

**URBAN TRANSPORT STUDY
IN
GREATER METROPOLITAN AREAS
OF
GEORGETOWN, BUTTERWORTH AND BUKIT MERTAJAM**

MALAYSIA

HIGHWAY INVENTORY SURVEY

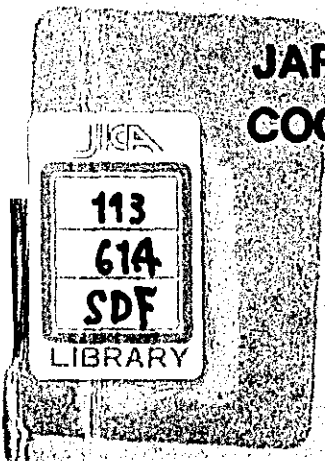
TECHNICAL REPORT - 10



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**JAPAN INTERNATIONAL
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**GOVERNMENT OF
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HIGHWAY INVENTORY SURVEY

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1.

Introduction.

The objective of this highway inventory survey is to know the condition of existing road in study area.

There are 15 survey stations in Penang Island and 16 survey stations in Province Wellesley.

This survey studies the functions, traffic characteristics, cross section and conditins of the existing roads.

The cross section was measured using a tape, and the traffic capacity volume of each cross section was also calculated. The percentage of trucks and buses were assumed for this purpose.

Results of the Survey in Penang Island

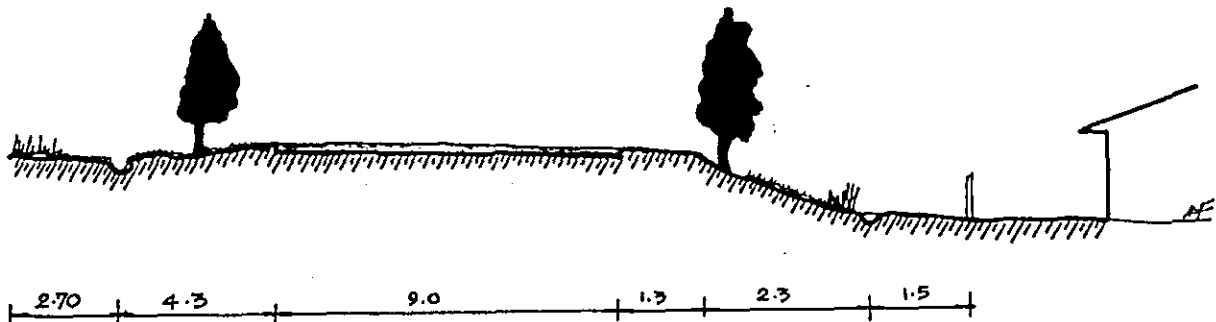
2-1

NORTHAM ROAD (Station G-1)Functions and Characteristics.

- 1) This road is the primary road that connects Georgetown to Batu Ferringhi.
- 2) It is the primary street inside of Georgetown.
- 3) Trips made outside the city-limits of Georgetown are long trips and trips made inside the city-limits are short trips so that this road has two different types of traffic flow.

Traffic Characteristics.

- 1) There is a heavy flow of cars, motorcycles and bicycles on this road.
- 2) The volume of traffic on this road is high and as such the traffic capacity of the road is reduced.

Cross Section.

NORTHAM ROAD

Conditions.

- 1) There are no pedestrians on both sides of the road.
- 2) There is no problems with the geometrical design of the road.
- 3) The condition of the pavement is good and there is no necessity for improvement or for overlays.

2-2

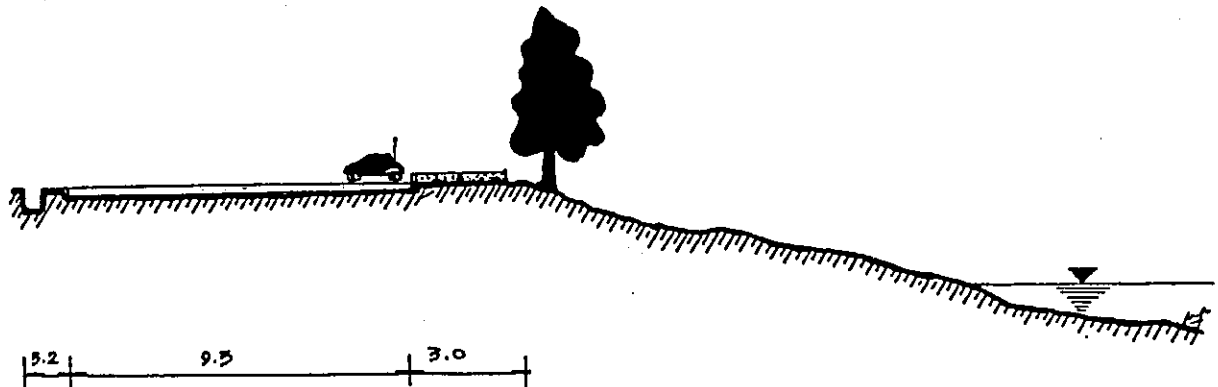
GURNEY DRIVE. (Station G-2)Functions and Characteristics.

- 1) This road is used as walking grounds.
- 2) Therefore, only short trips are made on this road.

Traffic Characteristics.

The traffic on this road does not include trucks and buses.

Cross Section.



GURNEY DRIVE

Conditions.

- 1) There are pedestrians on both sides of the road.
- 2) The pavement is in a poor condition only in certain parts.
- 3) Cars are parked only on one side of the road.

2-3

JALAN GOTTLIEB. (Section G-3)

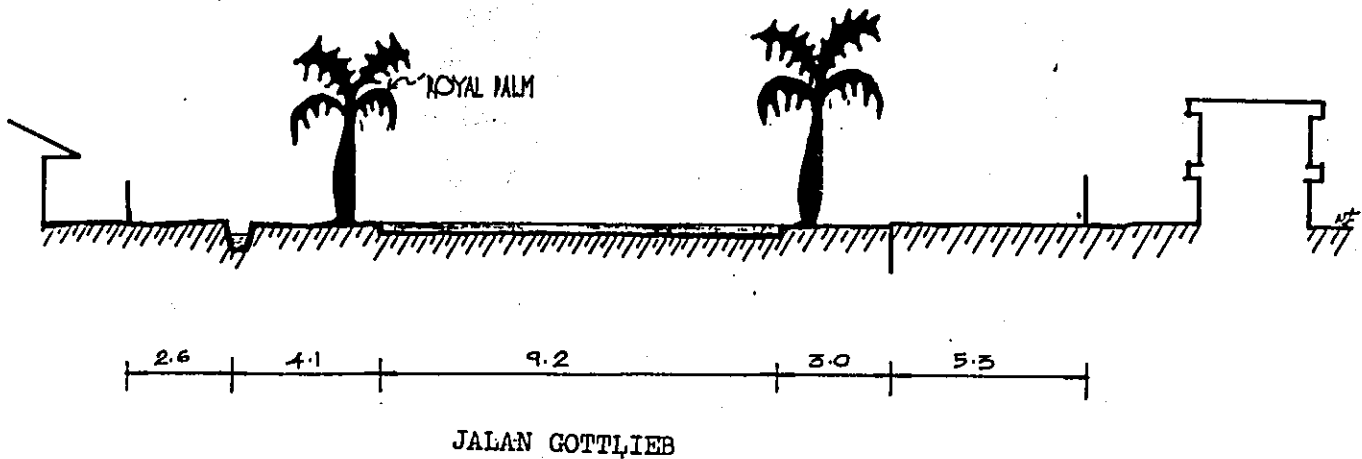
Functions and Characteristics.

- 1) This road constitutes a section of the external ring-road of Georgetown.
- 2) The length of this road is about 2 km. and there are no special characteristics that it has.

Traffic Characteristics.

- 1) As there are 2 schools along this road, many students make use of the side walks.
- 2) The proportion of trucks to other vehicles is comparatively small.

Cross Section.



Conditions.

- 1) There are pedestrians on both sides of road.
- 2) The condition of the pavement is good.
- 3) There is no problem with the geometrical design of the road. The road alignment is of a large radius and the longitudinal grade is about 1%.
- 4) From the environmental point of view, it would be difficult to expand the width of the road on the side of the school but it would be possible to do so on the other side which is a residential area.

2-4

JALAN BURMA. (Station G-4)

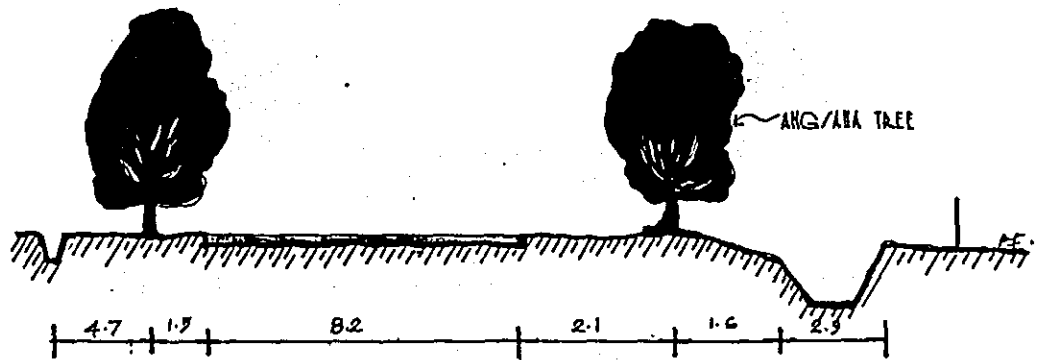
Functions and Characteristics.

- 1) This road is the main radial road which connects Georgetown to Batu Ferringhi and as such long distance trips are made.
- 2) Inside of Georgetown, this road forms a ring-road and therefore short distance trips are made via this road.

Traffic Characteristics.

- 1) There are many types of vehicles including motorcycles and bicycles and also pedestrians especially in the morning and afternoon.
- 2) As traffic flow increases, the traffic capacity on this road decreases.

Cross Section.



JALAN BURMA

Conditions.

- 1) The environmental aspect of this road is very good. There are large trees on each side of the road, which makes it look like a "tree tunnel".
- 2) The pavement condition is good, but nearer the trees, there is a lack of lateral clearance.

