SEMINAR ON
URBAN TRANSPORT IMPROVEMENT IN SINGAPORE
— AN OPTION FOR THE FUTURE —

SUMMARY OF SINGAPORE URBAN TRANSPORT IMPROVEMENT STUDY (SUTIS)

February 1990

JICA / PWD

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1. INTRODUCTION

o Singapore is one of the world's few metropolises where urban planning initiatives have been successfully implemented and that is relatively free from urban transport problems such as traffic congestion, excessive environmental pollution and high accident rates. However, it is foreseen that with further growth of Singapore's economy and improvement in the standard of living, there will be a stronger demand for more diversified urban services/ activities and higher quality/level of transport services.

o The Singapore Urban Transport Improvement Study (SUTIS) commissioned in September 1987 to the JICA Study Team has the following objectives:

- Under the first phase, to study on a schematic basis, the introduction of how urban transit systems in large-scale new towns already developed and/or are in the process of development now or in the future, and potential areas other than new towns:

- Under the second phase, to examine more in detail the feasibility of introducing new urban transit systems as a case study in selected area(s) identified in the first phase.

o The selected case study areas comprise the following:

(1) Ang Mo Kio New Town: This area represents a typical, developed new town. A detailed study was undertaken.

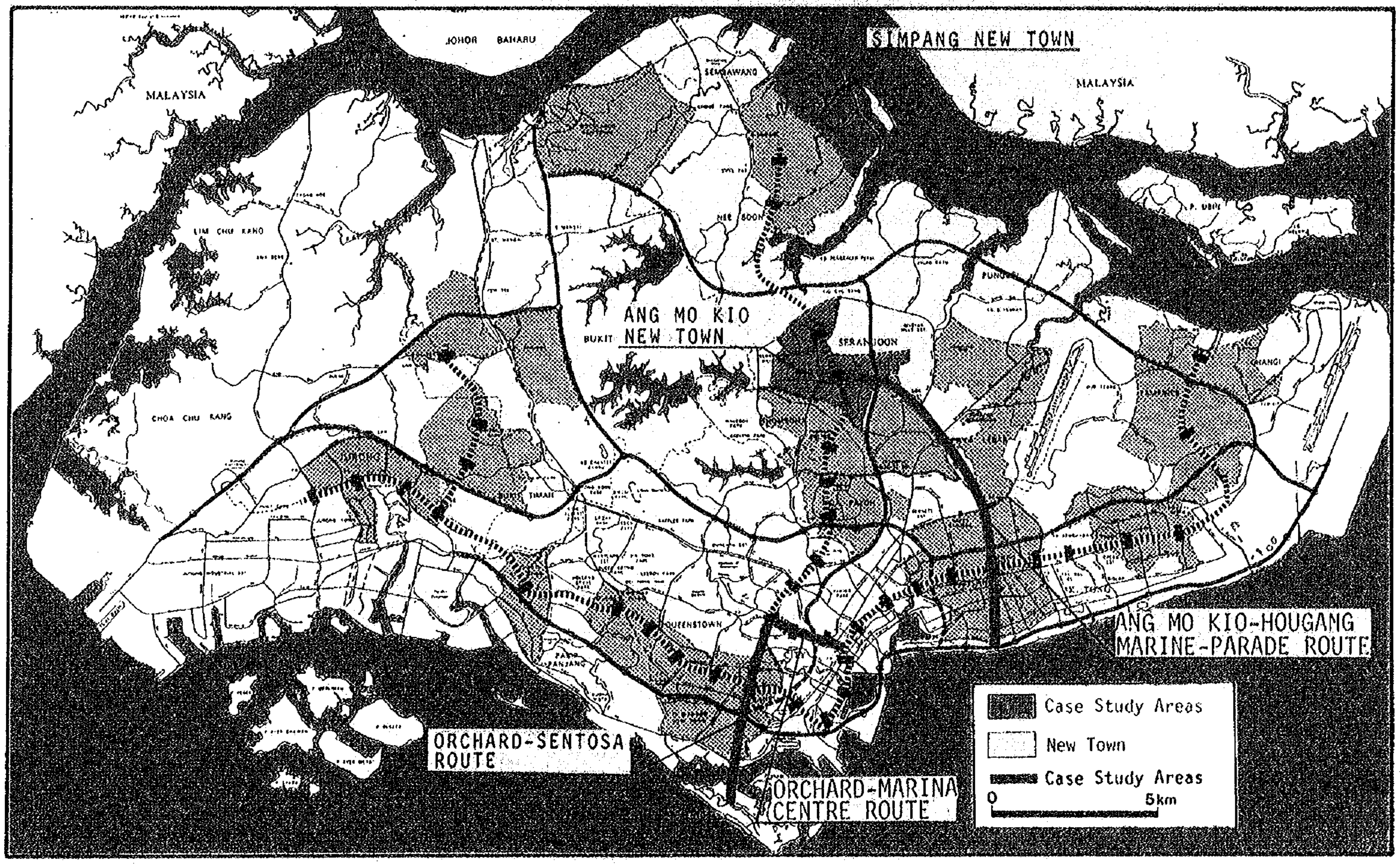
(2) Simpang New Town: This area is being planned and is, therefore, considered suitable for a case study on the feasibility of integrating new town development with a new transit system. Conceptual plans were subsequently prepared.

(3) Other Areas: Preliminary study and conceptual planning were made:

a) Ang Mo Kio/Hougang/Marine Parade Route
b) Orchard Road/Marina Centre Corridor
c) Orchard Sentosa Route

The location of study areas is shown in Figure 1.1

Figure 1.1
The Location of Study Areas



2. URBAN DEVELOPMENT PROFILE

- The Concept Plan lays out the overall directions on a long term basis, while the Master Plan sets out the regulations for land use through zoning, density, and plot ratio control and land reservation for various public uses, i.e., for implementation within a short-term period. The Concept Plan, otherwise called the Ring Plan, envisages the development of a ring of new satellite towns around the Central Water Catchment Area. These planned urban developments including the medium to high density new town, CBD and industrial areas are designed to be linked and integrated with strategically developed island-wide expressways and MRT systems. The basic urban infrastructure in Singapore is approaching completion.

- The socio-economic features of the Singapore society has changed rapidly over the years. Population growth rate decreased from a high of 2.8% per year in 1970 to 1.3% in 1980 and further to 1.1% in 1986. Reduction in the average household size or family nuclearization has also been taking place while per capita GDP grew from S$10,149 in 1978 to S$16,494 in 1987.

- There are, at present, twenty HDB new towns with an average overall completion rate of about 68%. Approximately, half of these have been completed, while the other half are in various stages of development. As of 1986, 85% of the total population reside in HDB new towns.

- Increase in affluence of Singaporean will result to increasing demands for improved levels of services and activities. The major areas of concern in the future society of Singapore would be:

  - increased demand for diversified services and activities;
  - increased demand for car ownership; and
  - increased demand for a better living environment.

  In addition to the above internal requirements, Singapore would also have to meet the increasing demand from the international community, either in terms of tourism or other business endeavors. An efficient and quality urban system in Singapore will, therefore, continue to be an important infrastructure to maintain its principal advantage of attracting increasing demands of the international community.

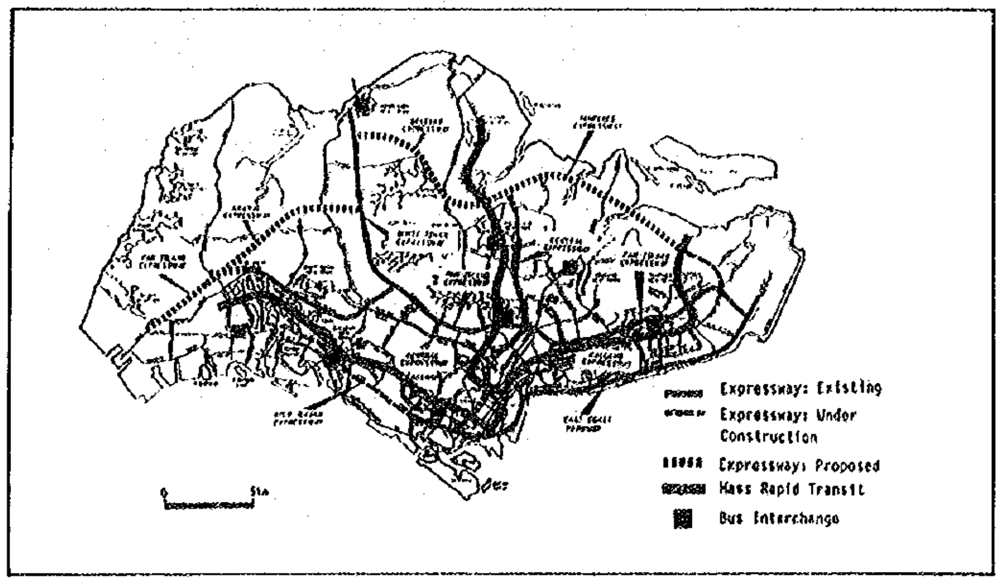
3. URBAN TRANSPORT SYSTEM

- Singapore's urban transport system consists primarily of well-developed road networks, coupled with a densely configured bus transport system. Public roads in 1986 had a total length of 2,690 kms, including 77 kmms of expressways and 460 kms of major arterial roads. The 67-km long MRT system, comprising of a 22-km long North-South line and a 39-km long East-West line with a 6-km long branch line, started partial operations in November 1987 and is expected to be in full operation by 1990. The MRT system of 42 stations (15 underground and 27 above ground) connects major new towns and the Orchard Road Corridor and the CBD. It, thus, offers a very attractive transport mode with a high level of services. (See Figure 3.1)

- In 1980, urban transport demand totalled some 3.7 million trips/day and is estimated to reach 4.2 million by 1990. The modal split between public and private (53% and 47% in 1980) is expected to remain the same due mainly to current policy of restricting ownership and usage of cars. The traffic demand distribution pattern in not so CBD-oriented, inasmuch as of the total traffic demand, trips to/from the CBD accounts for only about 25%.

- Singapore is relatively free from various urban transport problems. This is largely due to the successful simultaneous implementation of several transport system management measures and policies, such as (a) extensive road network development, (b) well-controlled land use and urban development, (c) restriction in ownership of private vehicles, (d) extensive implementation of traffic control and management, including Areal Licensing Scheme for CBD, (e) well-developed bus transport system, and (f) strong/effective enforcement capabilities. The development of the MRT system and the expansion of planned expressways will further contribute to the improvement of the existing traffic situation.

Figure 3.1
Major Transport System in Singapore



4. FEEDER TRANSPORT SERVICES

- o Among various feeder transport modes in Singapore, the more important ones are as follows:

  Feeder Bus: This is the most widely practiced feeder transport mode in Singapore. Among the PWD officials who stay in new towns, more than 40% use it one way or another.

  Walk: This is the largest and most unavoidable feeder mode. A few limited surveys conducted in SUTIS indicate the contrary to expectations, people walk fairly long under proper environmental conditions.

