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

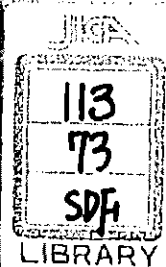
**SOME ANALYSES OF TRAFFIC CENSUS**  
**BY JKR**

TECHNICAL REPORT — 09



**AUGUST, 1979**

**JAPAN INTERNATIONAL COOPERATION AGENCY**



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This report is a supplement to the main report of our study and it is written to meet the pressing demand for a technical report presently. Although this report fails to meet the requirement of a complete technical report, it may be rewritten in a more refined form for future use. This report section by section would be especially useful as a reference for various purposes, for example, manual of survey, data edition, explanation of methodology, detailed analysis, etc.

SOME ANALYSIS OF  
TRAFFIC CENSUS DATA BY J.K.R.

CONTENTS

1.	An Outline of Traffic Census -----	1
2.	Trend of Traffic Voume -----	3
3.	Comparison with the result of our Survey -----	6
4.	Estimation of day-night ratio -----	12
5.	A Survey Forecast of the Traffic Volume -----	14

An outline of Traffic Census.

In Penang State, there are 25 stations for traffic census by J.K.R.; the census is classified into three categories of survey-types, as follows:-

Type 1 : Manual counting ; 7 days.

Type 2 : Manual counting ; 1 day ; machine counting ; 7 days.

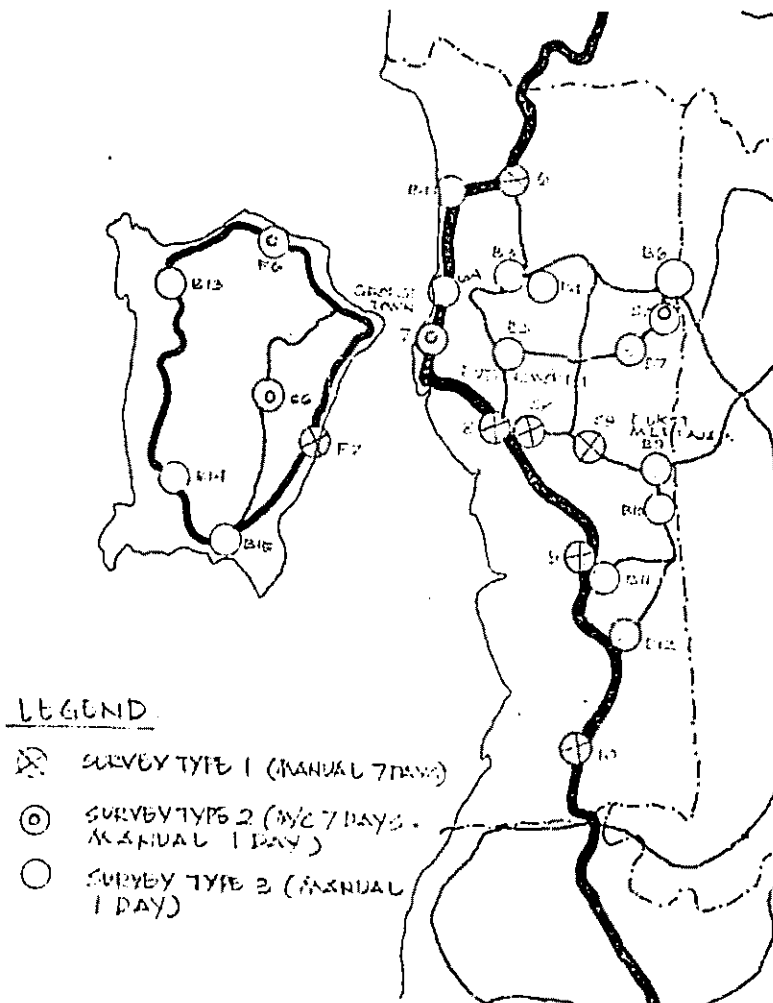
Type 3 : Manual counting ; 1 day.

\* 1 day (manual) : 6.00 a.m. - 10.00 p.m. (16 hours)

\* 1 day (machine) : 6.00 a.m. - 6.00 a.m. (24 hours)

These stations in Penang State are shown in the following figure according to each type.

Fig. 1. Location of Traffic Census Station.



The classification of type of vehicle by J.K.R. are as follows:-

- a) Motorcars and taxis
- b) Small Vans and Utilities (light 2 axles)
- c) Lorries and large vans (heavy 2 axles)
- d) Lorries with 3 axles or Trailers (heavy 3 axles)
- e) Buses
- f) Motorcycles and scooters

The above classification is a little different from ours. However, each can be compared sufficiently. Our classification is as follow:-

- a) Motorcars
- b) Taxis
- c) Vans, pick-ups
- d) Medium-size lorries
- e) Lorries with 3 axles, trailer
- f) Buses
- g) Motorcycles and scooters
- h) Others.

2. Trend of traffic volume.

The Traffic Census is held twice a year, April and October and our data is from that of 1970. In accordance with these data, the trend of traffic volume (both directions) at each station is summarized into the following table and figures.

Table 1. The Trend of Traffic Volume.

