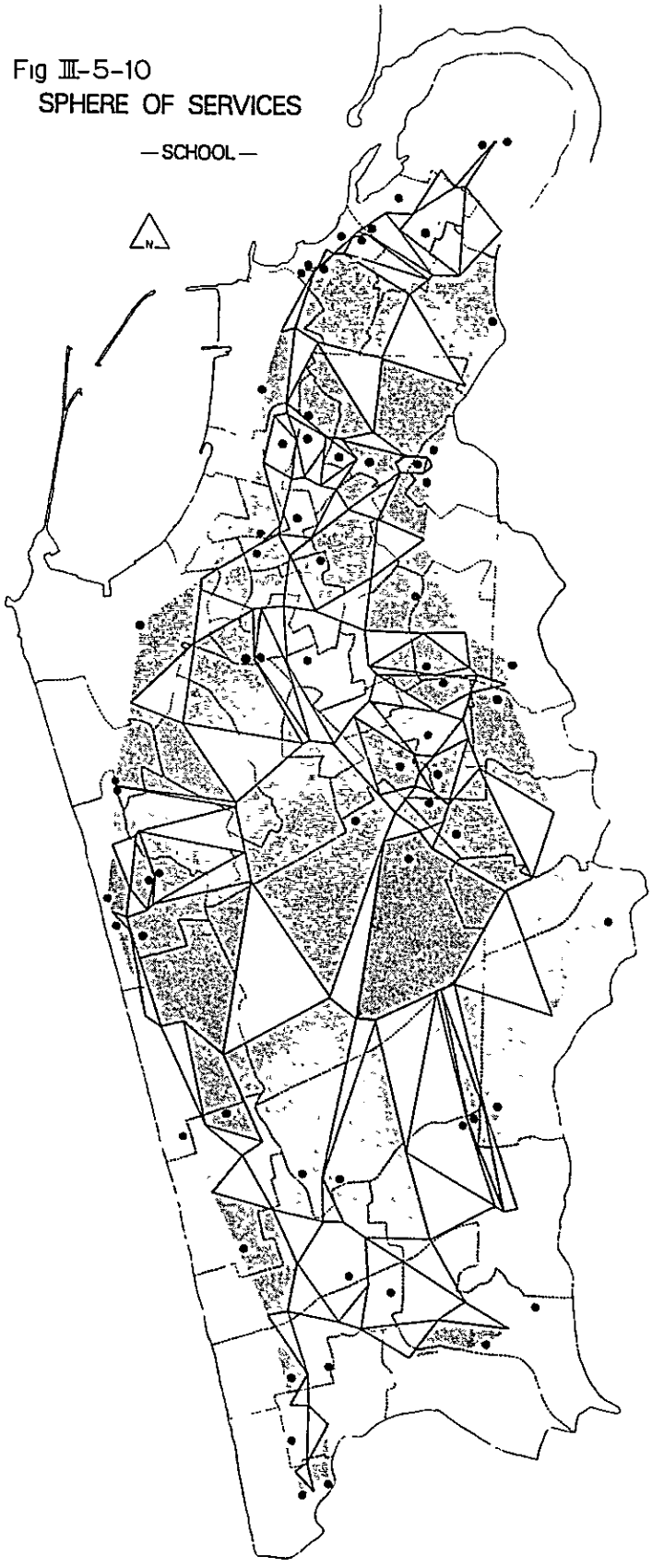


Fig. Ⅲ-5-11

SPHERE OF SERVICES

—CHURCH—

Fig. Ⅲ-5-12

SPHERE OF SERVICES

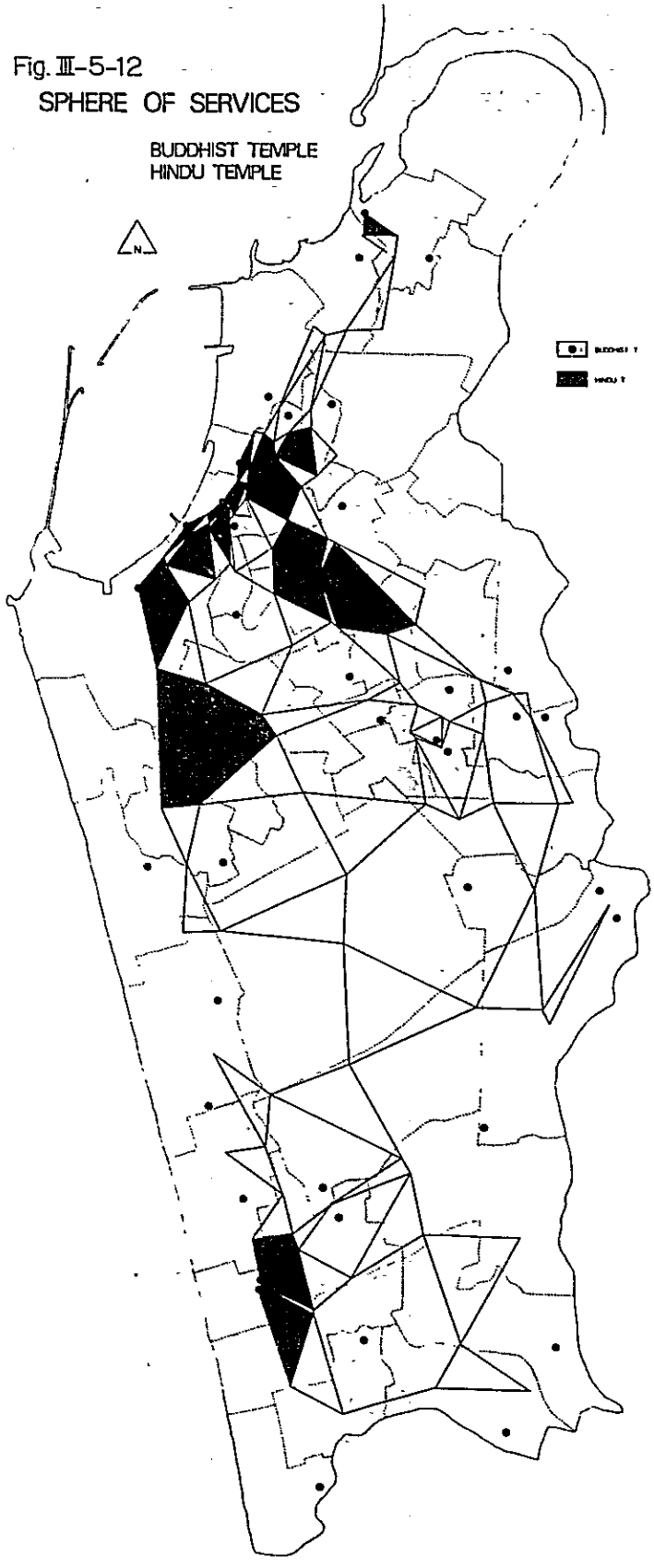


Table III-5-1 Organization Chart of Colombo District Reclamation and Development Board