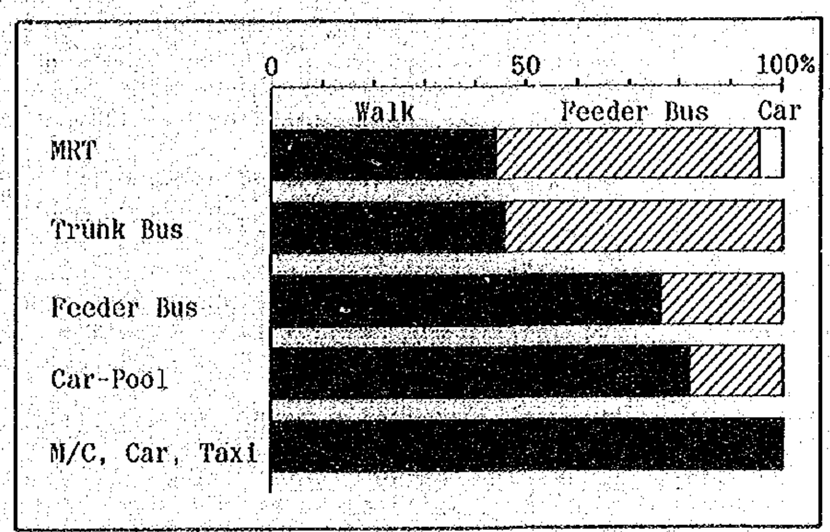
  Car (Kiss & Ride, Park & Ride): This is a practice wherein a person is driven by a car to a bus stop/interchange and then transfers onto a public transport to continue the journey. Among the PWD officials, 35% of the total 85% of the car-owning households practice "kiss and ride." Of those who practice "kiss and ride", 21% do it daily and mainly to/from work. On the other hand, only few practices "park and ride."

  The access modes of Ang Mo Kio new town residents are shown in Figure 4.1.

- o Feeder bus services cover major HDB new towns, Jurong Industrial Area and other housing and industrial estates. They play within the new towns or industrial areas for passenger collection and distribution to/from the bus interchange and also for local travel within the area. In 1987, there were 84 feeder bus services, out of which 65 services or 77% operate in HDB new towns. Singapore Bus Service Ltd. (SBS) provides 59 services for the new towns except Woodlands and Yishun new towns which are served by Trans Island Bus Service (TIBS). The feeder bus services are characterized with their short route distance (6.9 kms on average), wide coverage, frequent services (5.1 minutes frequency on average), long operating hours (usually 0500 through 2400 hours) and cheap fare (mostly 15 cents only). Their operation are assessed as shown in Figure 4.2.

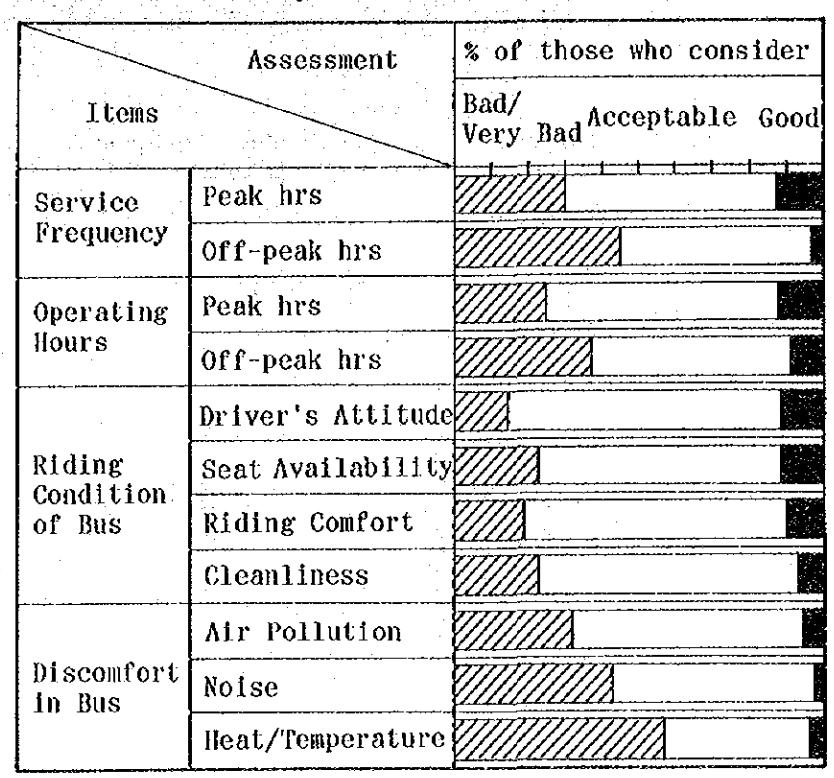
- o The recently opened MRT provides high quality transport services and the competitive opportunity for the public transport system vis-a-vis private cars along the MRT routes. However, it is also clear thaht an overall improvement of transport services has to be addressed from the viewpoint of door-to-door transport service where the improvement of feeder services is likely to become a critical issue.

Figure 4.1
Access Mode of Ang Mo Kio New Town Residents



Source: Ang Mo Kio HIS, 1988

Figure 4.2
Assessment of Feeder Bus Operating Conditions
By PWD Officials



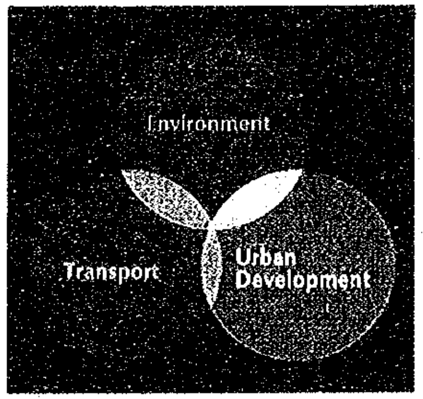
Source: PWD Officials Interview Servey, 1988

5. FEEDER TRANSPORT IMPROVEMENT PLANNING DIRECTION AND OPPORTUNTIES

o It would be ideal to obtain an efficient public transport system that can be competitive, or serve as an alternative for private cars. Singapore is one of the countries which can best achieve this goal due to the following inherent factors: (a) a strategically located MRT providing high quality service linking all major new towns, the CBD and other major traffic generating sources, (b) administrative ease of planning and decision making in a city state with one level of government, and (c) the presence of an institutionally effective means and capabilities of controlling urban development.

o In order, however, to achieve the above goal effectively, it is essential to look into the issue not only from its transportation aspect but also from the total urban development aspect. Investments into quality transport development always require such sizeable resources that it would be difficult to be justified by mere replacement of the existing system with a new system; it would only become feasible when the new system is developed as an integral and strategic part of the envisioned total urban/community development scenario. The overall planning goals of feeder transport improvement can, therefore, be set as follows:

PLANNING GOALS



Improve the Living Environment
Short-term: reduce noise, air pollution and other nuisances caused by motor vehicles.
Long-term: increase overall amenities

Improve Transport Efficiency and Capabilities
Short-term: restructure existing feeder transport system in compliance with the MRT within the existing transport system.
Long-term: develop/create a more competitive new public transport system by integrating the MRT with the new transit mode to substitute or compete with the private car usage.

Encourage Better Urban Development
Short-term: provide transport services to various land uses where demand exists/is expected.
Long-term: realize the envisioned community/urban development.

o Various areas identified for feeder transport improvements are categorized as follows:

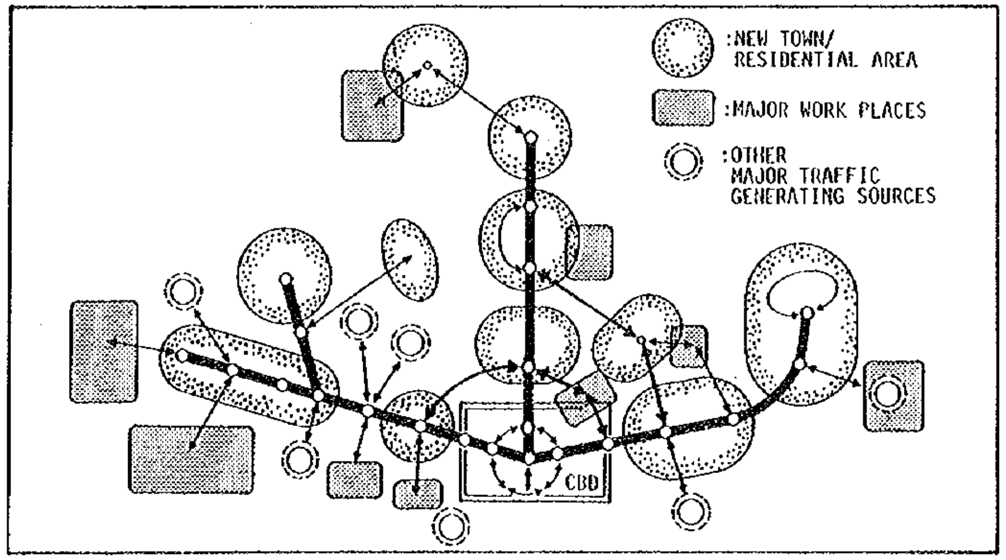
Area I: where better feeder transport system can be provided for new town residents and activities to make both inter and intra new town movement efficient and to enhance better living environmental conditions.

Area II: where better transport links and services can be provided between MRT stations and major traffic generating sources such as industrial area, educational facilities, port and airport and recreational facilities. For example, one end of a trip is a new town or residential area, while on the other end, various activity areas are distributed. To door-to-door services, Area II must be considered simultaneously with Area I.

Area III: where a better internal circulation can be provided. There are a number of locations where demand is high within a relatively small area, hence, it would require quality service. They include various parts of CBD, university campus or science park, airport complex, etc.

Area IV: where the existing/planned trunk transport system can be more effectively structured or supplemented by an intermediate capacity transit system rather than by an expanding trunk system. Development of secondary transport route along circumferential direction has a great possibility.

Figure 5.1
Conceptual Understanding of Potential Areas of Feeder Service Improvement



6. AVAILABLE NEW TRANIST SYSTEMS

- Three groups of existing systems have been studied for possible introduction to each of the case studies as to: (a) transport capabilities, and felxibility in operation; (b) impact on the environment; noise and aesthetic factor; (c) technological maturity; (d) construction cost; and (e) operation and maintenance costs. The selected groups of transport systems are as follows:

  Group I: The systems of this group are supported with relatively matured technologies and most widely applied, particularly in Japan and USA. An average car has approximately 85 to 100 passenger capacity, supported by rubber tyre. The systems are fully automated and meet passenger demand of 5,000 to 10,000/hour/direction. Considering the transport capabilities and technological maturity and experiences, they are considered the most realistic ones to be applied in most of the new towns in Singapore.

  Group II: This group specifically represents minimonorails which have smaller capacity that Group I systems. Lighter vehicle and monorail structure provide better aesthetic features. Although the application cases are yet limited, they are suited in CBD, recreational places and other activity centers.