YEAR STN. NO.	1970	1971	1972	1973	1974	1975	1976	1977	1978 1)	1979 1),2)
00F6	2140	2114	2842	3409	4462	4304	4492	-	4994	5930
00F7	8811	9448	10635	14261	18080	18242	21290	-	31018	32342
0B13	224	290	341	344	414	447	376	-	117	818
0B14	1073	1112	1306	1436	1784	1764	1969	-	2739	3009
0B15	-	4116	4429	5262	6602	7442	8797	-	10094	10002
00S6	2241	2277	3164	3535	4132	4755	5026	-	7039	8254
0006	5726	6508	7026	7346	8948	10387	10069	-	11225	11097
0007	14712	13608	14882	11787	15423	18324	18517	-	20001	31675
0008	9299	9725	10127	12276	13920	12711	13876	-	16622	17691
0009	5967	6926	7230	8140	10176	10239	11550	-	14534	23350
0010	7085	7920	8027	8824	9954	9296	10880	-	12435	14059
006A	-	10462	13453	12547	11795	12229	11297	-	14238	15257
00B1	800	960	1028	1088	1464	1541	2095	-	2077	2992
00B3	547	850	1254	1624	743	1237	879	-	1270	1179
00B4	2048	2824	2857	3170	2569	2762	4105	-	4061	5363
00B6	457	457	467	779	1088	1001	675	-	866	1026
00B7	1203	1134	1177	1116	1567	1521	1528	-	2166	2599
00B8	1627	2121	2387	2036	2798	2703	3943	-	3716	4970
00B9	2783	3093	2956	3255	3319	3510	3908	-	4962	4603
00S7	1205	1199	972	1365	1914	1979	1826	-	2699	2785
00S8	8567	9819	7583	8939	9628	10541	11913	-	11649	17208
00S9	4008	4480	6162	6594	7429	8666	9105	-	14487	15099
0B10	481	519	1104	493	534	460	548	-	627	818
0B11	826	877	867	1129	1310	1308	1542	-	2583	2122
0B12	970	1091	970	1001	1285	1254	1245	-	3719	2018

1) 1978 & 1979 data are taken in April only.

2) The data for 1979 has not been authorized.

Except at one station, B 13, in Penang Island, the volume of traffic at every other station is increasing from 1970.

At Station F 7, near Bayan Lepas, the traffic is heavy with over 30,000 vehicles per 16 hours. Also, the increasing ratio is very high, approximately 16% annually.

While in P. Wellesley, on Federal Route I, the traffic is heavy, 10,000 - 30,000 vehicles per 16 hours ('79) and especially at stations 07 & 09, the increasing volume from 1978 to 1979 was more than 50% of the former.