2-5

JALAN MACALISTER. (Station S-5)

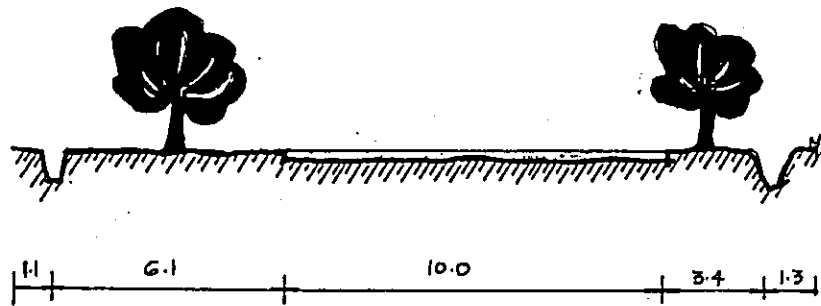
Functions and Characteristics.

- 1) This road is a radial road but it is not of very long length.
- 2) Due to the above reason, only short distance trips are made on this road.

Traffic Characteristics.

- 1) This road passes through the centre of Georgetown, and so short distance trips are made.
- 2) For this reason, the volume of lorry traffic is small but during peak hours there is traffic congestion in the morning and afternoon.
- 3) The volume of traffic at other times is very small.

Cross Section.



MACALISTER ROAD

Conditions.

- 1) As there are many large trees on both sides of the road which provides shade, the environmental aspect of the road is very good.
- 2) As the pavement of this road is not very good, it would be difficult to widen the road for which reason, improvement of the asphalt overlay must be made in the future.

2-6

BRICK KILN ROAD. (Station G-6)

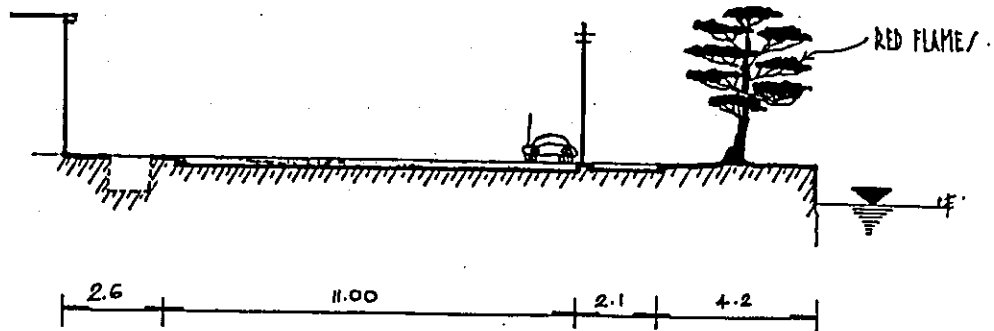
Functions and Characteristics.

- 1) This is the main radial road which connects the C.B.D. areas of Georgetown to the areas in the direction of the airport in Bayan Lepas.
- 2) For this reason, this road is used more for long distance trips.

Traffic Characteristics.

- 1) Since traffic flow on this road is from the C.B.D. area, there are various kinds of vehicles, that is, cars, motorcycles, bicycles, heavy lorries and buses. Moreover, the traffic flow on this road is very heavy.
- 2) For this reason, this road has adopted a one-way traffic system.
- 3) There is parking on one side of the road, and this is an obstacle to the volume of traffic which is decreased greatly due to this.

Cross-section.



BRICK KILN ROAD

Conditions.

- 1) The condition of the pavement is good, and there are sidewalks on both sides.

2-7

JELUTONG ROAD. (Station G-7)

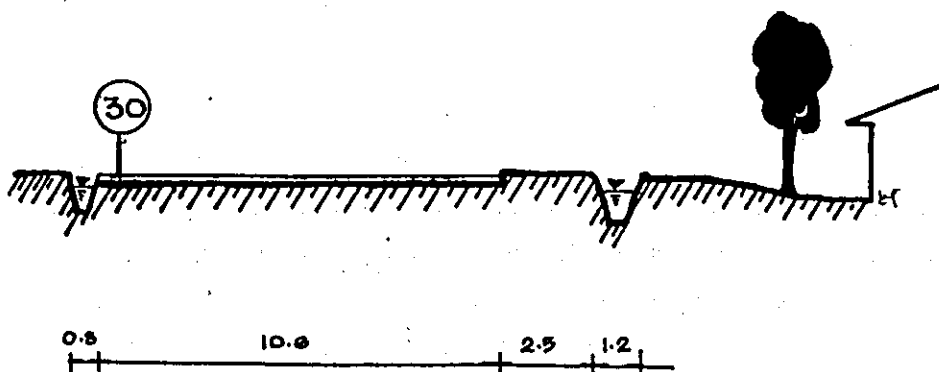
Functions and Characteristics.

- 1) This is a main radial road which connects the C.B.D. in Georgetown to Bayan Lepas airport areas. Thus, long distance trips are made.
- 2) From all other aspects, the functions and characteristics of this road are the same as that of BRICK KILN ROAD.

Traffic Characteristics.

- 1) Traffic characteristics are the same as that of BRICK KILN ROAD.
- 2) The running speed is about 50km/hour.

Cross Section.



JELUTONG ROAD

Conditions.

- 1) There are sidewalks on each sides of the road.
- 2) The carriageway is wide, but the lane is narrow.
- 3) As the asphalt pavement is in a poor state, improvements must be made on the road surface in the future.

2-8

JALAN GELUGOR. (Station G-8)

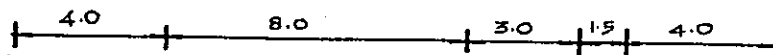
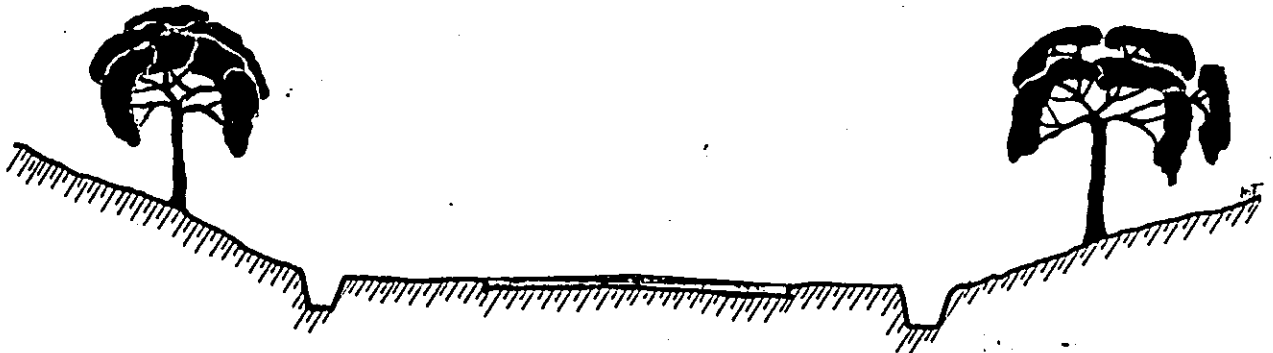
Functions and Characteristics.

- 1) This road connects the urbanized area of Georgetown to Bayan Lepas area.
- 2) This is the only route that links these two areas and one has to pass through it to get from one to the other.
- 3) As such, this is a very important main route.

Traffic Characteristics.

- 1) This road is a main radial route.
- 2) As such, there are various vehicles, i.e., motor-cars, motor-cycles, heavy lorries, buses and bicycles.
- 3) The peak hours in the morning and afternoon are very congested with vehicles.

Cross Section.



JALAN GELUGOR

Conditions.

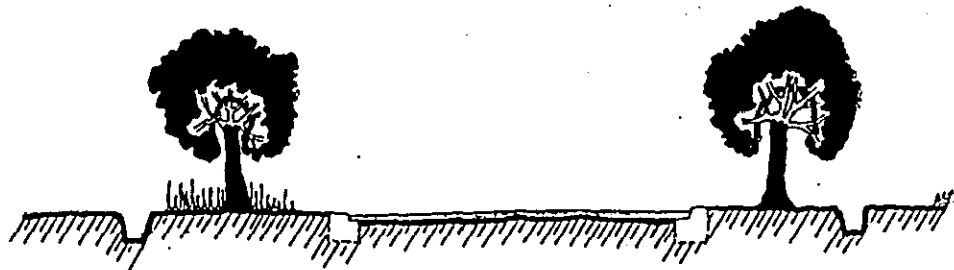
There is sufficient width interms of lateral clearance and carriageway but the pavement of the carriageway is in poor condition so that there is a need for improvement of the asphalt pavement surface in the near future.

JALAN PERAK. (Inclusive of stations G-9 and G-10)Functions and Characteristics.

- 1) This road is the 2nd main ring-road and it's total length is about 5 km.
- 2) The traffic flow inside of Georgetown is concentrated on this road and therefore short distance trips are made along this road.

Traffic Characteristics.

- 1) Both ends of this route is connected to the radial road. However, there are not many heavy lorries.
- 2) The traffic flow is made up of a variety of vehicles, i.e., motor cars, motor-cycles, trishaws and bicycles. There are also many pedestrians on this road. In peak hours, it seems an impossibility to pass through this road smoothly.

Cross Section.

JALAN PERAK

Conditions.