  Group III: The systems of this group are expected to be more highlighted in the near future. One is the magnetic levitated systems and the other more personal type systems. The former with less noise and better riding comfort is an alternative to Group I systems. The latter system intends to provide more personal and flexible transport services.

  The characteristics of the selected representative systems are shown in Table 6.1 and Figure 6.1.

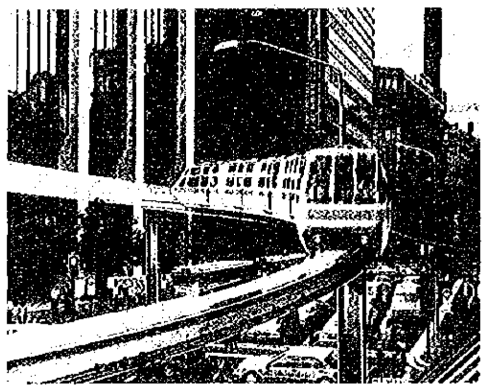
- Conventional monorail systems, various types of LRT (Light Rail Transit) bus systems and PRT (Personal Rapid Transit) were not included in the study.

Table 6.1
Outline of Selected New Transit Systems

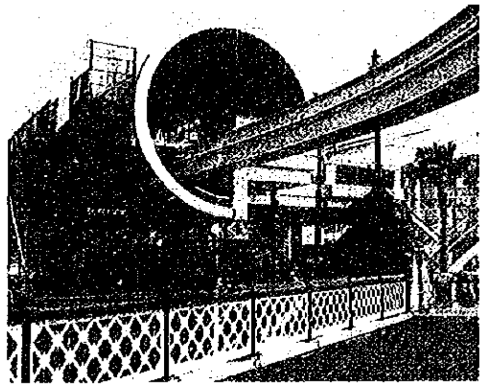
ITEM		GROUP I		GROUP II		GROUP III
Representative System		Kobe Portliner	Miami Metromover	Dortmund H-Bahn	Sydney Minimonorail	M-Bahn
System Outline	Purpose	feeder to MRT intra-island loop	feeder to MRT CBD loop	feeder to S-Bahn shuttle in campus	feeder to MRT CBD loop	feeder to S-Bahn experimental line
	Route Length (km) Sta. Spacing (m)	6.4 943	3.0 375	1.05 1050	3.6 450	1.6 800
	Route Configuration	double track loop/shuttle	double track loop	single track shuttle	single track loop	double track shuttle
	Guidance	lateral guidance	central guidance	running beam	running beam	lateral guidance
	Car Support	rubber tyre (stuffed)	rubber tyre (air)	rubber tyre (solid)	rubber tyre	magnetic levitated
	Power	3ph,alt,600V	3ph,alt,380V	3ph,alt,500V	3ph,alt,500V	DC 960V
	Automation	full	full	full	full	full
Vehicle	Size:L x W x H(m)	8.4x2.4x3.2	11.9x2.9x3.6	8.2x2.1x2.4	32x2.1x2.3 (7 units/train)	11.8x2.3x2.3
	Weight (tons)	10.5	14.5	7.3	22/train	7.5
	Capacity/Car	75	100	42	170/train	71
	Max. Speed (kph)	60	96	50	33	
	Acc. (km/h/sec) Dec. (km/h/sec)	3.5 33.5	3.2 2.4	3.6 7.2	2.5 2.5	4.7 - 10.8 3.6
	Propulsion	90kw x 8/train	75kw x 2/car	23kw x 4/car	37kw x 6/train	linear motor
Structure	Guideway	concrete partially steel	PC concrete & steel box	steel	steel	steel
	Max. Gradient (%) Min. Curvature (m)	50 30	100 24	45 30	up 44, down 60 20	120 30
Current Status		In operation since 1985	In operation since 1986	Operated only w/in University. Extension planned.	Commercial Operation has started 7/1/88.	Commercial Operation has not started.
Similar Systems		Osaka New Tram Yukarigaoka VONA Saitama Ina Line Others	Atlanta A.P. Tampa A.P. Seattle A.P. Changi A.P.		Sentosa Monorial	HSST

Source: Worked out by Study Team based on available information.

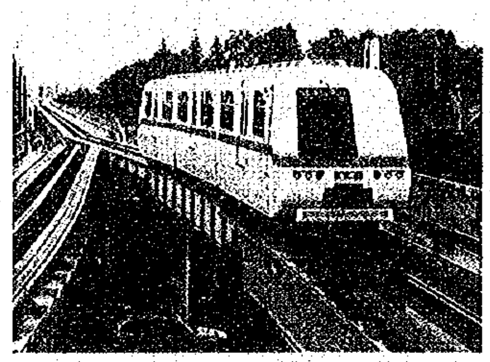
Figure 6.1
New Transit Systems Selected
For Case Studies



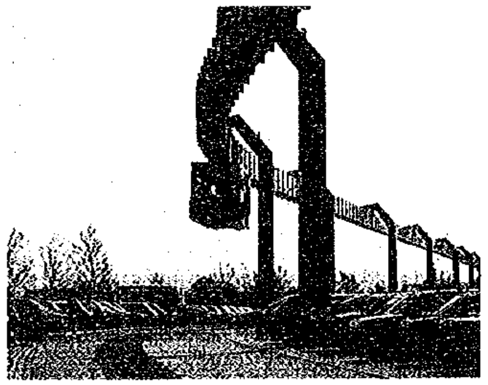
Sydney Mini-monorail



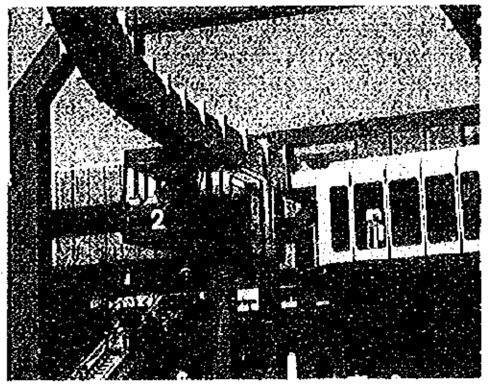
Sydney Mini-monorail Station



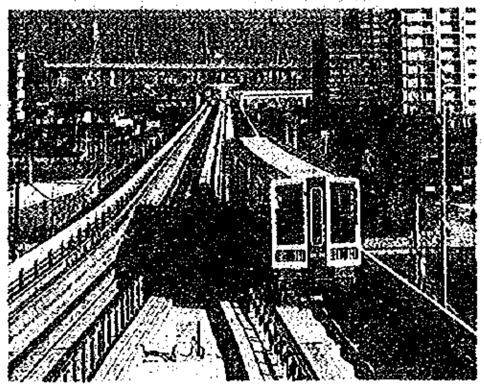
Yukarigaoka VONA



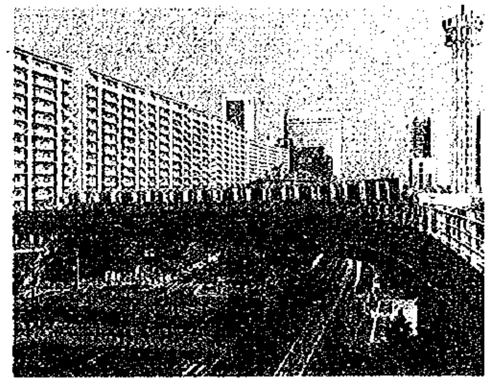
H-Bahn



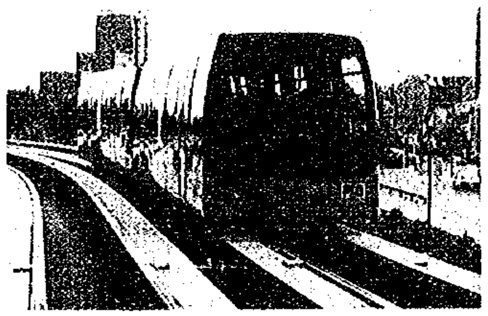
H-Bahn Station



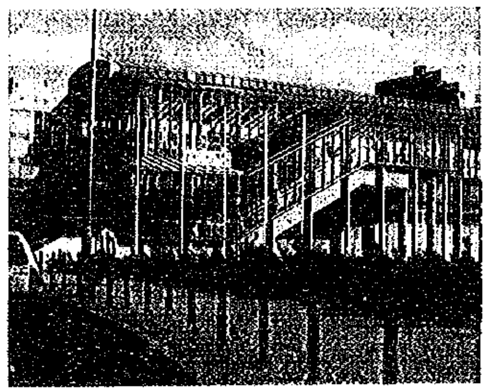
Osaka Nanko New Tram



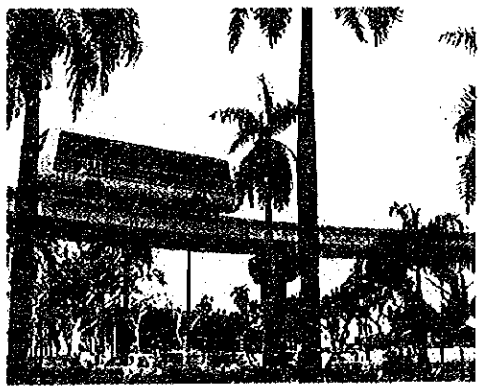
KOBE Port Liner



M-Bahn



M-Bahn Station



Miami Metro Mover

Platform Door (Kobe Port Liner)

7. CASE STUDY FOR ANG MO KIO NEW TOWN

7.1 Development Needs

New Town Profile

- o Ang Mo Kio new town has some 200,000 residents occupying 740 hectares of land is located in the north, about 12 to 15 km. from the CBD. The area extends over 4 km. in the east-west and 3 km. in the north-south directions. Of the total land, 37% is allocated for residential use, while 17% and 16% are for industrial use and major road space, respectively. It provides 33,000 employment opportunities.

- o Ang Mo Kio is served by both roads including expressways and the MRT. With the commencement of the MRT operation, travel time along the MRT route has been reduced considerably: for example 55 to 65 minutes of bus travel time compared to MRT's 19 minutes between CBD (City Hall). Feeder services are dominated by the feeder bus system which is operated with 55 buses at 3 to 8 minutes headway, between 5:30 a.m. and 1:00 a.m. It serves 90,000 cash rides or a total of 128,000 passengers a day.

Existing Traffic Demand

- o The total traffic demand for Ang Mo Kio new town is estimated to be 405,500 motorized trips which comprises of 67% by residents and 33% by non-residents. Of the total, public mode shares 79%, while private mode 21%. Feeder bus, school/company bus and car are the major transport modes for intra-town movements, while trunk bus, MRT, and private car are the major modes for inter-town movements (see Figure 7.1).

- o Feeder traffic characteristics were examined by analyzing the sub-modal choice of trips based on the HIS results. Feeder bus and walking are the main modes. It is estimated that the average time spent for feeder transport of inter-town movement is roughly 16 to 17 minutes and the average door-to-door travel time for intra-town movement is about 20 minutes.

Impact of MRT

- o The impact of MRT on travel pattern is significant according to Household Interview Survey conducted for Ang Mo Kio residents:

  - Travel Time: 94.2% of the residents say it has been reduced, while 5.8% say increased. The average reduction is 15.3 minutes.