Fig. 2. THE TRENDS OF TRAFFIC VOLUME (16 HOURS)  
IN PENANG ISLAND

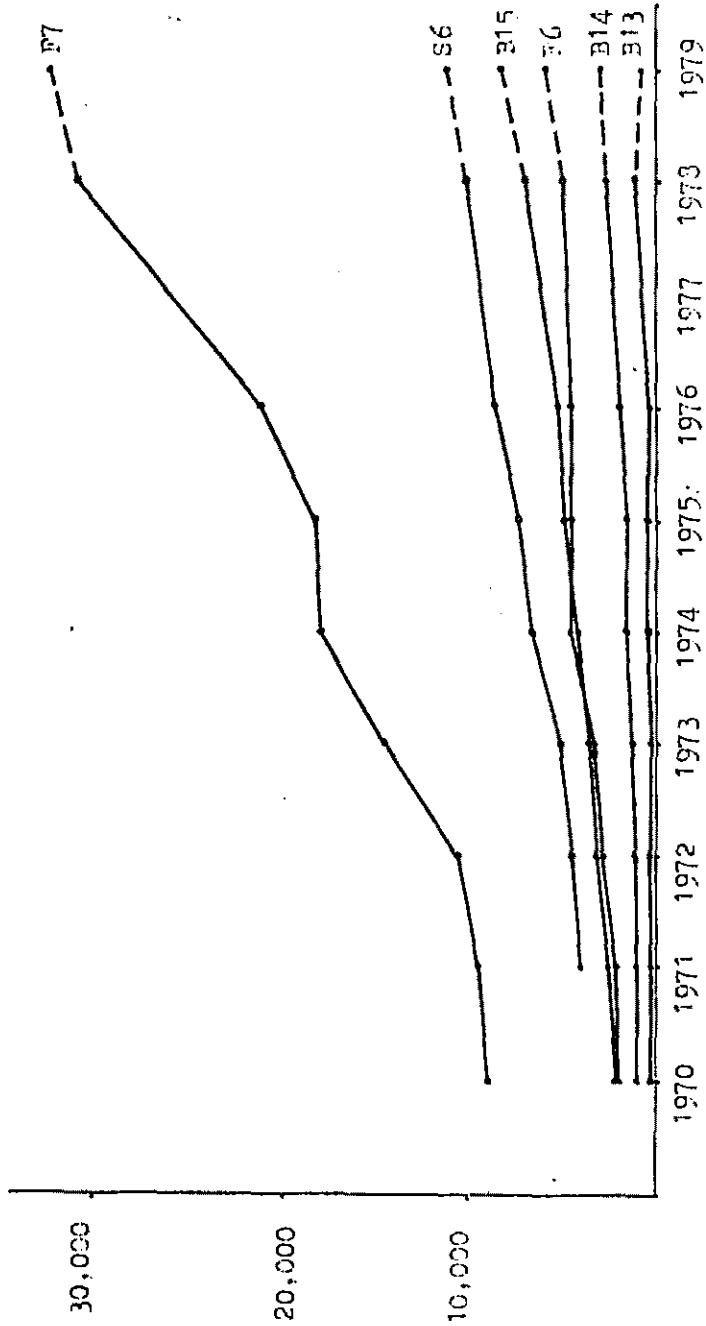


Fig. 3a. THE TRENDS OF TRAFFIC VOLUME  
(16 HOURS) IN PROVINCE WELLESLEY

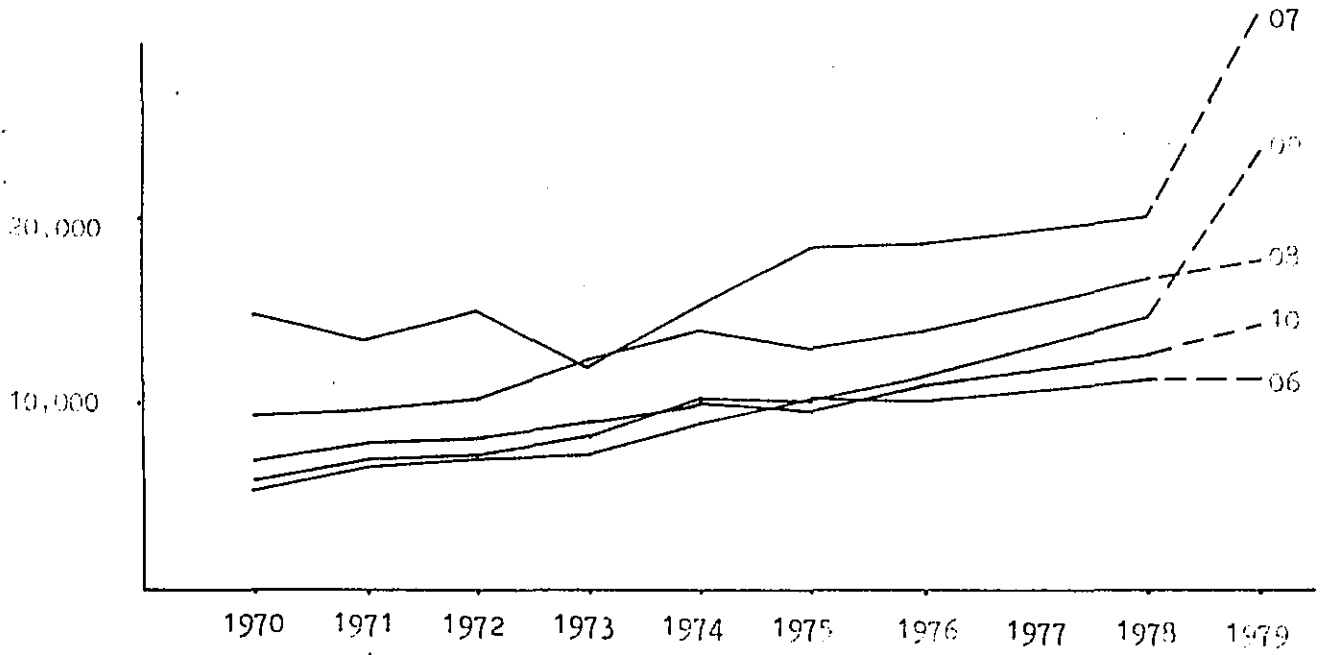
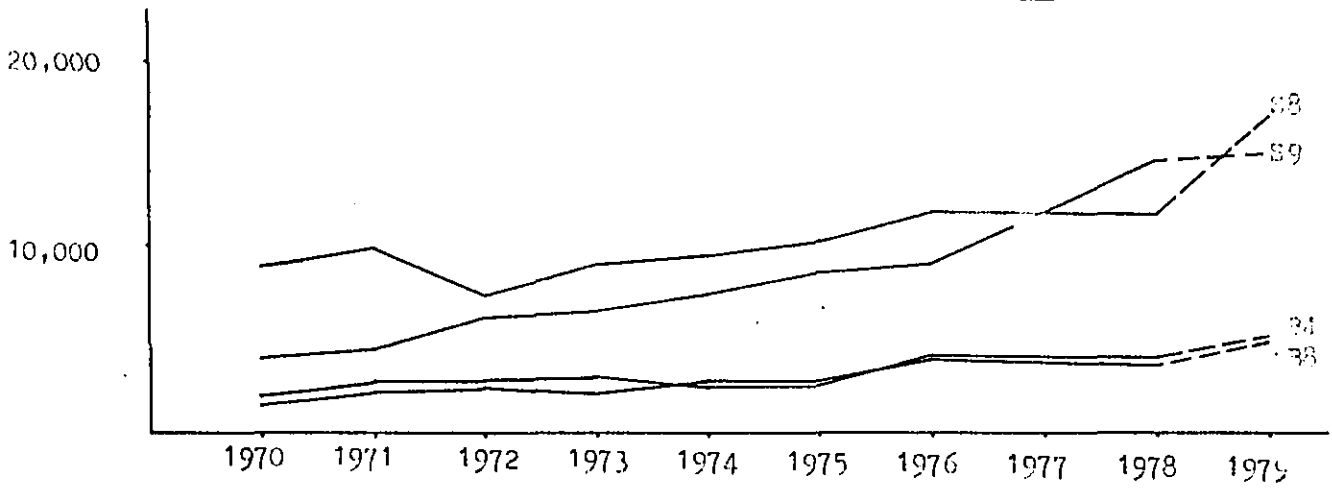