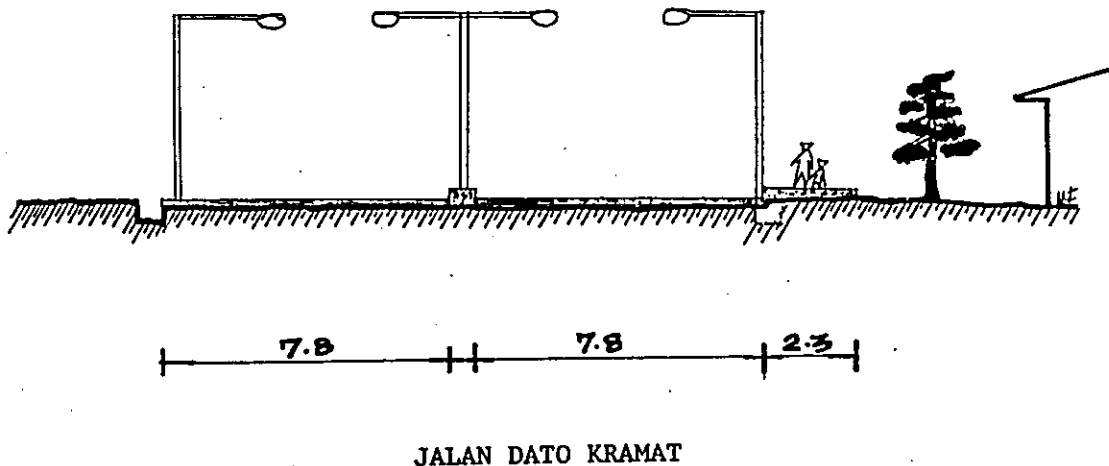
- 1) Although the carriageway width is very large, there are vehicles parked on both sides of the road.
- 2) Due to this reason, it lacks lateral clearance.

JALAN DATO KRAMAT. (Station G-11)Functions and Characteristics.

- 1) This road is the main radial road connected to JALAN AYER ITAM and it connects the C.B.D. of Georgetown to Ayer Itam.
- 2) Due to this, this route is for long distance trips.

Traffic Characteristics.

- 1) As more long distance trips are made on this road, the traffic volume is big comprising of various vehicles.
- 2) There are also many pedestrians on this road because it leads to a school.

Cross Section.Conditions.

- 1) The carriageway width is large about 8.0m but it would be better to have one specific lane for all bicycles.
- 2) The directional flow of traffic should be divided by a median strip.

AYER ITAM ROAD (Station G-12)Functions and Characteristics.

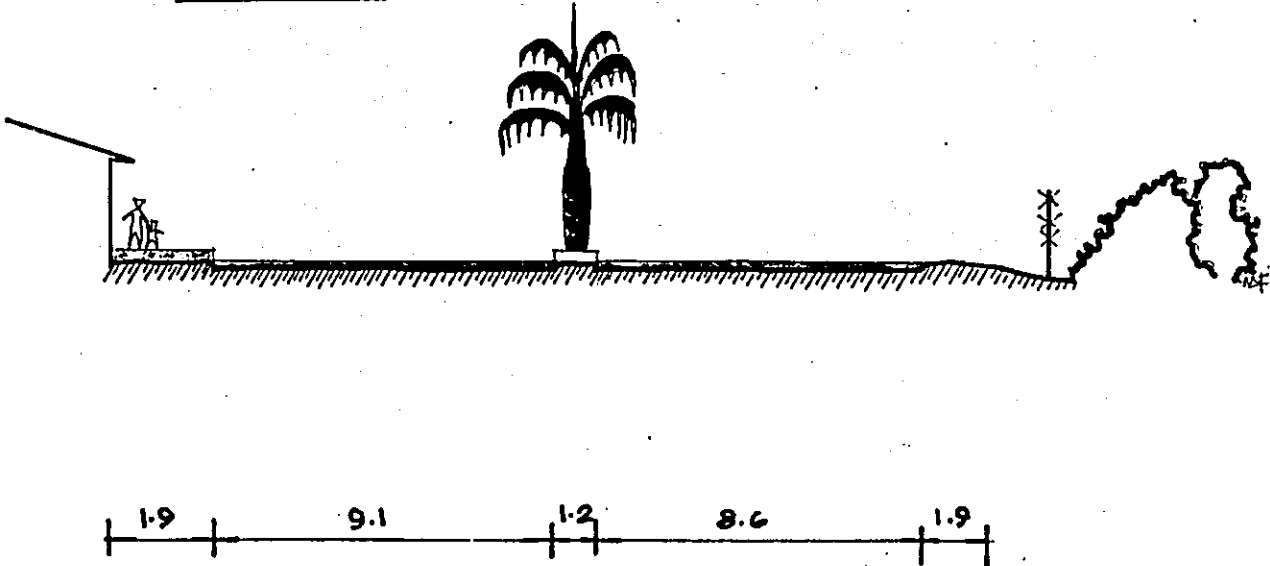
- 1) This route is a very important main radial road for which is a connection to Georgetown, AYER ITAM, BAYAN LEPAS and Balik Pulau.

- 2) Long distance trips are made on this road.

Traffic Characteristics.

- 1) Various kinds of vehicles, especially a large volume of buses and trucks use this road.
- 2) The double carriageway section is the main cause of the occurrence of many traffic accidents.

Cross Section.



AIR ITAM ROAD

Conditions.

- 1) This section is a double carriageway with a width of 9.0 m. The direction of traffic flow is divided by a median strip. The width of one lane is 3.50 m. and there is a pedestrian walk on both sides of the road.

2-12

GREEN LANE. (Station G-13)

SCOTLAND ROAD. (Station G-14)

Functions and Characteristics.

- 1) This route is the main outer ring-road of Georgetown which is a link to BAYAN LEPAS, AYER ITAM and BATU FERRINGHI.
- 2) Long distance trips are made on this road and it serves as a by-pass of Georgetown.

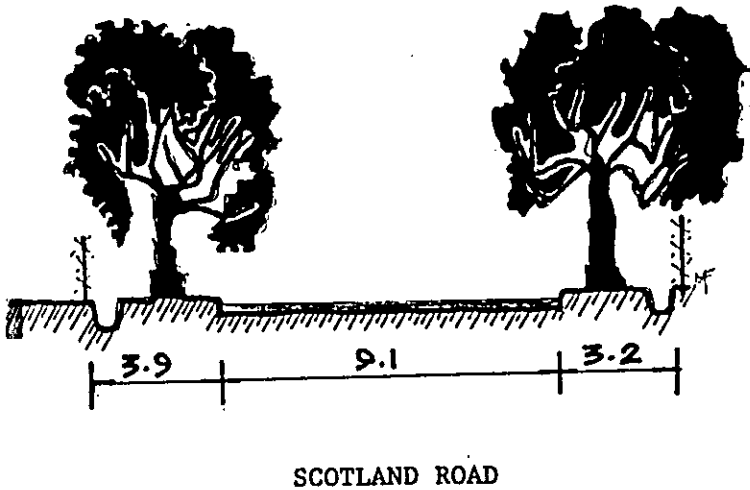
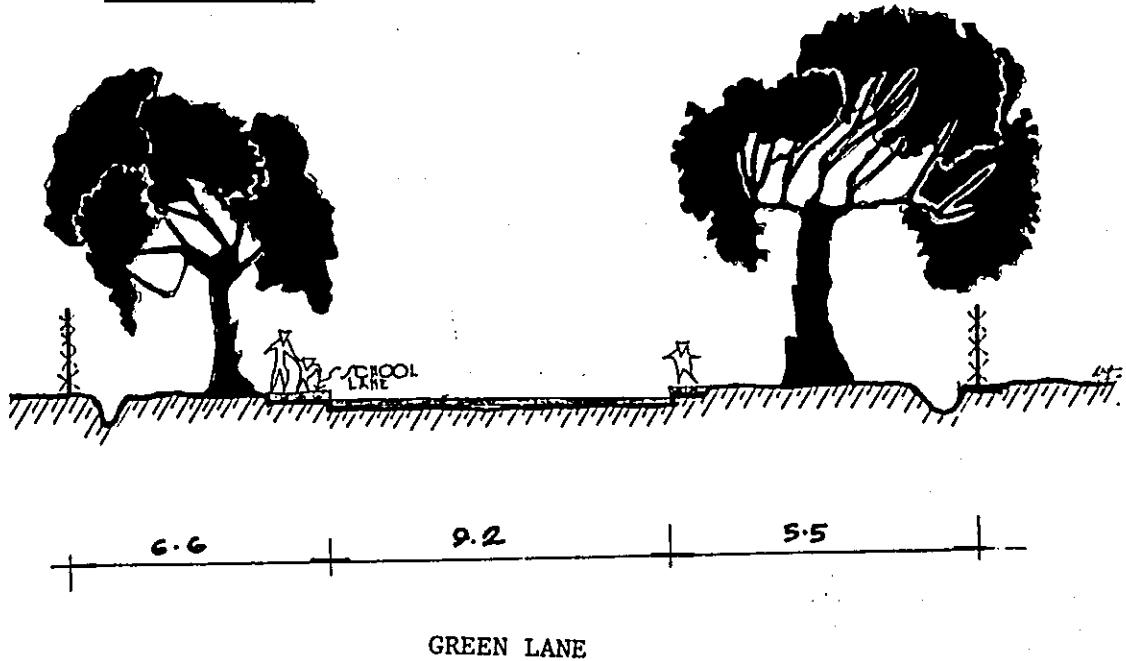
Traffic Characteristics.

- 1) The land-use pattern along this road is residential and

BATU FERRINGHI is a tourist area. Therefore, there are few heavy lorries that pass through here.

- 2) Many traffic accidents have occurred because of the heavy traffic volume.

Cross Section.



Conditions.