  - Fare: 91.4% of the residents say it has been increased, while 8.6% say decreased. The average increase is 17 cents.

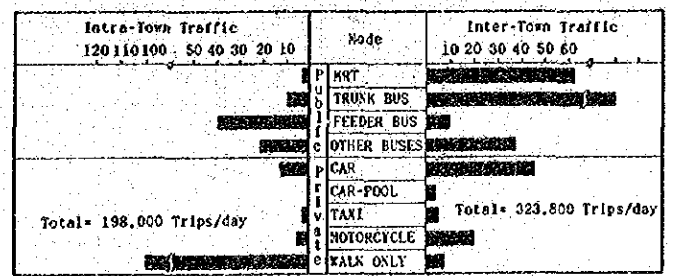
  - Walking Distance: 63.5% of the residents say it has increased, while 36.5% say decreased. The average increase is 4 minutes.

  - Punctuality and Reliability: 95% of the residents feel they have been increased. Half of them agreed the increase is considerable.

Estimated Feeder Traffic Demand

- o The potential feeder traffic demand for the proposed new transport system is composed of the following traffic for both residents and non-residents: (a) Feeder portion of the existing inter-town traffic of public transport mode. (b) Existing intra-town traffic of public transport mode. (c) Diverted traffic from existing private car trips. (d) Induced traffic due to the decrease in generalized transport cost (sum of time cost, distance cost, and comfort). The low side of the estimate is 122,700 passengers/day which is slightly lower than the present feeder bus passenger traffic of 138,350. The high side of the estimate is as many as 224,200 passengers/day (see Table 7.1).

Figure 7.1
Overall Traffic Demand of Ang Mo Kio New Town



Source: Ang Mo Kio HIS, 1988

Table 7.1
Estimated Potential Feeder Traffic Demand
for the Proposed New Transit System

	Mode	Intra-Town Trips: Residents	Intra-Town Trips: Non Res.	Inter-Town Trips: Residents	Inter-Town Trips: Non Res.
Total Actual Demand: No. of Trips/Day	Public Private Walk	56,200 10,300 110,100	15,500 5,900 -	158,600 47,200 6,200	89,300 22,500 -
Actual % of Feeder Bus User	Public Private Walk	60.1 0 0	62.3 0 0	37.9 0.8 0	38.1 0.9 0
Estimated Share of NTS (%)	Public: High/Low Private: High/Low Walk: High/Low	70/50 20/0 20/0	70/50 10/0 20/0	50/35 30/0 0	50/35 30/0 -
Total Potential Traffic Demand	High Side: 224,200 Low Side: 122,700				

7.2 System Plan

- For Ang Mo Kio, Group I system has been chosen because that it can handle more economically Ang Mo Kio new Town's expected transport demand which is considerably large, and there are more cases of applications for Group I system, with proven technologies and operational experiences.

- Route plan of the proposed transport system was prepared with due consideration given to network configuration, alignments and location of stations. More specifically, the factors considered include: Traffic demand in terms of quantity and quality, required transport service level (scheduled speed, riding comfort, accessibility), land use, availability of construction space, environment, geographical conditions, and minimum interference of existing structures/facilities. The proposed route plan is composed of 21.6 kms. of a single track loop route with 29 stations and 420-meter station spacing. This plan can cover most of the new town areas except the industrial area near Yio Chu Kang Station. It is also planned that the system can be extended towards the east eventually to form a regional secondary transit route. The structures are planned, as much as possible on available public spaces. They are not placed in the middle of the roads but along the sidewalks for passenger convenience and for aesthetic appeal. (see Figure 7.3 and Figure 7.5)

- The operational plan was formulated to meet the maximum passenger volume of 150,000 to 200,000 per day, with flexibility in operation and service pattern as demand changes. It will take 68 cars with passenger capacity of 75 per car. The system can provide services at 3-minute headways during peak hours and 5-6 minutes during off-peak hours with a four-car train. An alternative is to operate at 2-minute headway with a three-car train. (see Figure 7.4)

- Control System is based on full automation, because the system has relatively complex route configuration and is intended to operate at short headways. Since train operation is fully automated, fare collection might as well be automated too. Emergency and safety measures will also be provided to respond to the concerns of the operator and society. In order to operate and manage the proposed system, a separate organization with proper staffing is required.

Figure 7.2
An Image of the Proposed Car for Ang Mo Kio System

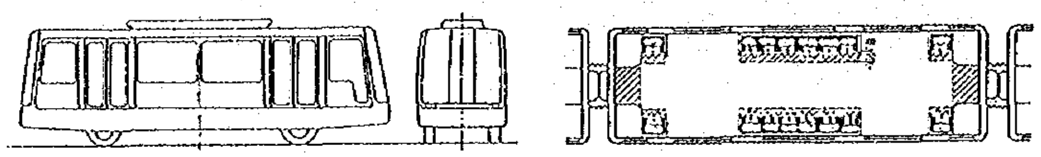


Figure 7.3
Location of Proposed Route

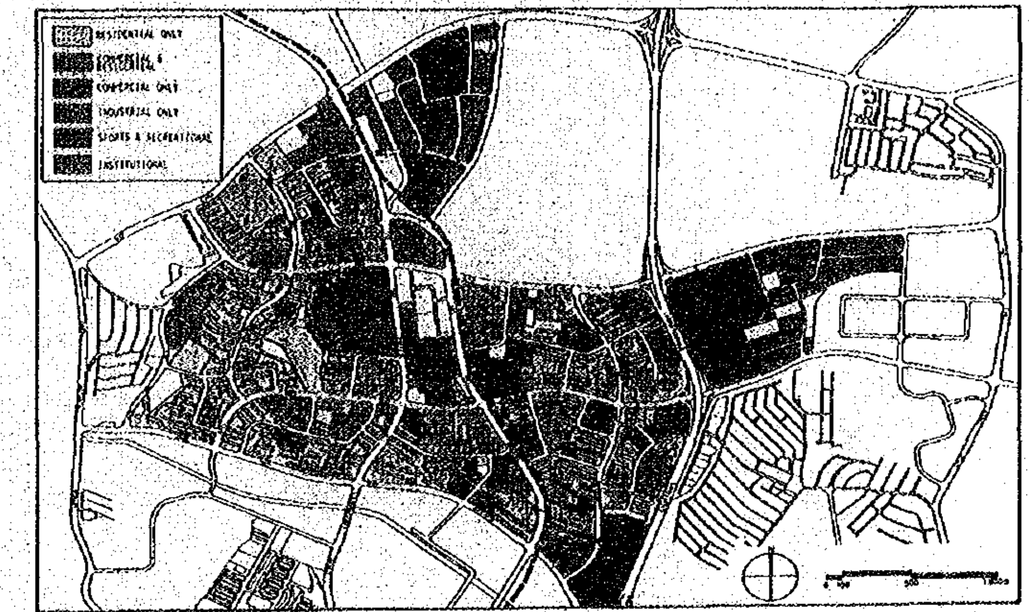
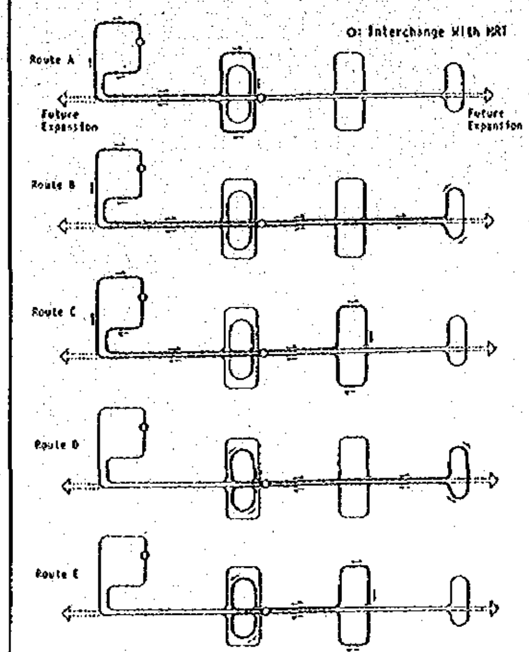
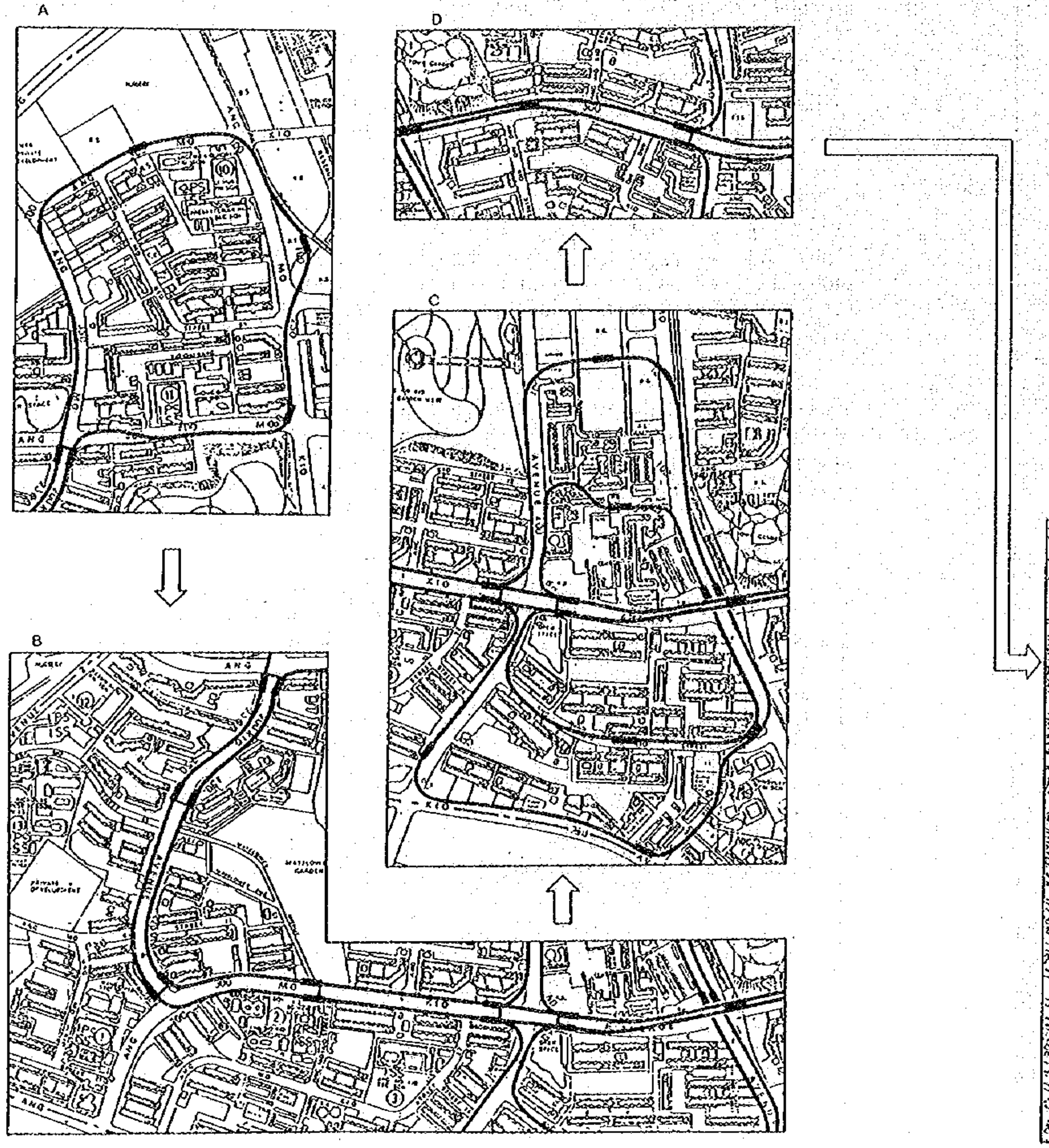