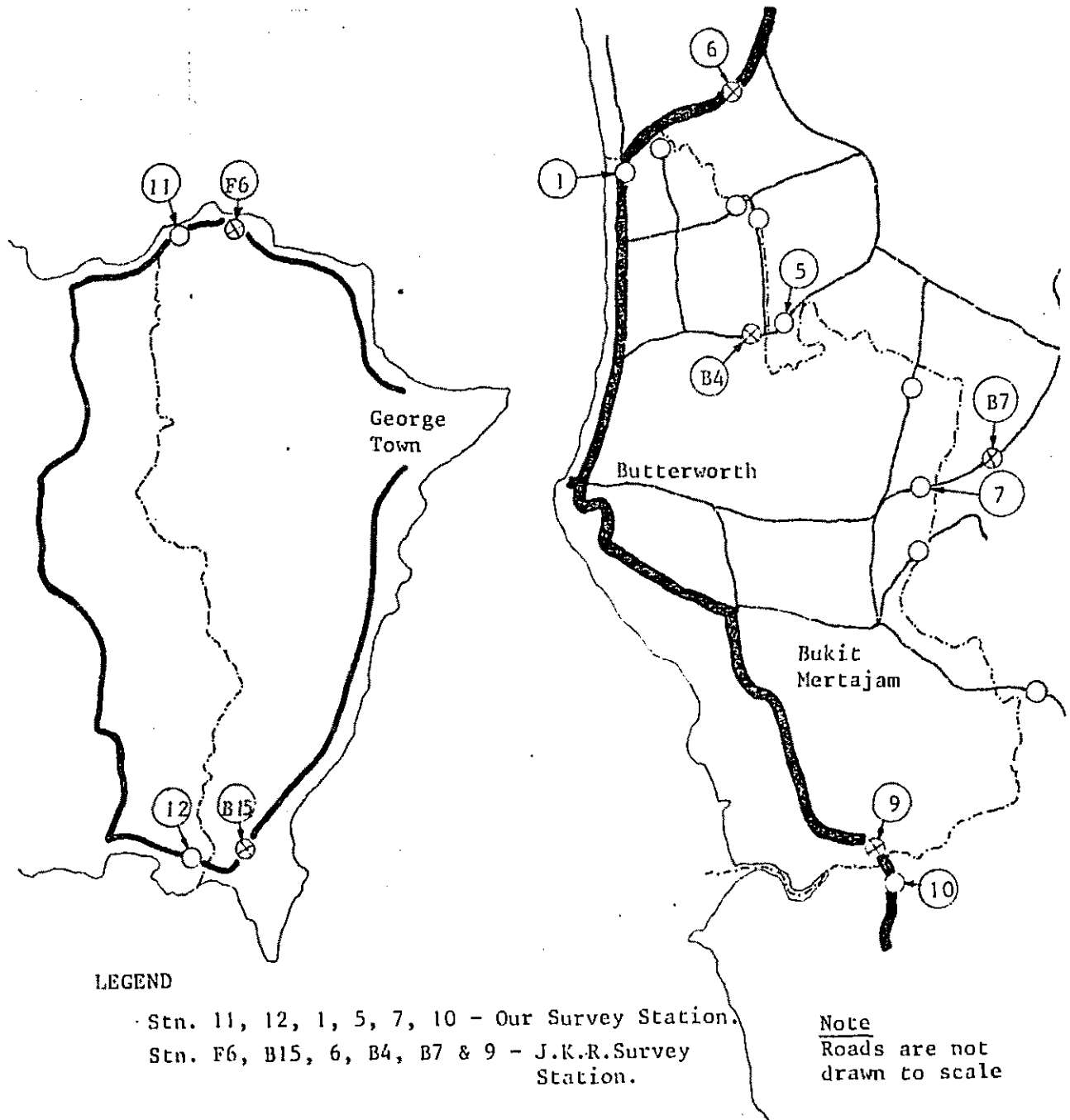
Fig. 3b. THE TRENDS OF TRAFFIC VOLUME  
(16 HOURS) IN PROVINCE WELLESLEY



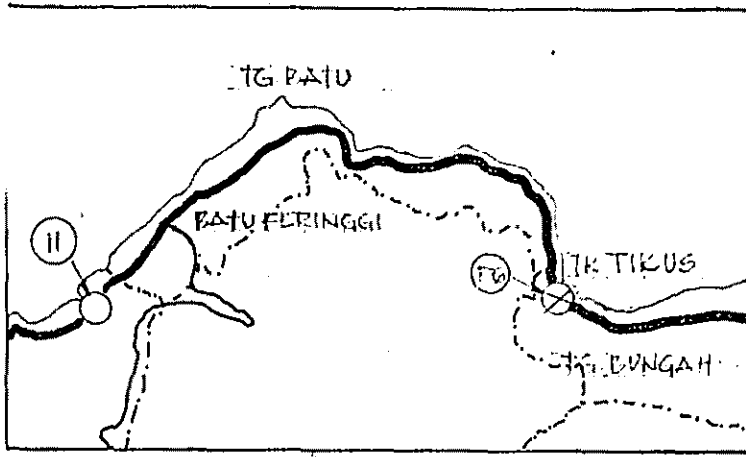
Comparison with the Results of Our Survey.

There are 6 stations, the data from which can be used to compare with our's because these stations are situated near to our stations. These stations are illustrated in Fig. 4.