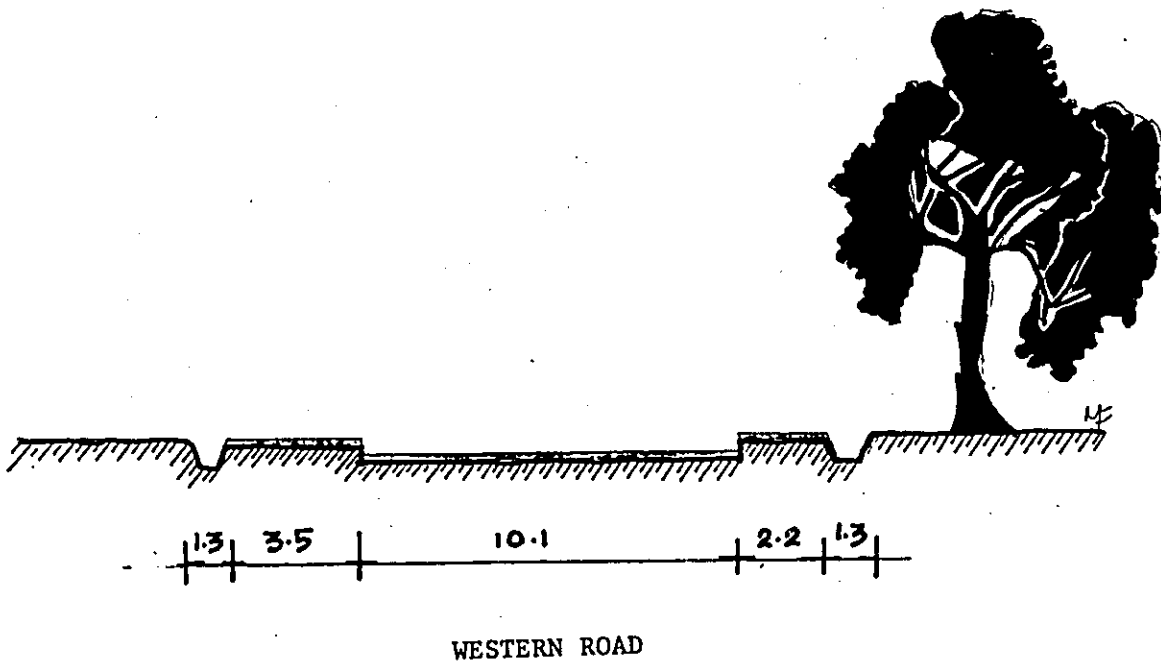
- 1) There is no problems with the geometrical design. The alignment is of large radius and the longitudinal gradient is almost flat.
- 2) The pavement is in normal condition.

WESTERN ROAD. (Station G-15)Functions and Characteristics.

- 1) This route leads to the BOTANICAL GARDENS which is separated from JALAN DATO KRAMAT.
- 2) The road length is about 5 km. and there are residential areas throughout so that short distance trips are made.

Traffic Characteristics.

- 1) As this is a residential area, throughout, there are very few heavy lorries but there is a heavy traffic of motor-cycles and bicycles.

Cross Section.Conditions.

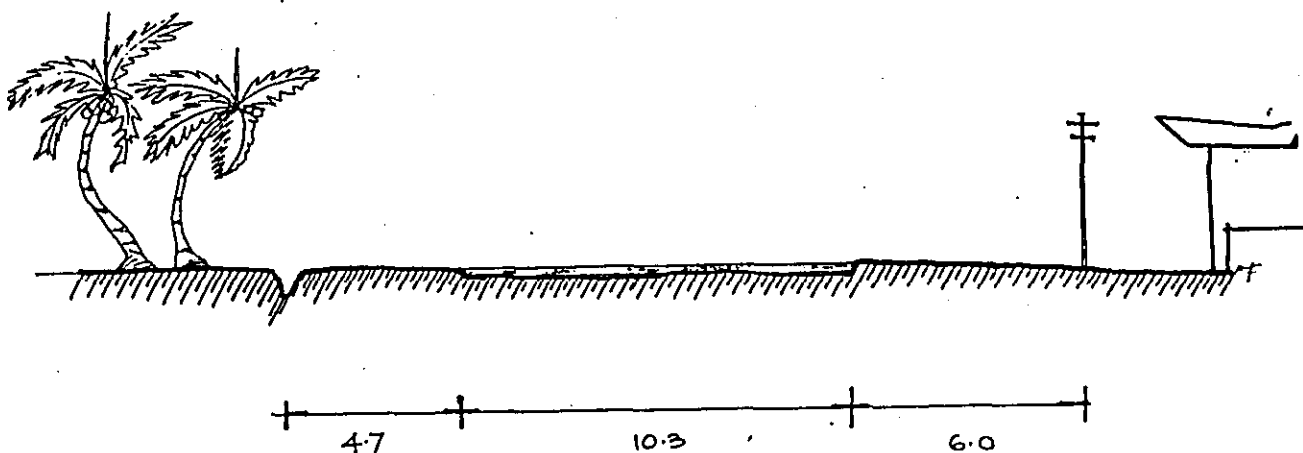
- 1) There are large trees on both sides of the road which provides shelter and makes the environment very pleasant.
- 2) Pavement here is in normal condition.
- 3) In certain parts of the road, there are pedestrian walks, either on both sides of the road or on one side of the road.

Results of the Survey in Province WellesleyJALAN BAGAN DALAM. (Station P-1)Functions and Characteristics.

- 1) This is a local road on which that trips are made.
- 2) It serves the purpose of linking the traffic flow from Jalan Chain Ferry to the port of Butterworth and directly to the ferry terminal.

Traffic Characteristics.

- 1) The running speed of traffic on this road is an average of 30 m.p.h.
- 2) The traffic flow is heavy for all types of vehicles except buses during peak hours.
- 3) There are also many trucks, i.e., heavy lorries throughout the day and night.

Cross Section.

JALAN BAGAN DALAM

Road Condition.

- 1) The road is not wide enough and this explains why the traffic on this road is rather slow.
- 2) There is no proper sub-division of road for slow-moving traffic (like bicycles and trishaw) and fast-moving traffic (like cars and trucks).
- 3) There is improper positioning of lamp-post. These are deterrants to attempts at widening the road.

- 4) Some parts of the asphalt pavement needs improvement and some parts do not.
- 5) The road alignment is almost straight and the longitudinal grade is about 2%.
- 6) There is an absence of trees along this road. There are only creepers and hangers.
- 7) There is a soil-drain on one side of the road. There is no chain on the other side.
- 8) There is an absence of a pedestrian pavement.
- 9) The land use along this road is residential.

3-2

JALAN RAJA UDA. (Station P-2)

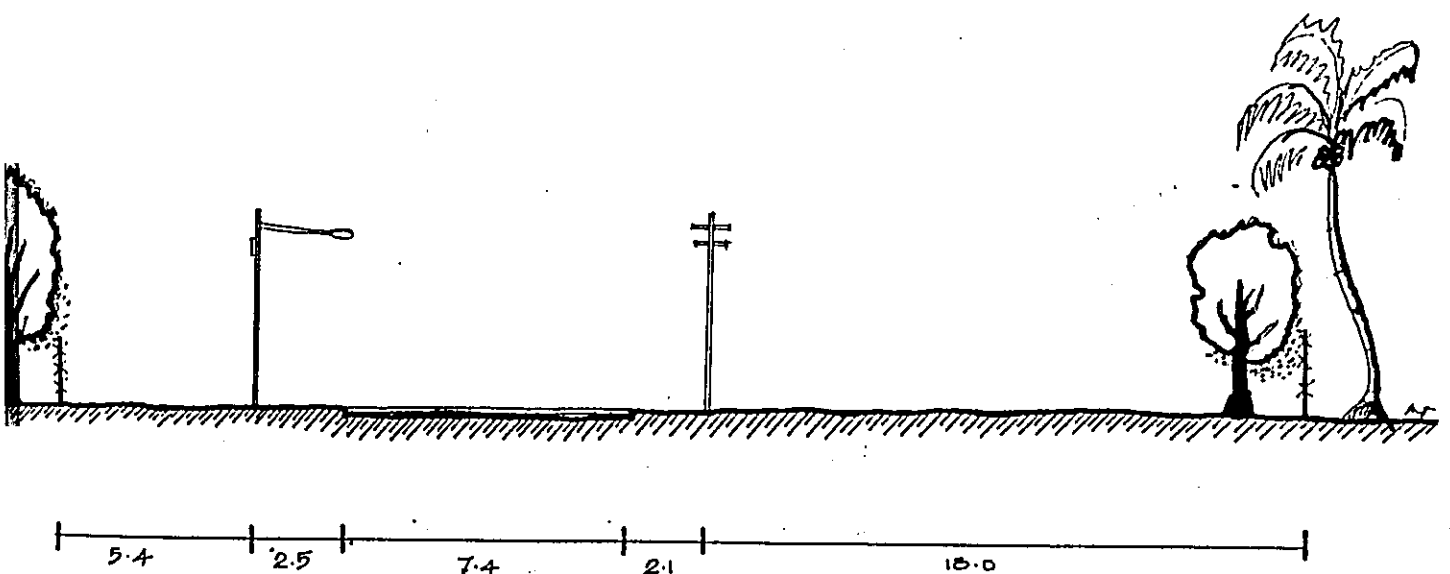
Functions and Characteristics.

- 1) This is a local road on which short trips are made.
- 2) This road serves the purpose of linking the route from Jalan Permatang Pauh to Bagan Ajam (Federal Route No. 1).

Traffic Characteristics.

- 1) During peak hours the traffic for all types of vehicles, i.e., bicycles, motor-cycles, cars, buses and lorries, are heavy.
- 2) This is because this road is the short cut from Federal Route No. 1 to Mak Mandin Industrial area.
- 3) Most of the road users during peak hours are workers from Mak Mandin Area.

Cross Section.



JALAN RAJA UDA

Road Condition.

- 1) The asphalt pavement of this road does not need any improvement.
- 2) The road-shoulder in some parts of the pavement is wide.
- 3) The road alignment is almost straight and the longitudinal grade is about 1%.
- 4) There are no trees alongside the road. However there are soil drains along both sides of the road.
- 5) There is an absence of bicycle lanes which puts the safety of bicycle pedlars at stake.
- 6) The area is a residential area with a few factories around.

3-3

JALAN FEDERAL ROUTE NO. 1. (Station P-3)

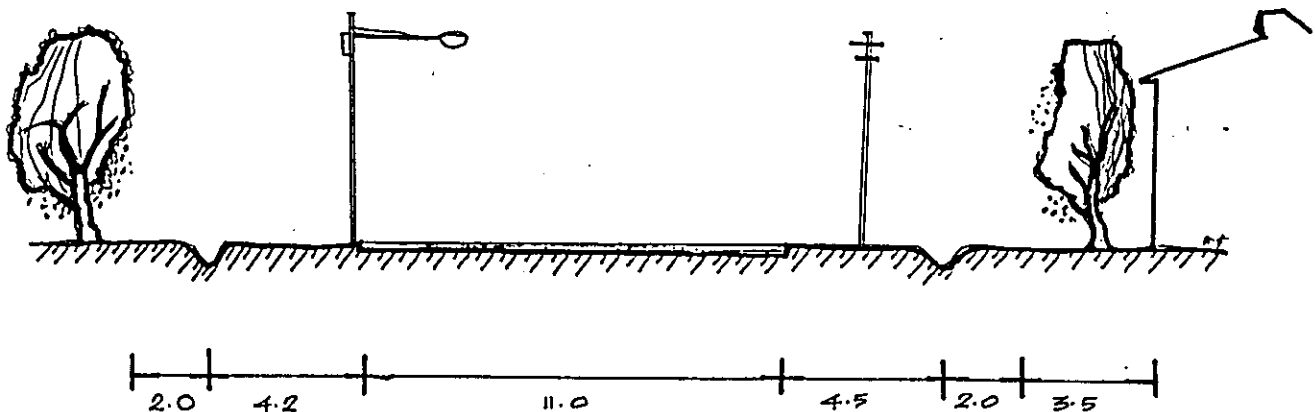
Functions and Characteristics.