Figure 7.4
Operational Characteristics of Selected Services



Item	Service Type			Total Operation
	A	B	E	
Service length (single track in km)	9.5	12.8	7.6	21.6
No. of Sta.	20	28	18	29
Ave. Station Spacing (m)	475	456	422	420
Max. Speed (kph)	60	65	60	60-65
Scheduled Speed (kph)	21.1	21.5	19.1	19-22
Turn-around Time (min)	27	36	24	-
Headway (min)	6	6	6	3
No. of trains Allocated	4	7	4	15

(Cont. Figure 7.4)



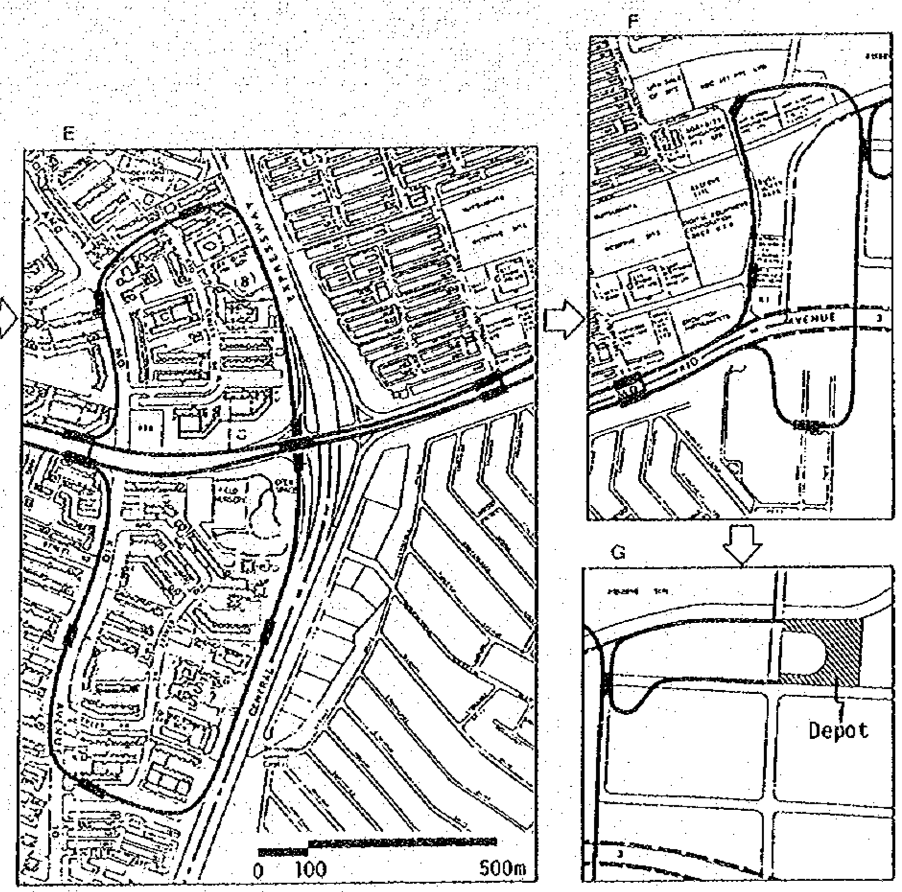
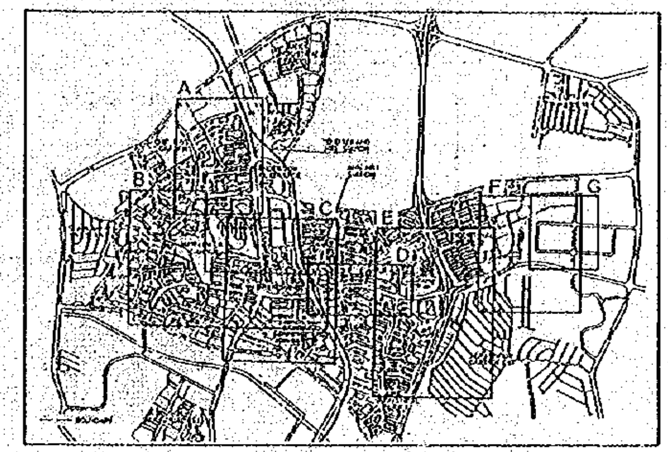


Figure 7.5
Location of the Alignments of the Proposed Ang Mo Kio New Transit System



7.3 Facility Plan

- o Related facilities, i.e., carriageway structure, stations and terminals, depot/workshop, were studied in detail with due consideration of; (a) preparation of a set of preliminary design standards to be applied for the proposed system, including loading condition, geometric standards for alignment, especially minimum curvature and maximum gradient, (b) comparison of concrete structure and steel structure, (c) aesthetic aspect of structures, (d) environmental consideration, and (e) users requirement and convenience with particular regard to the stations.

- o The basic design policy for the stations is to simplify facilities as much as possible to lower costs, but to allocate more budget for provision of access facilities such as lift and slope. Ang Mo Kio central station, was planned such that the station be constructed right above the MRT so that passengers can transfer directly from one platform to the other. (see Figure 7.6 , Figure 7.7 and Figure 7.8)

- o It is more economical to put both depot and workshop in the same location rather than provide them separately. Space requirement is approximately 1.4 hectares for two storey-type or 2.7 hectares for at-grade type, location of which will be in the industrial area, east of the New Town.

Figure 7.6
Conceptual Cross Section of
Typical Intermediate Station

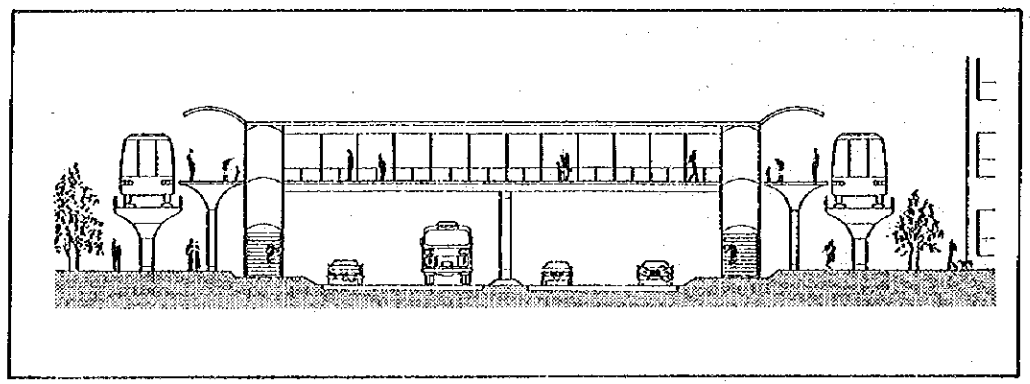


Figure 7.7
Conceptual Illustration for
Ang Mo Kio Central Station

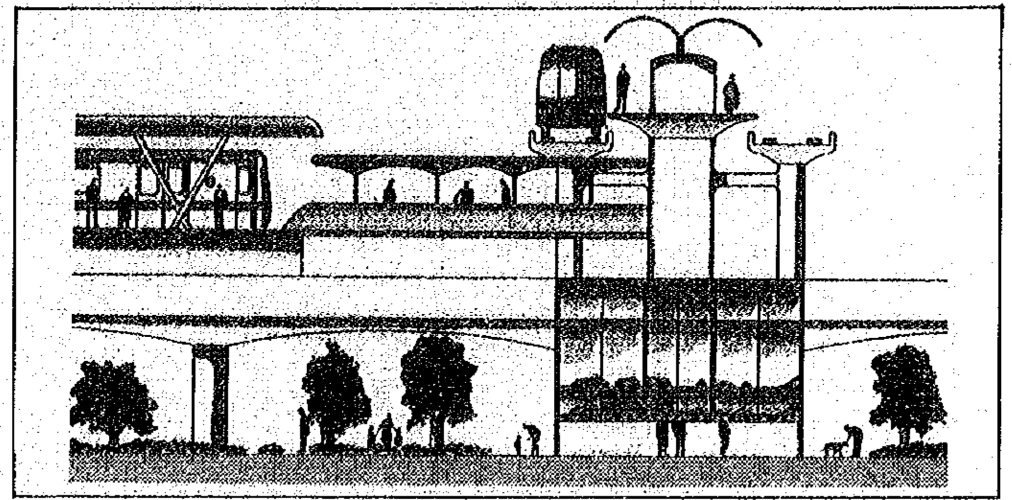
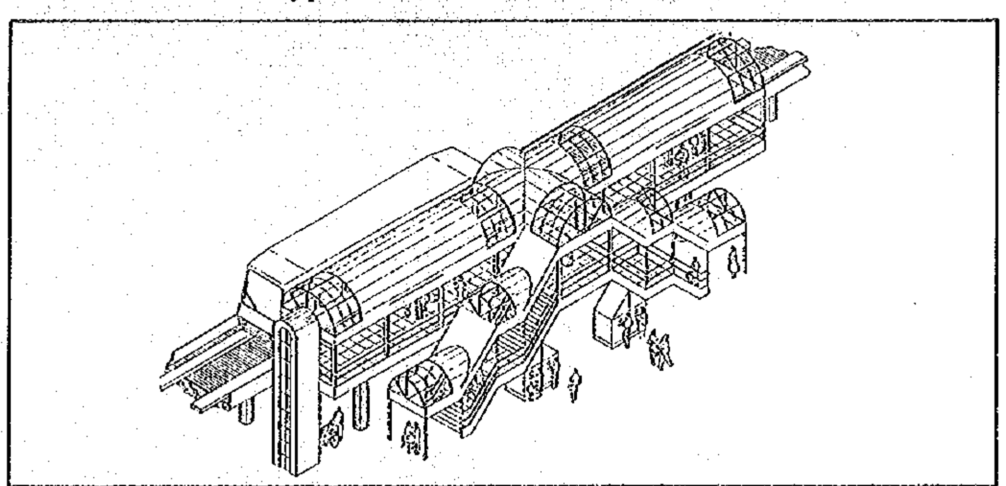
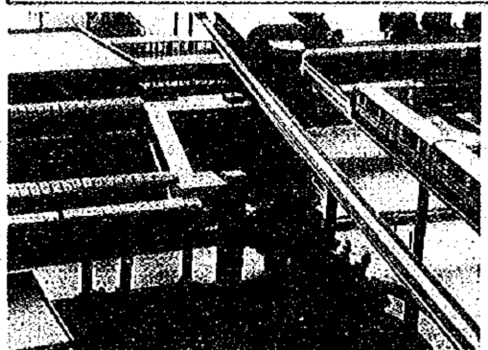
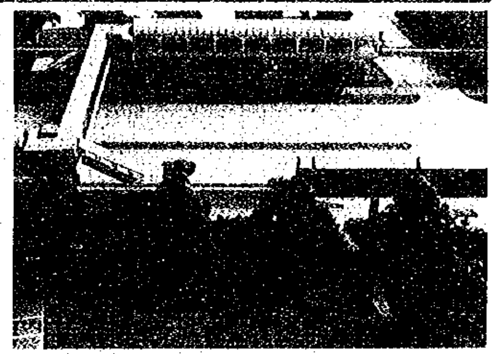