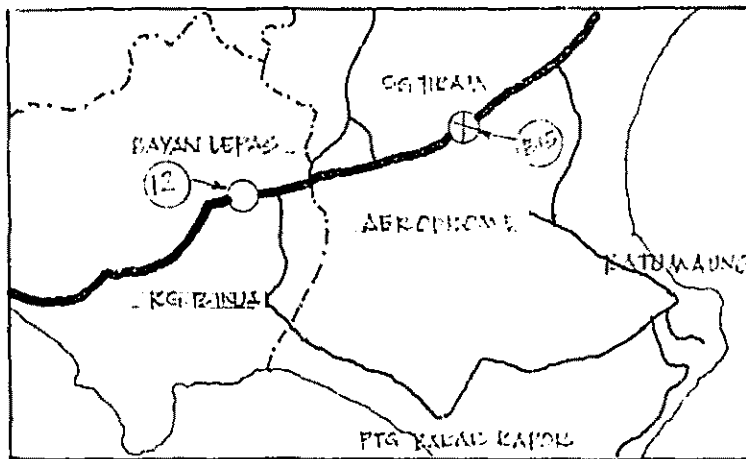
Fig. 4. Comparison of Survey Stations.



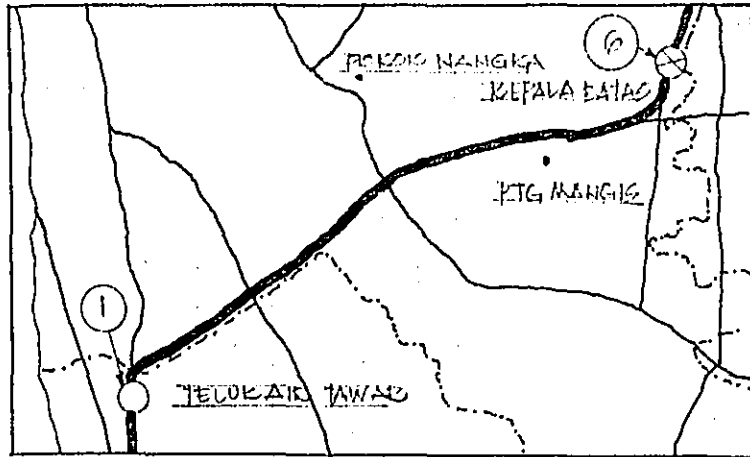
The main result of this comparison is shown below:-



<u>Traffic Census by J.K.R.</u>			<u>Our Survey.</u>			<u>Comparison</u> A/B
<u>Stn.</u>	<u>Name</u>	<u>No. of Vehicles (A)</u>	<u>Stn.</u>	<u>Name</u>	<u>No. of Vehicles (B)</u>	
F6	Bt. 6.9. Jln. Keliling Pulau	5930	11	Bt. Feringgi	2364	2.5.



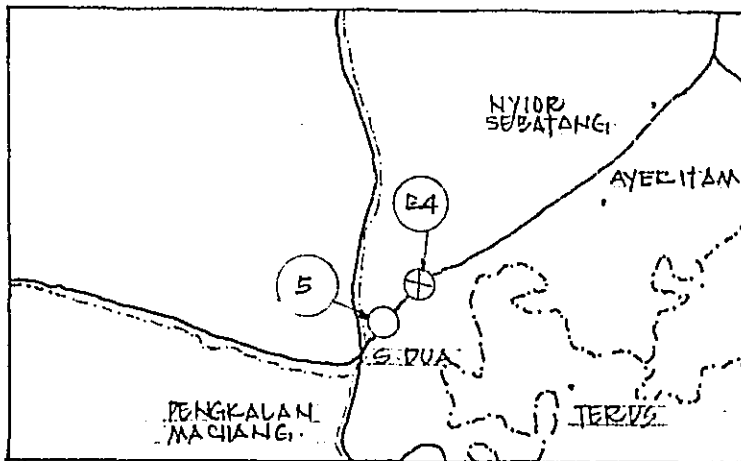
<u>Traffic Census by J.K.R.</u>			<u>Our Survey.</u>			<u>Comparison</u> A/B
<u>Stn.</u>	<u>Name</u>	<u>No. of Vehicles (A)</u>	<u>Stn.</u>	<u>Name</u>	<u>No. of Vehicles (B)</u>	
B15	Bt. 35.5 Bayan Lepas -Georgetown	10,002	12	Bayan Lepas	5745	1.7



Traffic Census by J.K.R.

Our Survey.

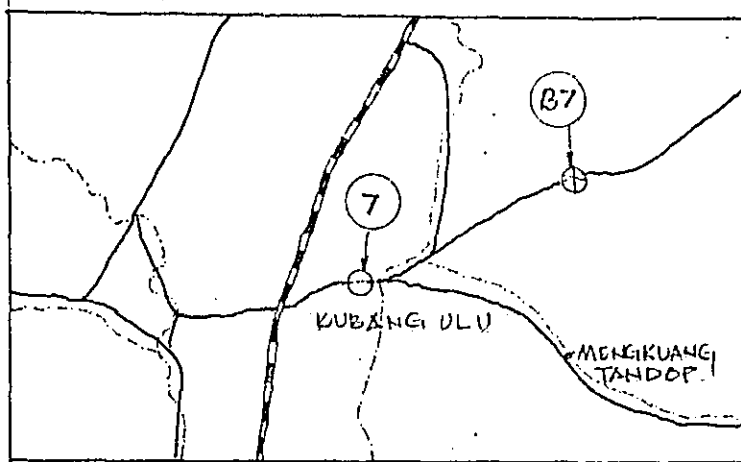
<u>Stn.</u>	<u>Name</u>	<u>No. of Vehicles (A)</u>	<u>Stn.</u>	<u>Name</u>	<u>No. of Vehicles (B)</u>	<u>Comparison A/B</u>
6	M.S. 010 $\frac{3}{4}$ B'worth/Sg. Petani	7356	1	Teluk Air Tawar	10,849	0.7