- 1) This road is a primary road on which long trips are made.
- 2) It serves the purpose of linking vehicles from the south (Kuala Lumpur) to the north (Alor Star).
- 3) The running speed of traffic on this road exceeds 45 m.p.h.

Traffic Characteristics.

- 1) The traffic which consists of all types of vehicles is very heavy during peak hours.
- 2) Truck i.e. heavy lorries constitute a big proportion of the traffic from morning till night.

Cross Section.



JALAN FEDERAL ROUTE NO. 1

Road Condition.

- 1) Asphalt pavement condition is good.
- 2) The geometrical design is as follows. The alignment is straight and the longitudinal grade is almost flat.
- 3) There is no lane either for pedestrians or for bicycles.
- 4) The land-use on both sides of the road is allocated for residential and shop houses.

3-4

JALAN PERMATANG KUCING. (Station P-4)

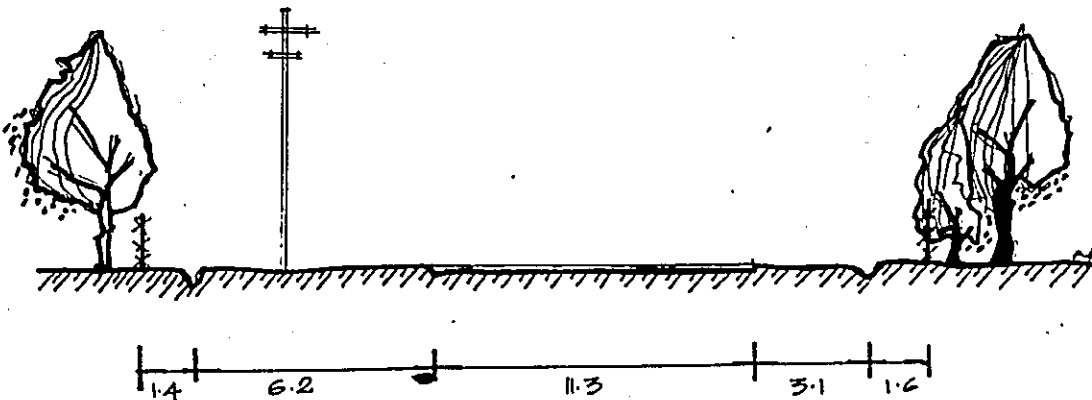
Functions and Characteristics.

- 1) This road is a primary road.
- 2) Long distance trips are made on this road as it serves the purpose of linking vehicles from Kuala Lumpur to Butterworth to Alor Star.

Traffic Characteristics.

- 1) The traffic is very heavy for all types of vehicles. Heavy lorries and buses constitute a big proportion of the traffic from morning to night.

Cross Section.



JALAN PERMATANG KUCING

Road Condition.

- 1) The pavement is an asphalt pavement and it is in good condition.
- 2) The road alignment is of very big radius and the longitudinal grade is flat.
- 3) There is an absence of a pedestrian walk and a bicycle lane.
- 4) The land-use along this road is allocated for residential houses and the RMAF base..

5

JALAN PERMATANG TOK JAYA (Station P-5)

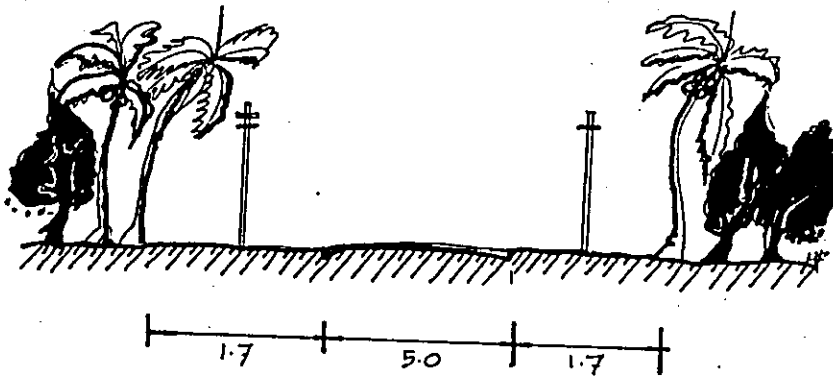
Functions and Characteristics.

- 1) This is a local road on which short trips are made.
- 2) It serves the purpose of linking vehicles from the village of Pekan Darat to Sungéi Dua and from Bagan Ajam to Butterworth.
- 3) The running speed of vehicles is an average of 25 m.p.h. This is because the road is very narrow.

Traffic Characteristics.

- 1) The traffic is not heavy even in peak hours.
- 2) Bicycles and motorcycles are a major means of transport.

Cross Section.



JALAN PERMATANG TOK JAYA

Road Condition.

- 1) The road alignment is of radius 300 m. and the longitudinal grade is almost flat.
- 2) The road shoulder is rather small and there is improper drainage system.

- 3) The land alongside this road is used for residential houses and for agriculture.

6

JALAN SUNGAI DUA. (Station P-6)

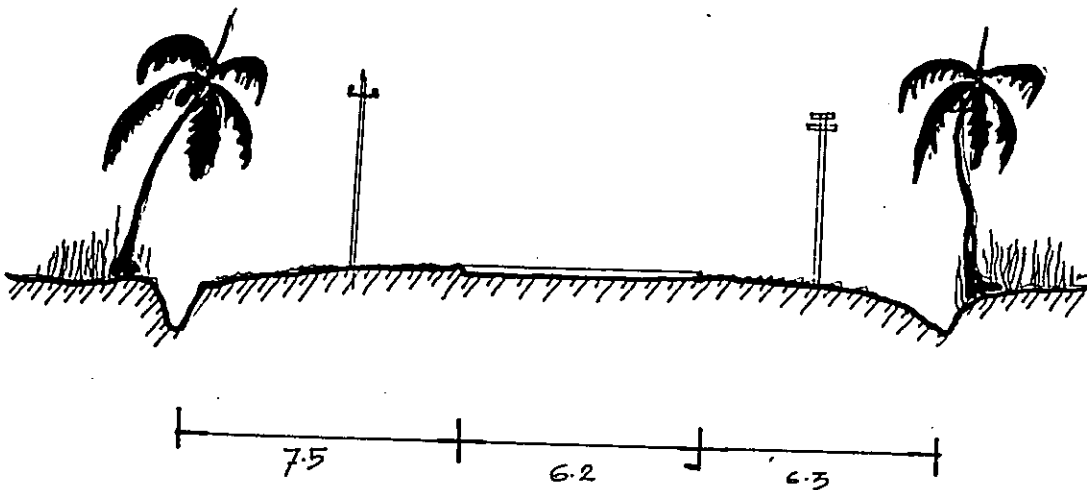
Functions and Characteristics.

- 1) This is a local road on which short trips are made.
- 2) It serves the purpose of linking vehicles from Sungai Puyu to Kepala Batas and Bukit Mertajam.
- 3) The running speed on this road is an average of 30 m.p.h.

Traffic Characteristics.

- 1) The traffic is not heavy during peak hours.
- 2) There are few heavy lorries and buses.

Cross Section.



JALAN SUNGAI DUA

Road Condition.

- 1) The pavement is asphalt pavement and it is in good condition.
- 2) The road alignment is of radius 300 m. and the longitudinal grade is about 1%.
- 3) There is no pedestrian walk on either side of the road. Neither is there any bicycle lanes.
- 4) Although the road-shoulder is wide enough, the bridge-railing was constructed just next to the edge of the asphalt pavement. This reduces the running speed of vehicles.

- 5) The area along this road is residential and there are also padi-fields.

7

JALAN KAMPONG PERMATANG SUNGAI DUA. (Station F-7)

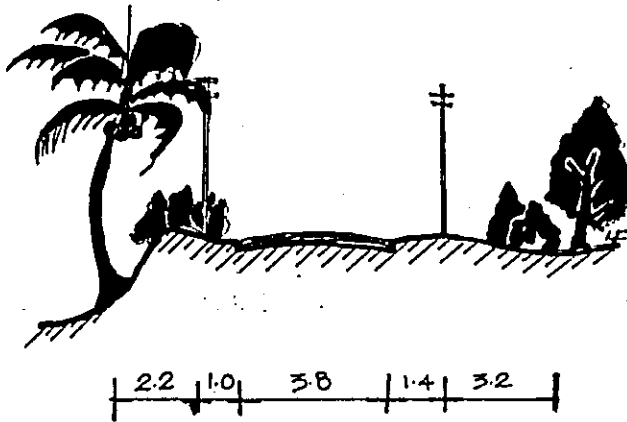
Functions and Characteristics.

- 1) This is a local road on which short trips are made.
- 2) It serves to link Sungai Dua to Kampung Tok Hamid.
- 3) The running speed on this road is an average of 25 m.p.h.

Traffic Characteristics.

- 1) The traffic is not heavy during peak hours.
- 2) There are not many heavy lorries and buses that pass along this road.

Cross Section.



JALAN PERMATANG SUNGAI DUA

Road Condition.