Figure 7.8
Typical Intermediate Station





Central Station



Intermediate Station

7.4 Project Cost and Evaluation

- The total investment cost is estimated to be S$354 million or S$16.4 million/km. (single-track length). Of the total investment costs, infrastructure costs, including civil works and station/building, share 44% while vehicle cost is 20% of the total. The operating cost is estimated to be S$7.6 million/ year or S$20,720/day. (see Table 7.2 and Table 7.3)

- The economic impact due to the completion of the project is extensive on transportation, environment and urban development aspects. However, the tangible benefits are limited. Reduction in travel time alone would generate an EIRR of 8.5% at an estimated average time value of S$3.1 for year 1988 and S$6.6 for year 2000.

- The results of the financial analysis are summarized, as follows:

  (a) Without government subsidy, the project will not be financially viable.

  (b) If the government provides the cost of civil works and stations, the project will produce a positive internal rate of return of 2.7% at S¢30 fare level and 7.0% at S¢40.

  (c) If the government provides for all investment costs, with the exception of vehicles, the project will give an attractive financial return of 14% at S¢30 fare.

- Positive environmental impact is expected in terms of noise and air pollution. Although the present environmental conditions in the new town are well within standard norms, the proposed transit system would further improve the situation. Impact on landscaping is subject to the design of structures and facilities. Light and single track guideway could add positive aesthetic value to the new town landscaping. Overall amenity in new town environment is expected to be significantly improved. Reduction in road traffic will not only increase road safety but will also increase road space, which can be of more and better use to pedestrians and other non-transport activites in the new town (see Table 7.4).

Table 7.2
Summary of Investment Costs
for Proposed Ang Mo Kio System

Item	Amount: S$ 000	%
1) Civil Work	131,310	37.0
2) Station/Building	23,210	6.6
3) Depot	26,800	7.6
4) Vehicles	70,720	20.0
5) Power Supply	48,490	13.7
6) Control/Signalling/ Telecommunications	53,610	15.1
Total	354,140	100.0
Cost/km. (Single track lenght) : 16,400		

Table 7.3
Estimated Operating Cost for
Proposed Ang Mo Kio System

Item	Amount: S$ 000	%
1) Vehicle Maintenance	1,523	20.1
2) Maintenance of Equipment and Facilities	2,592	34.3
3) Electric Consumption	1,431	18.9
4) Manpower	1,330	17.6
5) Overhead	688	9.1
Total: per year (S$ 000)	7,564	100.0
per day (S$)	20,723	-

Table 7.4
Environmental Consequences of New Transit System

Impact and Possible Consequences			NTS User	Road User	Community
Impact on Traffic	Reduction in Bus Traffic	Reduction in Noise and Air Pollution	○	○	○
		Removal/Replacement of Bus Facility	—	△ Saved space can be used for other purposes	
		Improvement of Road Traffic Safety	△	○	○
	Generation of NTS Traffic	Improvement of Transport Amenity	○	—	—
	Changes in Pedestrian Traffic flow	Modification to Pedestrian Facilities	*	*	*
		Impact on Landuse	○	—	○
Construction on NTS Facilities	Station / Structures	Visual Effects	*	*	*
	Structures	Blocking of Sunlight and Foliage	—	—	—

○ : Positive impact
△ : Positive limited impact
— : Insignificant impact
* : Impact could be positive or negative

8. CASE STUDY FOR SIMPANG NEW TOWN

8.1 Planning Concept

o The purpose of selecting Simpang New Town for a case study is to assess whether or not a new transit system can be more effectively applied when it is developed in an integral manner together with the new town.

o The proposed Simpang New Town, located at the northern part of the island, approximately 20 km. from CBD, is expected to accommodate around 30,000 dwelling units or 120,000 persons. a preliminary plan has been prepared by HDB. Its land area, which extends 4 kms. nothwest to southeast and 2 kms. northeast to southwest, covers about 700 hectares including two offshore islands, 50 hectares and 90 hectares, respectively.

o New towns are designed based on the neighbourhood concept. The features of the neighbourhood unit will basically fit the proposed new transit system when a station is allocated to a neighbourhood unit. Each neighbourhood unit would have a radius of 300 to 350 meters centred on a station to allow ease of access. If the current planning concept is modified to have better integration with the new transit system, additional advantages are expected, such as clear segregation of car from pedestrian, better control of cars entering into the community and a resultant increase in environmental amenity (see Figure 8.2).

o From the transport planning viewpoint, considerations were given to the following:

- Efficient linkage among various land uses within the New Town must be provided.

- Efficient link between the New Town and the CBD must be provided by the linking system directly with the MRT at Yishun Station.

- Since Yishun New Town is large enough to have its own system, Simpang system will be separated from the Yishun one.

Route plan for the entire new town is shown in Figure 8.3.

Figure 8.1
Project Site

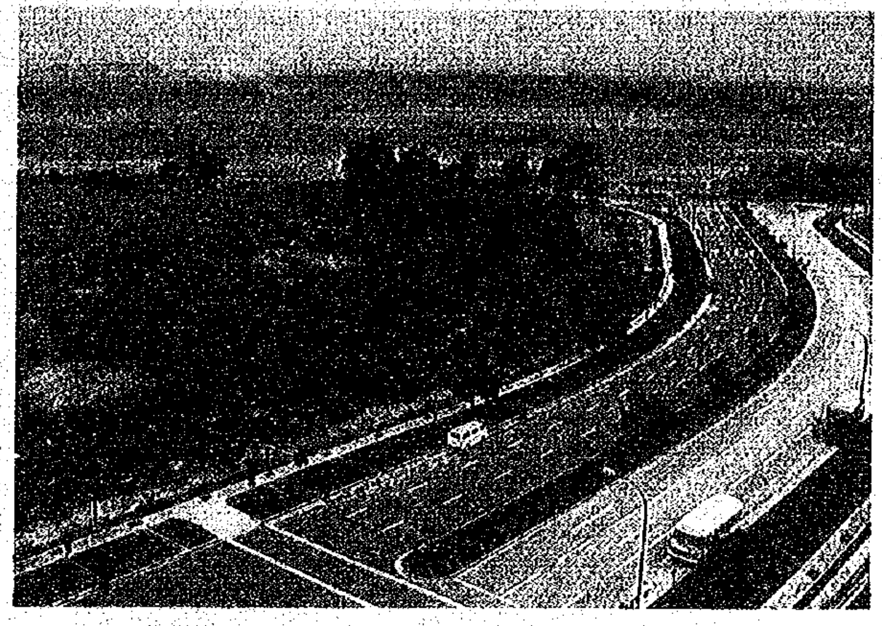
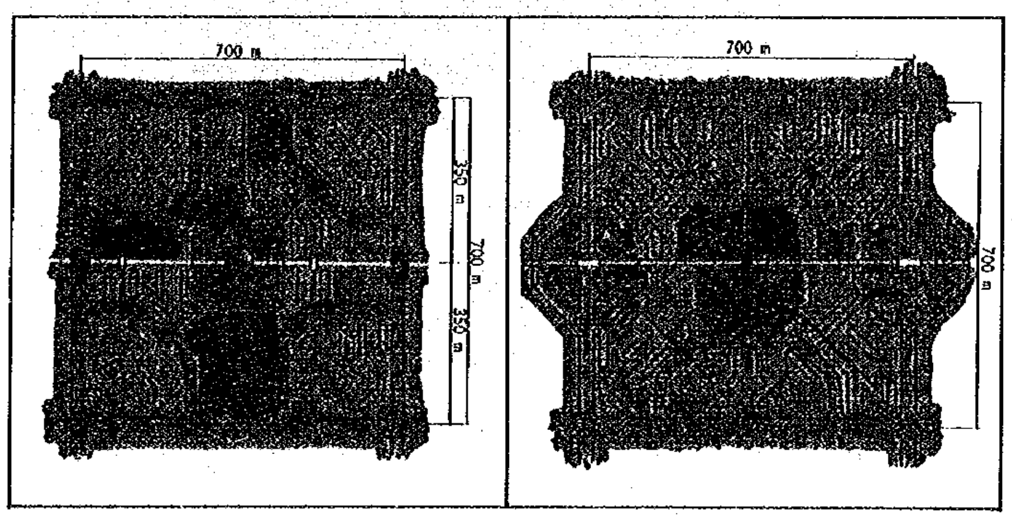


Figure 8.2
Alternative Planning Concept for Neighbourhood Unit Integrated New Transit System



8.2 System Plan

- The preliminary physical plan for the proposed transport system of Simpang New Town has the following characteristics:

  (a) The proposed transport system will have a total route lenght of 25 kms. (single track length), including a connection with Yishun MRT station.

  (b) The alignment within the new town is basically at-grade. However, where the system intersects with roads or pedestrian paths, it will be grade-separated either above or below ground level.

  (c) With relatively long station spacing made possible due to integrated development, the average scheduled speed will be 26 to 29 kph.

  (d) Loop routes within the new town will encourage access to various facilities and residential units located in other neighbourhoods and strengthen the community bond of the residents.

  (e) Stations will also be constructed according to the same planning concept. Not only stairs but also slope and lift, when and where necessary, will be provided to facilitate easy access and use of stations.

- The transport demand of Simpang New Town was estimated based on trip rate and travel pattern analysed in Ang Mo Kio New Town. Total traffic demand was estimated to be about 307,000 person trips/day. Considering the geographical location and transport network of the country, it is likely that the people would rely more on the MRT when a good feeder system is provided. Simpang New Town can be designed in such a way that people can have access to the new transit system station with ease at a maximum walking distance of about 300 m. The entire area can be fully covered by frequent, comfortable, and fast services. It is, therefore, not impossible to attract almost all public transport passengers and even expect considerable diversion from private transport. The estimated passenger ridership on the proposed system can reach 150,000 to 200,000 passengers a day, or even more.