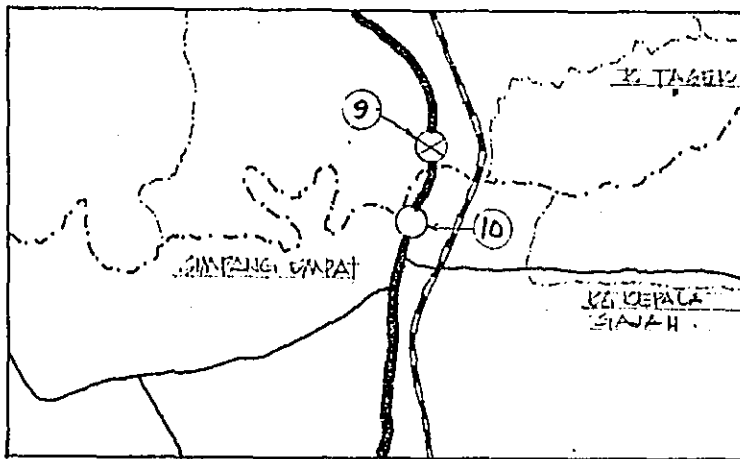
Traffic Census by J.K.R.

Our Survey.

<u>Stn.</u>	<u>Name</u>	<u>No. of Vehicles (A)</u>	<u>Stn.</u>	<u>Name</u>	<u>No. of Vehicles (B)</u>	<u>Comparison A/B</u>
B4	M.S. 7 $\frac{1}{2}$ Sg. Dua/Lalu Yoi	5363	5	Sg. Dua	4080	1.3



<u>Traffic Census by J.K.R.</u>			<u>Our Survey.</u>			<u>Comparison</u> A/B
<u>Stn.</u>	<u>Name</u>	<u>No. of Vehicles (A)</u>	<u>Stn.</u>	<u>Name</u>	<u>No. of Vehicles (B)</u>	
B7	M.S. 13 Kubang Ulu/Ara Kuda	2599	7	Kubang Ulu	4216	0.6



<u>Traffic Census by J.K.R.</u>			<u>Our Survey.</u>			<u>Comparison</u> A/B
<u>Stn.</u>	<u>Name</u>	<u>No. of Vehicles (A)</u>	<u>Stn.</u>	<u>Name</u>	<u>No. of Vehicles (B)</u>	
9	M.S. 12 $\frac{3}{4}$ B'worth/Taipung	23350	10	Simpang Empat	12,866	1.8

\* According with these result, we can consider our results to be an average volume.

Examination of the hourly flow of all types of vehicles show that there is little difference between these data. This is shown in the Table 2a & 2b.

TABLE 2a HOURLY FLOW AT J.K.R.'S STATIONS

TIME ZONE	STATION NO. OOF6		STATION NO. OB15		STATION NO. 0006	
	NO. OF VEHICLES	%	NO. OF VEHICLES	%	NO. OF VEHICLES	PERCENTAGE
6 - 7	185	3.1	703	7.0	303	4.1
7 - 8	376	6.3	814	8.1	645	8.8
8 - 9	426	7.2	644	6.4	513	7.0
9 - 10	314	5.3	568	5.7	570	7.7
10 - 11	307	5.2	732	7.3	560	7.6
11 - 12	367	6.2	619	6.2	424	5.8
12 - 13	339	5.7	598	6.0	485	6.6
13 - 14	337	6.4	632	6.8	475	6.5
14 - 15	439	7.4	704	7.0	308	4.2
15 - 16	390	6.6	643	6.4	537	7.3
16 - 17	408	6.9	735	7.3	637	8.7
17 - 18	620	10.5	900	9.0	900	7.8
18 - 19	522	8.8	595	5.9	446	6.1
19 - 20	391	6.6	399	4.0	390	5.3
20 - 21	249	4.2	384	3.8	209	2.8
21 - 22	220	3.7	282	2.8	277	3.8
TOTAL	5,930	100	10,002	100	7,356	100

TABLE 2b HOURLY FLOW AT OUR STATIONS

TIME ZONE	STATION NO. 11		STATION NO. 12		STATION NO. 1	
	NO. OF VEHICLES	%	NO. OF VEHICLES	%	NO. OF VEHICLES	PERCENTAGE
6 - 7	96	4.1	340	5.9	535	4.9
7 - 8	141	6.0	523	9.1	901	8.3
8 - 9	104	4.4	412	7.2	676	6.2
9 - 10	118	5.0	315	5.5	730	6.7
10 - 11	166	7.0	312	5.4	624	5.8
11 - 12	158	6.7	301	5.2	748	6.9
12 - 13	163	6.9	334	5.8	541	5.0
13 - 14	170	7.2	302	5.3	729	6.7
14 - 15	214	9.1	366	6.4	649	6.0
15 - 16	179	7.6	411	7.1	981	9.0
16 - 17	207	8.8	458	8.0	893	8.2
17 - 18	190	8.1	517	9.0	807	7.4
18 - 19	177	7.5	443	7.7	780	7.2
19 - 20	105	4.4	293	5.1	414	3.8
20 - 21	77	3.3	252	4.4	439	4.0
21 - 22	95	4.0	166	2.9	402	3.7
TOTAL	2,360	100	5,745	100	10,849	100

The pattern of hourly flow of all vehicle types is almost similar. This is illustrated in the following Fig. 5 - 7.