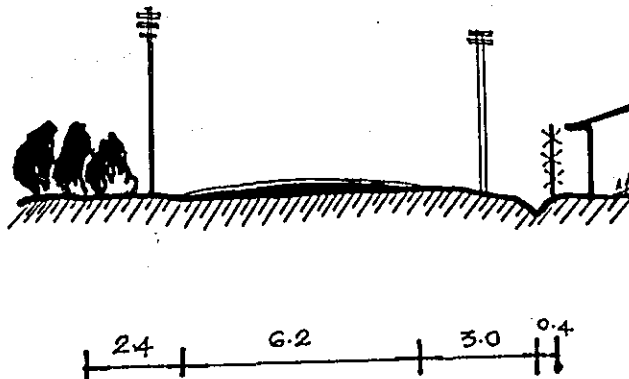
- 1) The road alignment is of radius 200 m. and the longitudinal grade is almost flat.
- 2) The road is very narrow. The road shoulder is also narrow and there is no drainage system along both sides of the road.
- 3) There is no special lanes either for pedestrians or for bicycles.
- 4) The area is a residential area with padi-fields around.

JALAN TANAH LIAT (Station P-8)Functions and Characteristics.

- 1) This is a secondary road on which long trips are made.
- 2) This road links vehicles from Bukit Mertajam to Kepala Batas to Alor Star and from Bukit Mertajam to Lunas to Baling.
- 3) The running speed on this road is an average of 25 m.p.h. due to the road being very narrow.

Traffic Characteristics.

- 1) The traffic is heavy during peak hours.
- 2) There are more heavy lorries at night. This is because lorries transporting fish from Thailand use this road.

Cross Section.

JALAN TANAH LIAT

Road Condition.

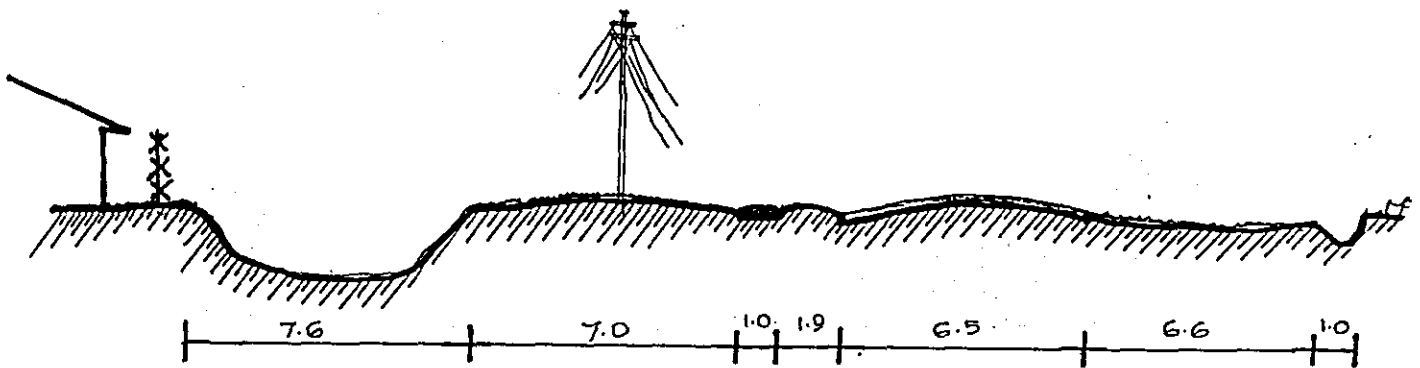
- 1) The road alignment is of a large radius and the longitudinal grade is almost flat.
- 2) The edge of the road pavement is comparatively high and there are no trees on both sides.
- 3) There is no lane for bicycles or for pedestrians.
- 4) The area along this road is residential.

JALAN PADANG LALANG. (Station P-9)Functions and Characteristics.

- 1) This is a local road on which short trips are made.
- 2) This road links Butterworth to Bukit Mertajam.
- 3) The running speed on this road is an average of 35 m.p.h.

Traffic Characteristics.

- 1) The traffic is heavy during peak hours for all types of vehicles.

Cross Section.

JALAN PADANG LALANG

Road Condition.

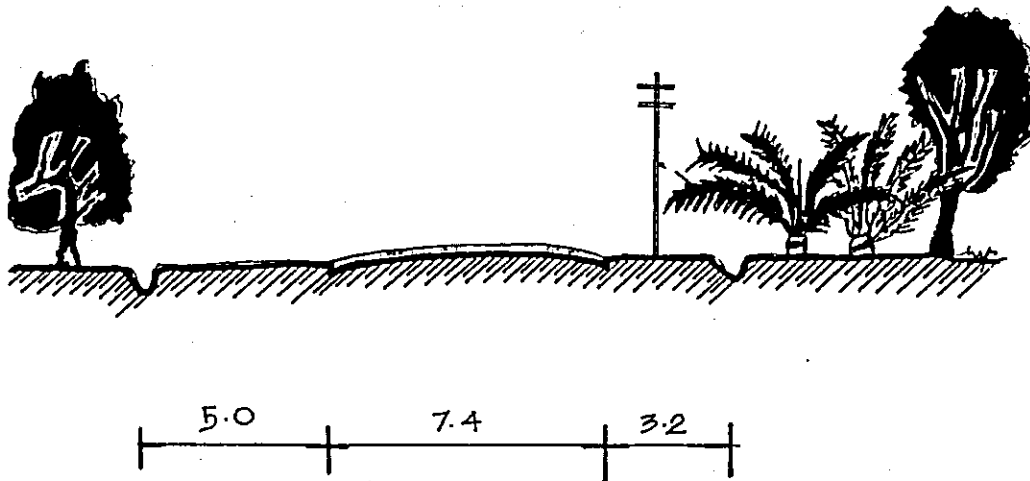
- 1) The road alignment is straight and the longitudinal grade is flat.
- 2) There are no trees along the side of the road.
- 3) There is a pedestrian pavement on one side of the road.
- 4) The surrounding area is residential.

JALAN PERMATANG RAWA. (Station P-10)Functions and Characteristics.

- 1) This is a secondary road on which short trips are made (almost Butterworth to Bukit Mertajam)
- 2) It links Butterworth and Kuala Lumpur to Bukit Mertajam.
- 3) The running speed of vehicles on this road is 35 m.p.h.

Traffic Characteristics.

- 1) The traffic is heavy during peak hours for all types of vehicles.

Cross Section.

JALAN PERMATANG RAWA.

Road Condition.

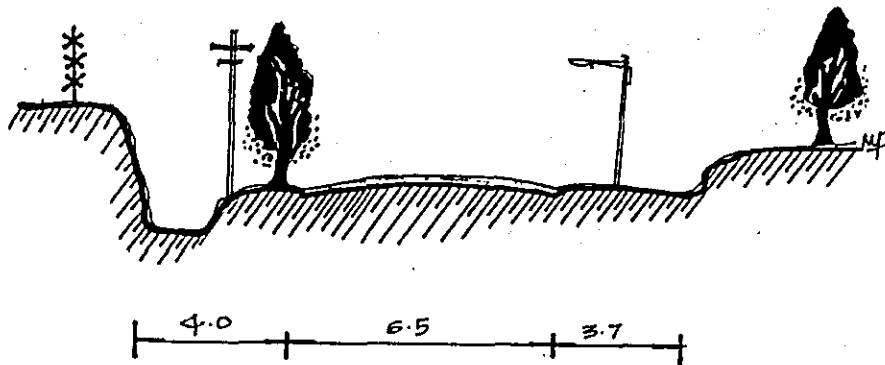
- 1) The road alignment is straight and the longitudinal grade is flat.
- 2) There is no pedestrian or bicycle lane.
- 3) The surrounding area is residential with padi-fields.

JALAN BUKIT TENGAH. (Station P-11)Functions and Characteristics.

- 1) This is a primary road on which long trips are made.
- 2) This road links vehicles from Butterworth to Kuala Lumpur, that is, north to south.
- 3) The running speed on this road is an average of 30 m.p.h.
- 4) This is a narrow road and the road-shoulder is also very narrow
- 5) This is an accident area.

Traffic Characteristics.

- 1) The traffic is very heavy during peak hours for all type of vehicles.
- 2) There are more heavy lorries and buses using this road.

Cross Section.

JALAN BUKIT TENGAH

Road Condition.

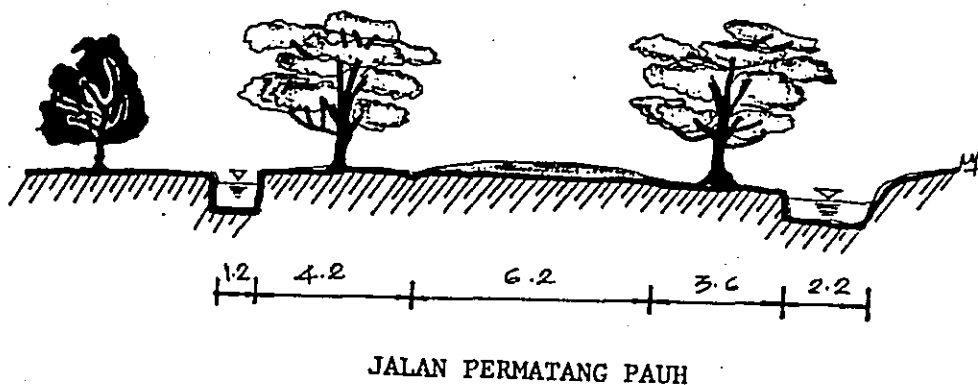
- 1) The road alignment is of radius 300 m. and the longitudinal grade is 0.5%.
- 2) There are trees along both sides of the road.
- 3) There is a reflecting post along one side of the road.
- 4) The surrounding area is residential.

JALAN PERMATANG PAUH. (Station P-12)Functions and Characteristics.

- 1) This is a secondary road on which long trips and short trips are made.
- 2) It links Bukit Mertajam to Butterworth.
- 3) The running speed of vehicles is an average of 40 m.p.h.

Traffic Characteristics.

- 1) The traffic situation is normal during peak hours.

Cross Section.Road Condition.