Figure 8.3
Conceptual Development Plan for Simpang New Town

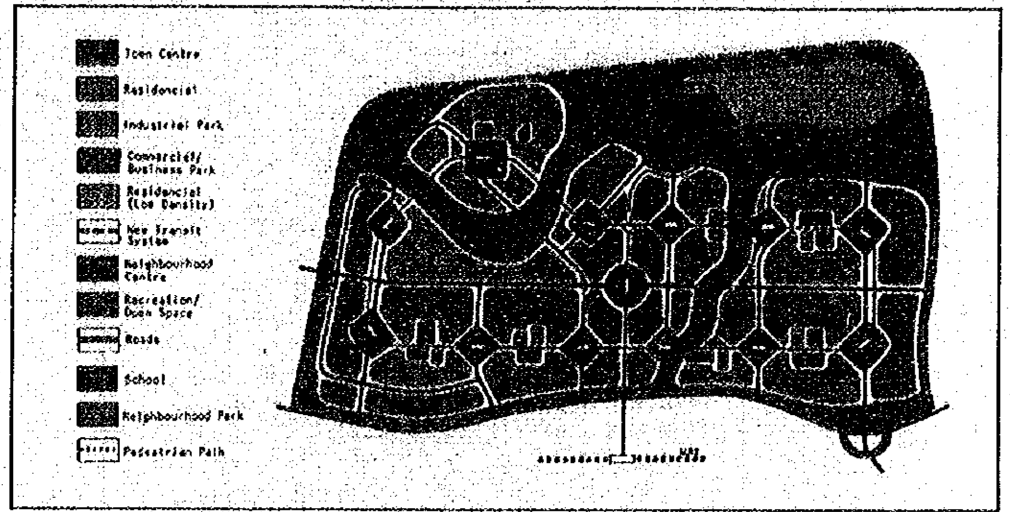
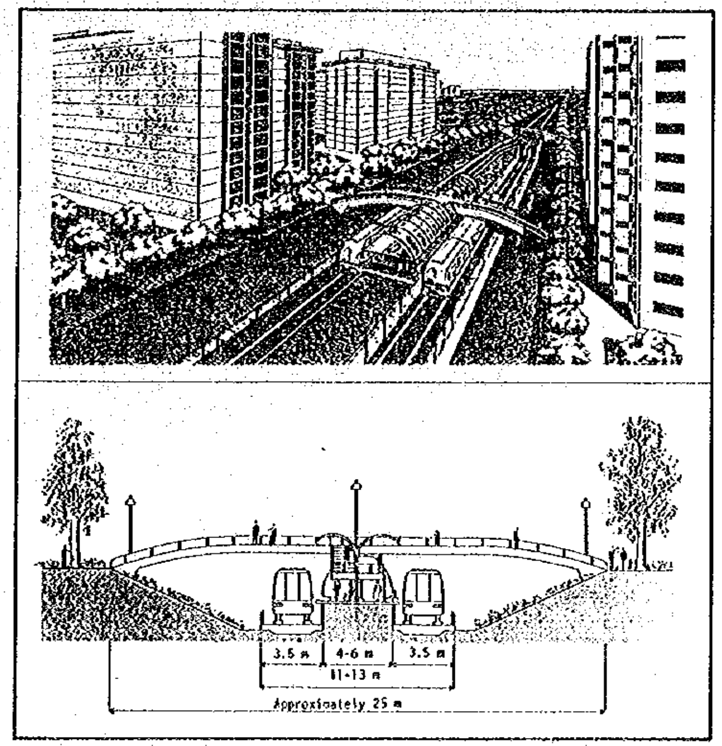


Figure 8.4
Conceptual Illustrations
of the Depressed Carriageways



8.3 Project Cost and Evaluation

- The estimated total investment cost is approximately S$306 million. The investment cost/km. is only about S$12 million/km. even with the inclusion of a grade-separated section between Yishun MRT station and the new town. This is largely due to the difference in civil work for grade-separated and depressed carriageways. The operating cost is S$8.7 million or S$18,780/day. (see Table 8.1 and Table 8.2)

- The economic viability of this project is significantly high due to the reduced construction cost and the increased accessibility through the integrated development approach. The proposed system will also contribute to the reduction in space of major roads by 15 to 25% of the total road space. The estimated savings from road construction alone is approximately S$28 million.

  With an estimated passenger patronage of 200,000/day, the project would generate an FIRR of 3.4% at the assumed fare of S¢30/trip (if the government shoulders civil works and station costs). An increase in fare to S¢40/trip, on the other hand, would generate an FIRR of 4.3%, even without government involvement, except land. If the project shoulders only the vehicle cost, the FIRR would be 15.6%, even with a S¢30 fare. This implies that the cost of infrastructure can be included into the new town development cost, while the operation is maintained by users of the system.

- Positive effects on landscaping and overall amenity of new town due to the construction of the project would be more significant than in the cases of Ang Mo Kio, as opportunities of coordinated and integrated developments are higher.

Table 8.1
Estimated Investment Cost for
Proposed Simpang New Town System

Cost Item	Amount (S$ 000)	%
1) Civil Work		
a) Viaduct/Bridge	39,220	12.8
b) At-Grade Carriageway	44,660	14.6
Sub-Total	83,880	27.4
2) Station/Terminal and Building	19,370	6.3
3) Depot	27,850	9.1
4) Vehicles	71,760	23.5
5) Power Supply System	53,420	17.5
6) Control/Signalling/ Telecom Systems	49,590	16.2
Total	305,870	100.0
Cost /km. (Single track length)	12,230	-

Table 8.2
Estimated Operating Cost for
Proposed Simpang New Town System

Cost Item	Amount (S$ 000)	%
1) Vehicle Maintenance	2,212	25.4
2) Maintenance of Equipment and Facilities	2,418	27.8
3) Electric Consumption	2,085	24.0
4) Manpower	1,199	13.8
5) Overhead: 10% of the above	771	9.1
Total: per year (S$ 000)	8,705	100.0
per day (S$)	23,849	-

Table 8.3
Comparison of Construction Cost Between
Grade-Separated and Depressed Carriageways

Grade-Separated	Depressed
S$ 12,280/km	S$ 6,810/km

9. CASE STUDY FOR OTHER AREAS

9.1 AMK - Hougang - M. Parade Route

- The study area comprises three major communities; Ang Mo Kio and Hougang new towns and Katong. The study area has a population of 230,000 and 66,000 employment in 1981 (excluding Ang Mo Kio new town) and since then, has been growing rapidly. The route provides the first major circumferential transit service in this region and links central corridor with eastern corridor directly. The route extends 12.6 km. with a grade separated system.

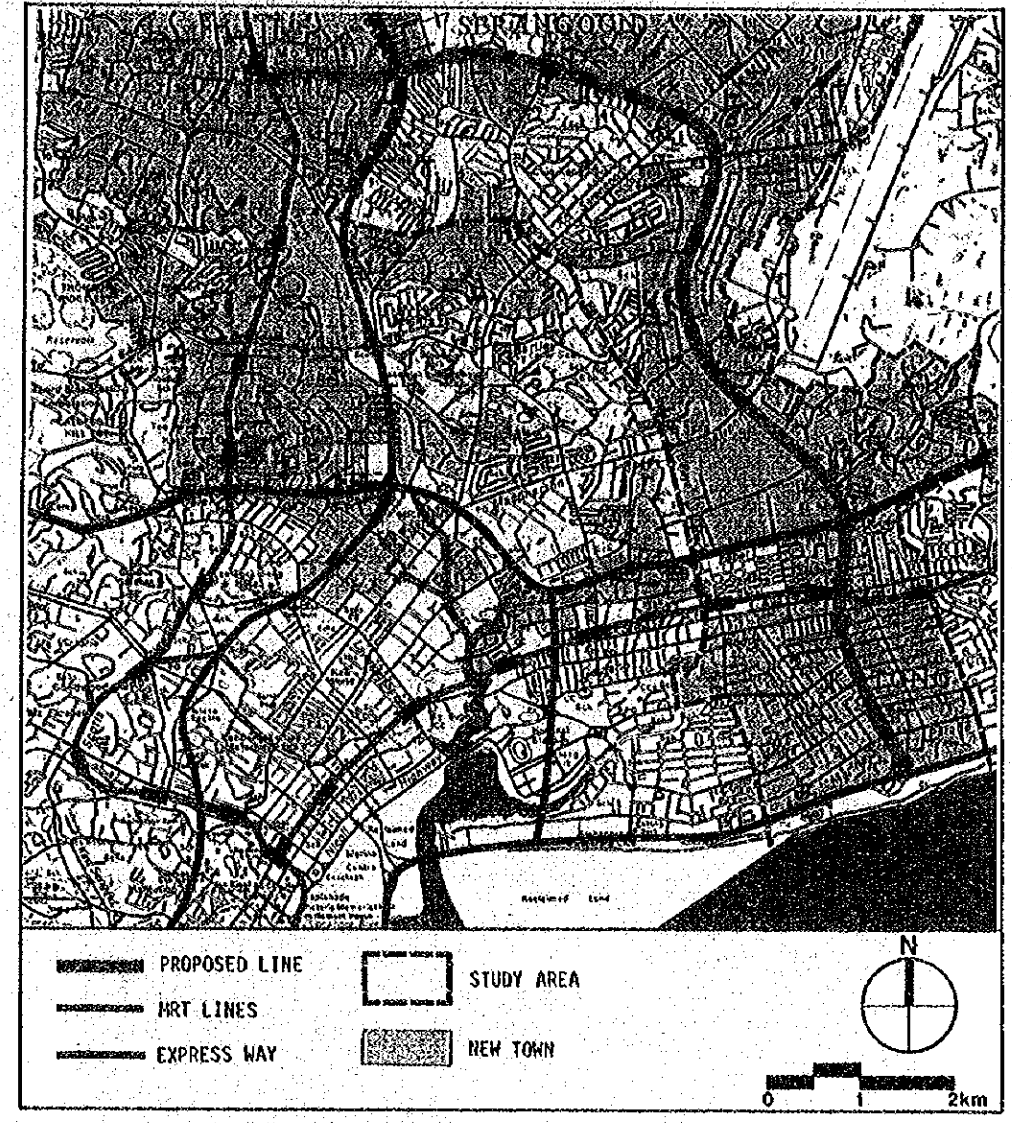
  The expected passengers are mainly three types: traffic moving within the study area, feeder traffic to/from the MRT and trunk bus and inter-zonal traffic moving along the route. The potential 112,600 passengers form roughly 17% of the total traffic demand of the study area. A high density of traffic is foreseen in the sections between Ang Mo Kio and Upper Serangoon Road and near the MRT in Katong area, where the sectional traffic was estimated to be about 55,000/day.

- The same system as that for Ang Mo Kio has been selected to be integrated with the Ang Mo Kio system. Accordingly, the integrated system will not only function as a feeder transport but also as a vital secondary transport route to strengthen and complement the trunk system. There are 18 stations with an average station spacing of 700 meters. The system provides services at three minutes intervals during peak hours and 5 to 6 minutes during off-peak hours with two-car trains. The average travel time is 25 minutes (one way) with a scheduled speed of 29 kph. The estimated construction cost of the project is about S$ 340 million or S$13.3 million/km. Operating and maintenance costs are S$6.6 million/year or S$17,950/day on the average.