Fig. 5. STATION 11 & F6

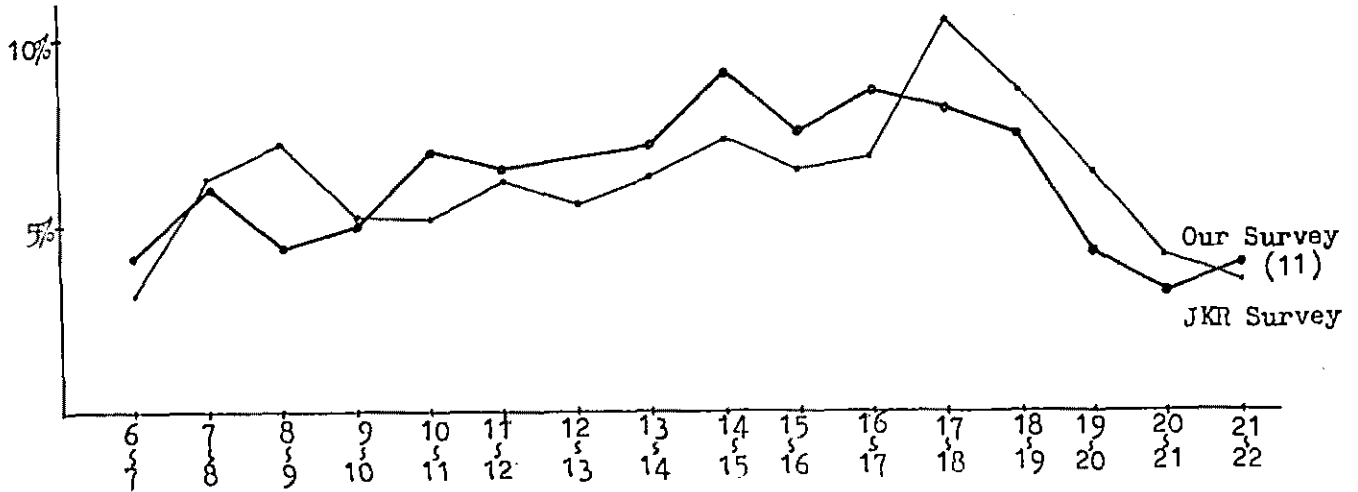


Fig. 6. STATION 12 & B15

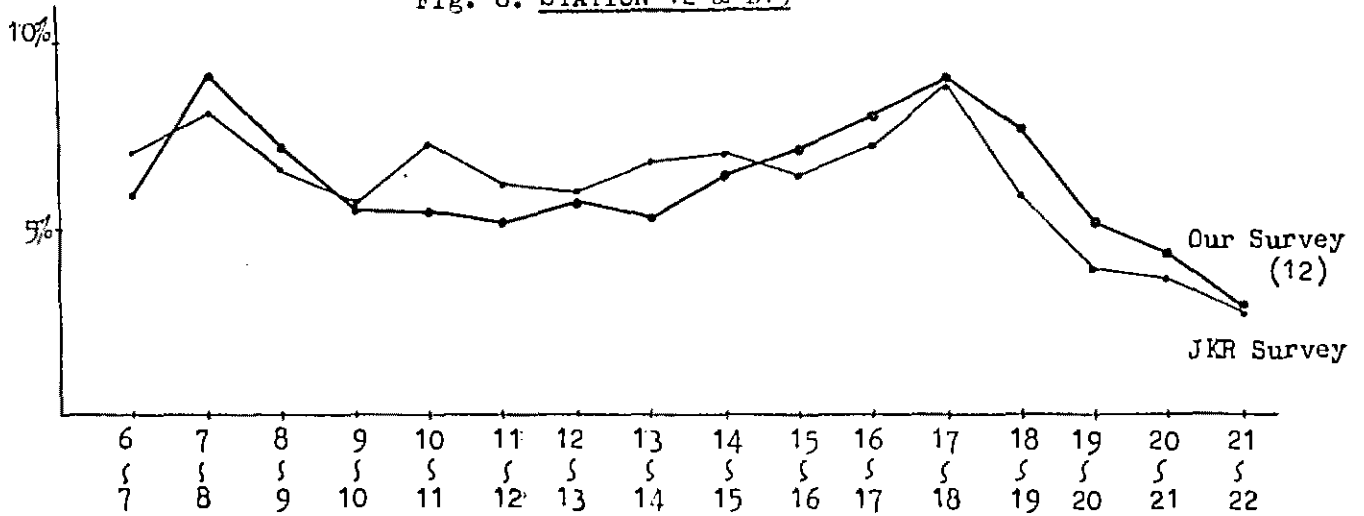
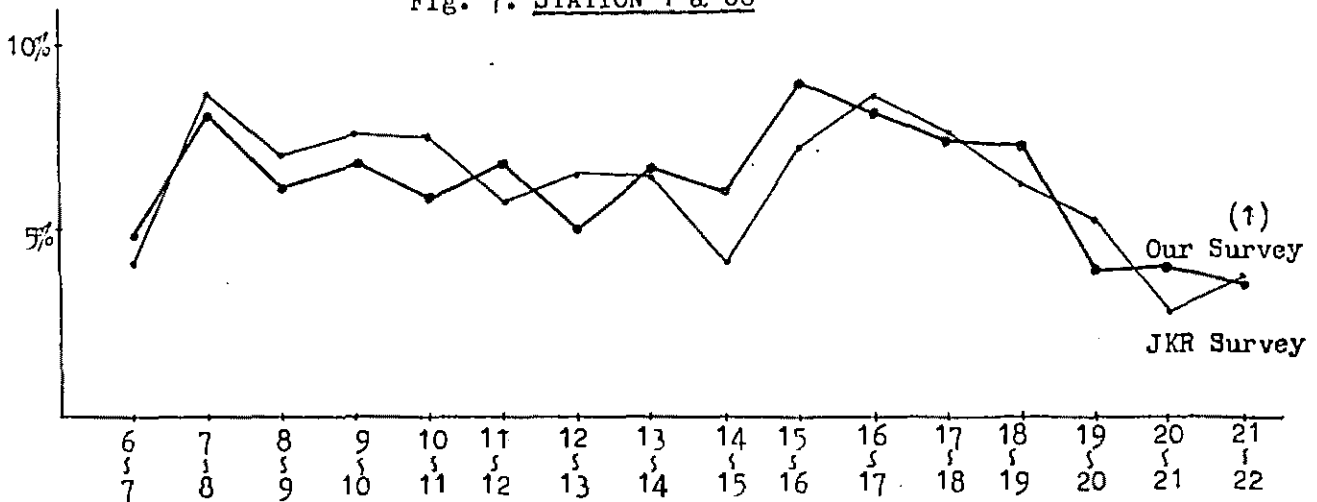