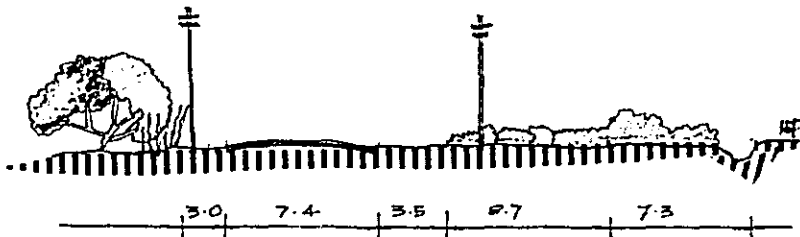
- 1) The road alignment is straight and the longitudinal grade is flat.
- 2) There are trees along both sides of the road.
- 3) There are padi-fields on both sides of the road.
- 4) There is no pedestrian walk and no bicycle-lanes.
- 5) The surrounding area is residential with padi-fields.

JALAN BARU PRAI (Station P-13 and P-14)Functions and Characteristics.

- 1) This is a primary road on which long trips are made.
- 2) It links Butterworth to Kuala Lumpur and Alor Star.
- 3) The running speed of vehicles on this road is an average of 30 m.p.h.

Traffic Characteristics.

- 1) The traffic is very heavy during peak hours.
- 2) All types of vehicles use this road with a large proportion of heavy lorries, buses and motorcycles.

Cross Section.

13. JALAN BARU PRAI.

Road Condition.

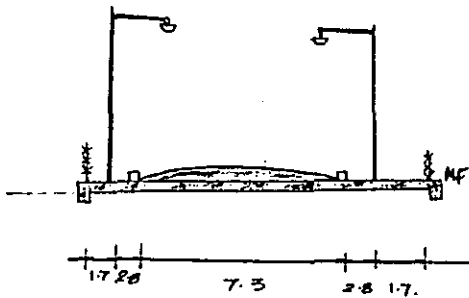
- 1) The road alignment is straight and the longitudinal grade is flat.
- 2) The edge of the pavement is comparatively high.
- 3) There are no trees along both sides of the road.
- 4) There is an absence of a pedestrian pavement and a bicycle lane. This road is a very busy road and it is important for there to be a pedestrian pavement.
- 5) The surrounding land-use is residential.

TUNKU ABDUL RAHMAN BRIDGE. (Station P-15)Function and Characteristics.

- 1) This is a primary road on which long trips are made.
- 2) It links Butterworth to Kuala Lumpur.
- 3) The running speed of vehicles on this road is 30 m.p.h.

Traffic Characteristics.

- 1) The traffic is very heavy during peak hours for all types of vehicles.

Cross Section.15. TUANKU ABDUL RAHMAN BRIDGE.Bridge Characteristics.

- 1) The bridge is delineated into three lanes by road-drivers.
 - * Motor-vehicle lane.
 - * Motor-cycle and bicycle lane.
 - * Pedestrian lane.

Structure of Bridge.

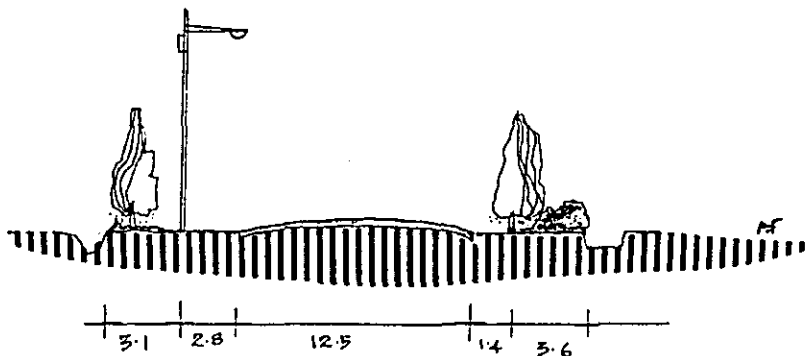
- 1) This bridge is a pre-stress concrete bridge.

JALAN CHAIN FERRY. (Station P-16)Functions and Characteristics.

- 1) This road is a primary road on which long trips are made.
- 2) This road links Butterworth to Kuala Lumpur.
- 3) The running speed of traffic on this road is an average of 35 m.p.h.

Traffic Characteristics.

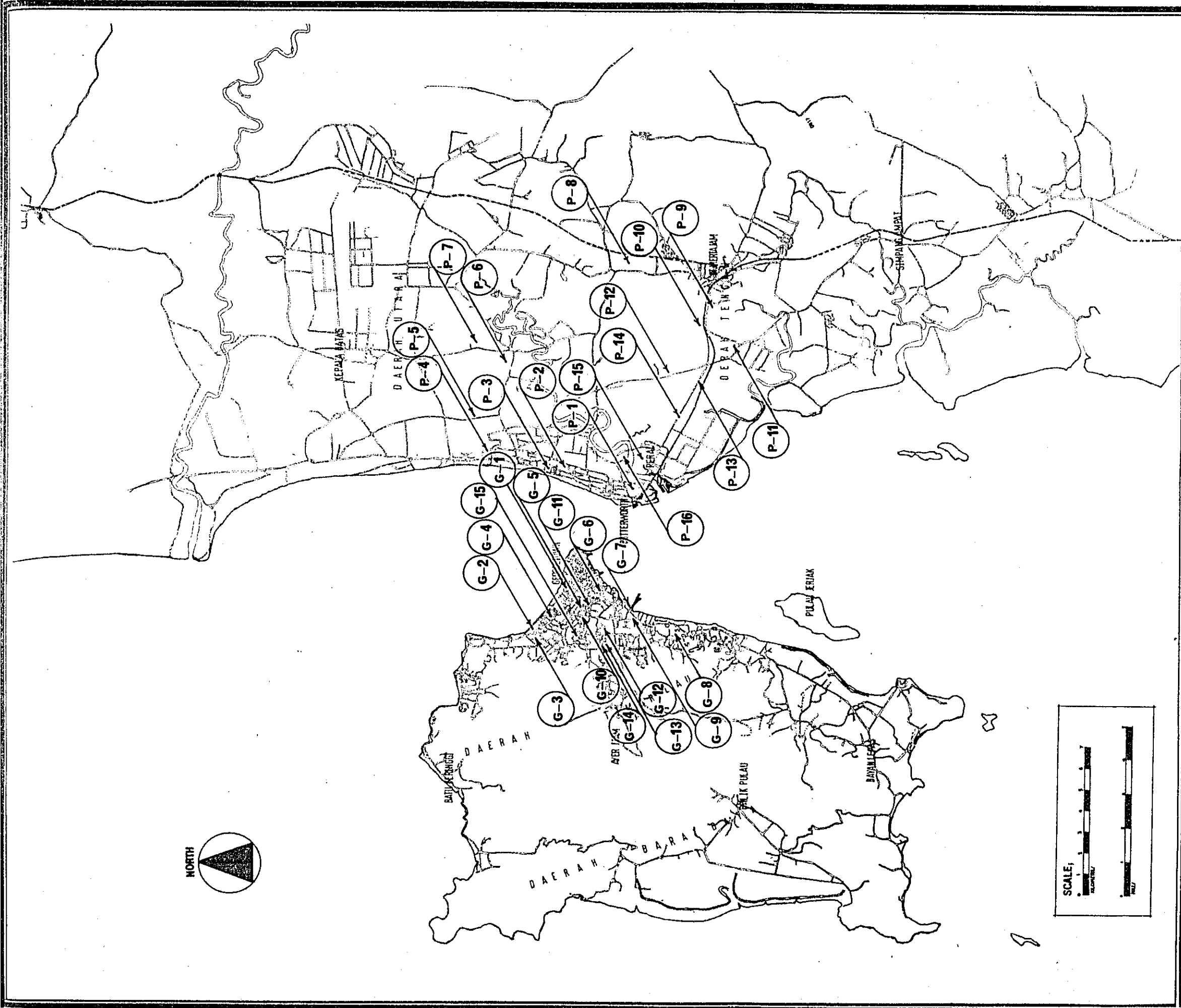
- 1) The traffic is very heavy during peak hours for all types of vehicles.

Cross Section.

16. JALAN CHAIN FERRY.

Road Condition.

- 1) The road alignment is of radius 400m. and the longitudinal grade is 2%.
- 2) There is improper drainage system.
The road-shoulder is very wide.
- 3) There is a pedestrian pavement.
- 4) The surrounding area is residential.



**URBAN TRANSPORT STUDY IN GREATER
METROPOLITAN AREAS OF GEORGETOWN;
BUTTERWORTH AND BUKIT MERTAJAM.**



**LOCATION OF
SURVEY STATIONS**

Calculation of Traffic Capacity.1) General

We calculated the traffic capacity according to the "Highway Capacity Manual."

Traffic capacity is affected by various factors. However we calculated this by using the following methods, viz. "the method effect of lane width method, the restricted lateral clearance method and the adjusted factor for trucks and buses method."

This capacity is for passenger car unit in the situation of uninterrupted traffic flow.

2) Basic Capacity.

Uninterrupted - flow capacities under ideal conditions

HIGHWAY TYPE	CAPACITY (PASS. VPH)
Multilane	2,000 per lane
Two-lane, two-way	2,000 total both dir.
Three-lane, two-way	4,000 total both dir.

3) Adjustment factor of lane width.

Effect of lane width on capacity for uninterrupted flow conditions.

LANE WIDTH (m)	CAPACITY (% OF 3.6m LANE CAPACITY)	
	2-LANE HIGHWAYS	MULTILANE HIGHWAYS
3.6	100	100
3.3	88	97
3.0	81	91
2.7	76	81

4) Adjustment factor of lateral clearance.

Combined effect of lane width and restricted lateral clearance on capacity and service volumes of divided freeways and expressways with uninterrupted flow.

DISTANCE FROM TRAFFIC LANE EDGE TO OBSTRUCTION (m)	ADJUSTMENT FACTOR, * W; FOR LANE WIDTH AND LATERAL CLEARANCE							
	OBSTRUCTION ON ONE SIDE OF ONE-DIRECTION ROADWAY				OBSTRUCTIONS ON BOTH SIDES OF ONE-DIRECTION ROADWAY			
	3.6 m LANES	3.3 m LANES	3.0 m LANES	2.7 m LANES	3.6 m LANES	3.3 m LANES	3.0 m LANES	2.7 m LANES
(a) 4-LANE DIVIDED FREEWAY, ONE DIRECTION OF TRAVEL								
1.8	1.00	0.97	0.91	0.81	1.00	0.97	0.91	0.81
1.2	0.99	0.96	0.90	0.80	0.98	0.95	0.89	0.79
0.6	0.97	0.94	0.88	0.79	0.94	0.91	0.86	0.76
0	0.90	0.87	0.82	0.73	0.81	0.79	0.74	0.66
(b) 6-AND 8-LANE DIVIDED FREEWAY, ONE DIRECTION OF TRAVEL								
1.8	1.00	0.96	0.89	0.78	1.00	0.96	0.89	0.78
1.2	0.99	0.95	0.88	0.77	0.98	0.94	0.87	0.77
0.6	0.97	0.93	0.87	0.76	0.96	0.92	0.85	0.75
0	0.94	0.91	0.85	0.74	0.91	0.87	0.81	0.70

* Same adjustments for capacity and all levels of services.