- The project is economically feasible. Time savings of 5 minutes per passenger alone would give a B/C ratio of 1.4 at 2% discount rate or EIRR of about 5%. The expected impact of this project is also on the urban development. With Ang Mo Kio new transit system completed, incremental cost benefit ratio for this route becomes more favourable.

  Financial viability of the project is assured if the government will assist in providing part of the infrastructure costs. If civil works and station costs are shouldered, the project generates FIRR of 5% and 10% under the average fare of S¢50 and S¢70 for 100,000 riders a day, respectively.

Figure 9.1
Ang Mo Kio - Hougang - Marina Parade Route



9.2 Orchard - Sentosa Route

- The study area is characterized by a combination of different land uses. Orchard and Sentosa are two major tourist destinations, and the areas in between comprise of new town, industrial area, commercial area, and others. Approximately 150,000 persons in 1981 reside in the area. Two projects are currently underway. One is the construction of a causeway to link Sentosa Island with the Mainland. The other is to develop Sentosa Island farther to attract more visitors from the 1987 record of 2 million to about 4 million by the early part of 1990s.

  The estimated total traffic demand of the area is about 435,000 trips/day, of which the potential demand for the proposed system is roughly 100,000 trips/day. Non tourism traffic of about 90,000 trips/day is dominant during weekdays, while Sentosa traffic will increase sharply to about 40,000 on Sundays and holidays after the completion of the planned development.

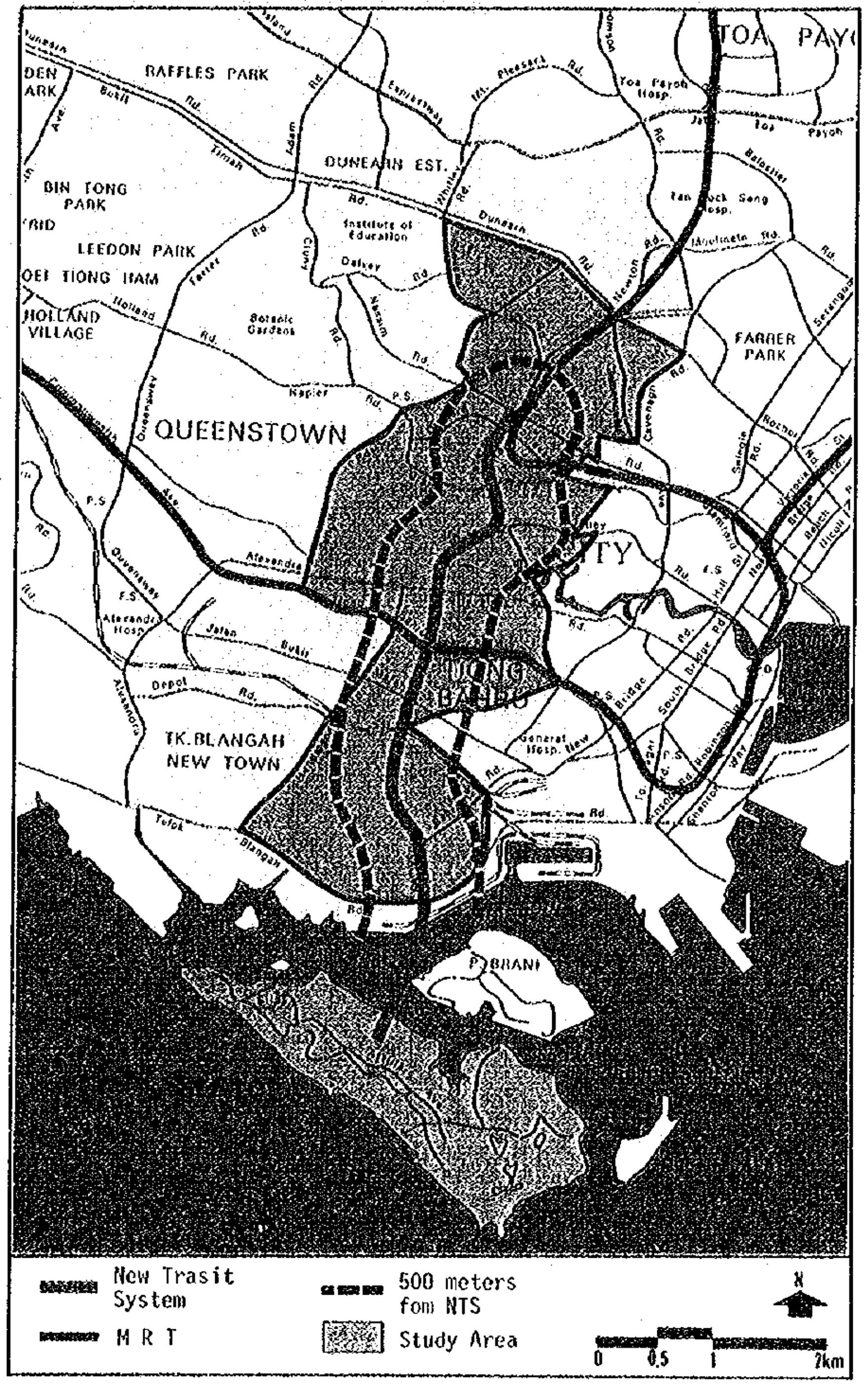
- Options for the system will include minimonorails (straddle type and suspension type) and the type of Ang Mo Kio new town. The system for the route should be separated from the existing and future systems of Sentosa Island considering that the required performance is different between the two systems and handling of visitors and control of entrance are easier. The proposed route runs through 5.6 kms., double-track, with 10 stations of an average spacing of 620 meters. The system with a 150-passenger capacity train provides services at three minutes interval during peak hours and 5 to 6 minutes during off-peak hours.

- The estimated construction cost of the project is S$158.8 million or S$14.2 million/km. Operating and maintenance costs total S$3.6 million/year of S$9,800/day on the average.

  The project can also be considered economically feasible by taking into account expected time savings only. The estimated B/C ratio of the project is 1.7 at 2% discount rate. If the average fare of S¢50 for 100,000 passengers can be charged, the project will generate an attractive financial return of about 15%. (It is assumed that Government will shoulder civil work and station costs including land.)

  One unique characteristic of this route is its role in providing a direct link between Orchard area and Sentosa. This route, therefore, will not oly encourage tourism development in Sentosa but will also integrate two strategic areas. The system must be developed in an integral manner with the urban/toursim developments.

Figure 9.2
Orchard-Sentosa Route



9.3 Orchard - Marina Centre Corridor

o The new transit system is aimed at revitalizing both transportation (accessibility) and urban development. The existing internal transport system, including walking, does not necessarily provide a high level of services which would restrain more attractive commercial developments in the future. This Project intends to propose a concept of improving and encouraging internal activities through the introduction of a new transit system that considers users requirements, flexible operation, aesthetic appeal, and urban development.

o The study area covers Orchard, Bras Basah, and Marina Centre. In 1981, the population was only 18,000 while employment was 64,000. It has been estimated that population will decrease to 13,000 while employment will increase to 101,000 by 1990.

Total traffic demand of the areas is about 420,000. Potential demand for the proposed system consists of the existing motorized trips moving within the area, feeder traffic to/from the MRT and trunk bus and diversion from pedestrians. With all modes of transport with good coverage and services, potential traffic demand is not expected to be so large interms of volume. There is, however, a higher percentage of tourists and shoppers, and, thus, patronage to the proposed system, may be largely affected by the level and nature of services which the system can provide. It is estimated that the proposed system would attract roughly 50 to 60 thousand passengers a day.

o A suspension-type minimonorail was selected. The route consists of two loop routes; one with a lenght of 5.1 kms. to serve the Orchard area and the other with a lenght of 3.7 kms. to cover Marina Centre and Bras Basah areas. A number of stations were allocated close to the major buildings to facilitate direct access to passengers. A total of 34 stations were provided with average station spacing of about 250 meters. The system with smaller passenger capacity provide frequent services throughout the day. Construction cost is estimated to be S$235 million for both system. Higher unit construction costs of S$26.7 million/km is expected due to the structures and stations in heavily developed areas along the proposed route. Operation and maintenance costs are about S$2.9 million/year or S$7,940/day.

o The economic viability of this proposal needs examination more in its integration/compatibility with urban development than purely from transportation aspect, although the expected benefits from transportation (mainly time savings) are considered large.

The associated financial viability also depends largely on the extent the government can provide the infrastructure costs. If the government can cover civil works cost, while commercial establishments cover station cost and users take care of the rest, the project is financially viable with the assumed fare of about S$1.0 for 50,000 passengers.

Figure 9.3
Orchard-Marina Centre Route

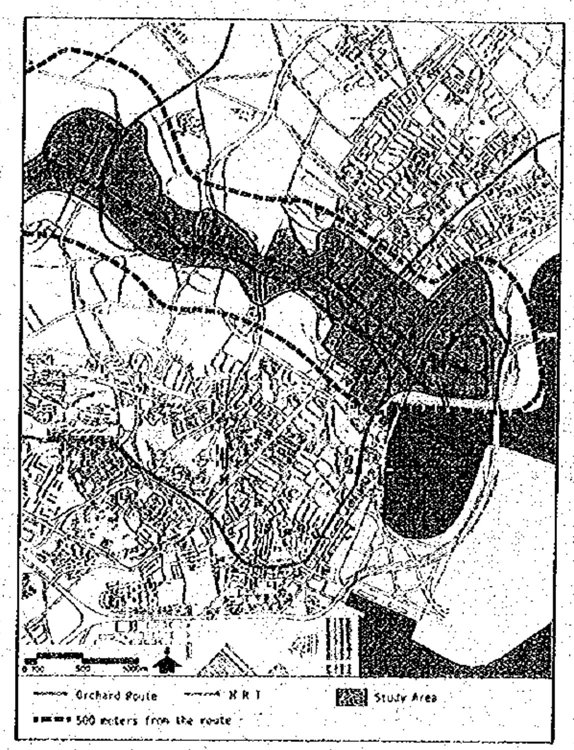


Table 9.1
Outline of the Operation of the Proposed System for Orchard Corridor Route

Item	Loop A	Loop B
1) Route of Length	5.1 km	3.7 km
2) No. Stations	21	13
3) Ave. Section Spacing	245	280 meters
4) No. of Trains	11 + 2 (spare)	7 + 2 (spare)
5) No. of Cars/Trains	1	1
6) No. of Cars Required	13	9
7) Capacity of a Car	45 passengers	45 passengers
8) Headway : peak	1.5 -2	1.5 -2
: off-peak	3 - 5	3 - 5
9) Scheduled Speed	14.7	15.6
10) Turn Around Time	21 minutes	14 minutes
11) Frequencies	370/day	370/day
12) Train-kms	2,000/day	1,350/day
13) Car-kms	2,000/day	1,350/day

Figure 9.4
Profile of the Selected System