5) Adjustment factors of Trucks and Buses.

Adjustment factors for trucks and buses on individual roadway subsections or grades on freeways and expressways (Incorporating passenger car equivalent and percentage of trucks or buses)

PASSENGER CAR EQUIVALENT,	TRUCK ADJUSTMENT FACTOR															
	PERCENTAGE OF TRUCKS															
	1	2	3	4	5	6	7	8	9	10	12	14	16	18	20	
2	0.99	0.98	0.97	0.96	0.95	0.94	0.93	0.93	0.92	0.91	0.89	0.88	0.86	0.85	0.83	
3	0.98	0.96	0.94	0.93	0.91	0.89	0.88	0.86	0.85	0.83	0.81	0.78	0.76	0.74	0.71	
4	0.97	0.94	0.92	0.89	0.87	0.85	0.83	0.81	0.79	0.77	0.74	0.70	0.68	0.65	0.63	
5	0.96	0.93	0.89	0.86	0.83	0.81	0.78	0.76	0.74	0.71	0.68	0.64	0.61	0.58	0.56	
6	0.95	0.91	0.87	0.83	0.80	0.77	0.74	0.71	0.69	0.67	0.63	0.59	0.56	0.53	0.50	
7	0.94	0.89	0.85	0.81	0.77	0.74	0.70	0.68	0.65	0.63	0.58	0.54	0.51	0.48	0.45	
8	0.93	0.88	0.83	0.78	0.74	0.70	0.67	0.64	0.61	0.59	0.54	0.51	0.47	0.44	0.42	
9	0.93	0.86	0.81	0.76	0.71	0.68	0.64	0.61	0.58	0.56	0.51	0.47	0.44	0.41	0.38	
10	0.92	0.85	0.79	0.74	0.69	0.65	0.61	0.58	0.55	0.53	0.48	0.44	0.41	0.38	0.36	
11	0.91	0.83	0.77	0.71	0.67	0.63	0.59	0.56	0.53	0.50	0.45	0.42	0.38	0.36	0.33	
12	0.90	0.82	0.75	0.69	0.65	0.60	0.57	0.53	0.50	0.48	0.43	0.39	0.36	0.34	0.31	
13	0.89	0.81	0.74	0.68	0.63	0.58	0.54	0.51	0.48	0.45	0.41	0.37	0.34	0.32	0.29	
14	0.88	0.79	0.72	0.66	0.61	0.56	0.52	0.49	0.46	0.43	0.39	0.35	0.32	0.30	0.28	
15	0.88	0.78	0.70	0.64	0.59	0.54	0.51	0.47	0.44	0.42	0.37	0.34	0.31	0.28	0.26	
16	0.87	0.77	0.69	0.63	0.57	0.53	0.49	0.45	0.43	0.40	0.36	0.32	0.29	0.27	0.25	
17	0.86	0.76	0.68	0.61	0.56	0.51	0.47	0.44	0.41	0.38	0.34	0.31	0.28	0.26	0.24	
18	0.85	0.75	0.66	0.60	0.54	0.49	0.46	0.42	0.40	0.37	0.33	0.30	0.27	0.25	0.23	
19	0.85	0.74	0.65	0.58	0.53	0.48	0.44	0.41	0.38	0.36	0.32	0.28	0.26	0.24	0.22	
20	0.84	0.72	0.64	0.57	0.51	0.47	0.42	0.40	0.37	0.34	0.30	0.27	0.25	0.23	0.21	
21	0.83	0.71	0.63	0.56	0.50	0.45	0.41	0.38	0.36	0.33	0.29	0.26	0.24	0.22	0.20	
22	0.83	0.70	0.61	0.54	0.49	0.44	0.40	0.37	0.35	0.32	0.28	0.25	0.23	0.21	0.19	
23	0.82	0.69	0.60	0.53	0.48	0.43	0.39	0.36	0.34	0.31	0.27	0.25	0.22	0.20	0.19	
24	0.81	0.68	0.59	0.52	0.47	0.42	0.38	0.35	0.33	0.30	0.27	0.24	0.21	0.19	0.18	
25	0.80	0.67	0.58	0.51	0.46	0.41	0.37	0.34	0.32	0.29	0.26	0.23	0.20	0.18	0.17	

UNINTERRUPTED - Flow CAPACITY (PENANG ISLAND)

ROAD NAME	STATION	LANE WIDTH (m)	PERCENTAGE OF TRUCKS AND BUS (%)	LATERAL CLEARANCE (m)	SHOLDER WIDTH (m)	BASIC CAPACITY	ADJUSTMENT OF FACTORS			NUMBER OF LANE	CAPACITY (V.P.H.)
							LANE WIDTH (W1)	LATERAL CLEARANCE (W2)	TRUCKS & BUS (T1)		
NORTHAM ROAD	G-1	3.00 x 2	5	1.5	1.5	2000	0.81	0.99	0.95	1	1520
GURNEY DRIVE	G-2	3.00 x 2	3	0.65	1.3	2000	0.81	0.97	0.97	1	1520
BAGAN JERMAL ROAD	G-3	3.00 x 2	3	1.6	1.6	2000	0.81	0.99	0.97	1	1560
JALAN BURMA	G-4	3.00 x 2	3	1.1	1.1	2000	0.81	0.97	0.97	1	1520
MACLISTER ROAD	G-5	3.00 x 2	3	2.00	2.00	2000	0.81	1.00	0.97	1	1570
BRICK KILN ROAD	G-6	one way 2 @ 3.00	10	2.00	2.00	2000	0.91	1.00	0.91	2	3310
JELUTONG ROAD	G-7	3.00 x 2	10	2.30	2.30	2000	0.81	1.00	0.91	1	1470
JALAN GELUGOR	G-8	3.00 x 2	10	2.00	1.00	2000	0.81	1.00	0.91	1	1470
JALAN PERAK	G-9	3.00 x 2	5	2.00	2.00	2000	0.81	1.00	0.95	1	1540
JALAN PERAK	G-10	3.00 x 2	3	1.50	1.50	2000	0.81	0.99	0.97	1	1560
JLN. DATO KRAMAT	G-11	2 @ 3.00x2	10	1.8	1.8	2000	0.91	1.00	0.91	4	6620
AYER ITAM ROAD	G-12	2 @ 3.50x2	10	1.6	1.6	2000	0.97	0.99	0.91	4	6990
GREEN LANE	G-13	3.50 x 2	10	1.1	1.1	2000	0.88	0.97	0.91	1	1530
SCOTLAND ROAD	G-14	3.00 x 2	5	1.5	1.5	2000	0.81	0.99	0.95	1	1520
WESTERN ROAD	G-15	3.00 x 2	10	2.00	2.00	2000	0.81	1.00	0.91	1	1470

UNINTERRUPTED - Flow CAPACITY (PROVINCE WELLESLEY)

ROAD NAME	STATION	LANE WIDTH (m)	PERCENTAGE OF TRUCKS & BUSES (%)	LATERAL CLEARANCE (m)	SHOULDER WIDTH (m)	BASIC CAPACITY B (P.C.U)	ADJUSTMENT OF FACTORS			NUMBER OF LANE	CAPACITY (V.P.H.)
							LANE WIDTH (W1)	LATERAL CLEARANCE(W2)	TRUCKS & BUS (T1)		
JLN. BAGAN DALAM	P-1	3.00 x 2	15	3.00	2.00	2000	0.81	1.00	0.89	1	1410
JLN. RAJA UDA	P-2	3.00 x 2	5	0.70	0.70	2000	0.81	0.97	0.95	1	1500
FEDERAL ROUTE NO 1	P-3	3.00 x 2	15	2.50	2.50	2000	0.81	1.00	0.87	1	1410
JLN. PTG. KUCING	P-4	3.00 x 2	15	2.6	2.6	2000	0.81	1.00	0.87	1	1410
JLN. PTG. TOK JAYA	P-5	2.15 x 2	2	1.00	0	2000	0.76	0.97	0.98	1	1470
JLN. SG. DUA	P-6	3.00 x 2	2	1.00	0	2000	0.81	0.97	0.98	1	1560
JLN. SG. DUA	P-7	2.00 x 2	2	1.00	0	2000	0.76	0.97	0.98	1	1490
JLN. TANAH LIAT	P-8	3.00 x 2	2	2.00	0	2000	0.81	1.00	0.98	1	1590
JLN PADANG LALANG	P-9	3.00 x 2	2	2.00	0.25	2000	0.81	1.00	0.98	1	1590
JLN. PTG. RAWA	P-10	3.00 x 2	5	2.30	0.7	2000	0.81	1.00	0.95	1	1540
JLN. BUKIT TENGAH	P-11	3.00 x 2	10	2.50	0.25	2000	0.81	1.00	0.91	1	1470
JLN. PMTG. PAUH	P-12	3.00 x 2	2	2.00	0.25	2000	0.81	1.00	0.98	1	1590
JLN. BAHARU PRAI	P-13	3.00 x 2	15	3.00	3.00	2000	0.81	1.00	0.87	1	1410
JLN. BAHARU PRAI	P-14	3.00 x 2	15	2.50	2.50	2000	0.81	1.00	0.87	1	1410
SG. RAHMAN BRIDGE	P-15	3.00 x 2	15	0.5	0.5	2000	0.81	0.90	0.87	1	1270
JLN. CHAIN FERRY	P-16	3.00 x 2	15	5.50	3.00	2000	0.81	1.00	0.87	1	1410