Fig. 7. STATION 1 & O6





## Estimation of day-night ratio.

The traffic volume of the whole day (24 hours) is necessary although our surveys (cordon-line survey and screen-line survey) were carried out only for 16 hours or 12 hours.

These data must therefore be converted into 24 hours data, and then the day-night ratio will be estimated from the results of J.K.R.'s Traffic Census.

The day-night ratio is defined as the ratio of 24 hours' volume to 12 hours' or to 16 hours', that is  $\frac{24 \text{ hours' volume}}{12 \text{ hours' volume}}$   
or  $\frac{24 \text{ hours' volume}}{16 \text{ hours' volume}}$ .

Usually this ratio is different depending on the type of road and location; e.g. the ratio in urban areas is higher than in rural areas and it is also higher at trunk roads than at feeder roads.

The results which we calculated from the data of J.K.R.'s traffic census are shown in Table 3 below.

TABLE 3 DAY-NIGHT RATIO

STATION NO.	DATE	NO. OF VEHICLES			DAY-NIGHT RATIO	
		24 HOURS (6.00-6.00)	16 HOURS (6.00-22.00)	12 HOURS (7.00-19.00)	$\frac{24 \text{ HOURS}}{16 \text{ HOURS}}$	$\frac{24 \text{ HOURS}}{12 \text{ HOURS}}$
OOF6	23/4/79 (Mon)	6261	5625	4607	1.11	1.36
	24/4/79 (Tue)	5804	5163	4256	1.12	1.36
	25/4/79 (Wed)	5549	4941	4076	1.12	1.36
	26/4/79 (Thu)	5629	5050	4127	1.11	1.38
	27/4/79 (Fri)	6146	5157	4552	1.19	1.35
	28/4/79 (Sat)	7394	6144	4859	1.20	1.52
	29/4/79 (Sun)	8871	8193	7255	1.08	1.22
					*(1.13)	*(1.36)
OOS6	23/4/79 (Mon)	10251	9440	7137	1.08	1.44
	24/4/79 (Tue)	-	-	-	-	-
	25/4/79 (Wed)	7551	6896	5534	1.09	1.36
	26/4/79 (Thu)	8245	7445	5588	1.11	1.48
	27/4/79 (Fri)	7951	7180	5734	1.11	1.39
	28/4/79 (Sat)	9432	8220	6100	1.15	1.55
	29/4/79 (Sun)	8492	7779	6681	1.09	1.27
					*(1.11)	*(1.42)

Contd.

STATION NO:	DATE	NO: OF VEHICLES			DAY-NIGHT RATIO	
		24 HOURS (6.00-6.00)	16 HOURS (6.00-22.00)	12 HOURS (7.00-19.00)	$\frac{24 \text{ HOURS}}{16 \text{ HOURS}}$	$\frac{24 \text{ HOURS}}{12 \text{ HOURS}}$
0007	23/4/79 (Mon)	34699	32966	26570	1.05	1.31
	24/4/79 (Tue)	32227	29546	23891	1.09	1.35
	25/4/79 (Wed)	29931	27765	23365	1.08	1.28
	26/4/79 (Thu)	32214	30239	24377	1.07	1.32
	27/4/79 (Fri)	34869	32520	26825	1.07	1.30
	28/4/79 (Sat)	36408	32105	24429	1.13	1.49
	29/4/79 (Sun)	-	36588	28274	-	-
					*(1.08)	*(1.34)
00S7	23/4/79 (Mon)	2898	2795	2357	1.04	1.23
	24/4/79 (Tue)	2988	2878	2490	1.04	1.20
	25/4/79 (Wed)	3026	2885	2511	1.05	1.21
	26/4/79 (Thu)	3066	2938	2491	1.04	1.23
	27/4/79 (Fri)	3676	3546	2940	1.04	1.25
	28/4/79 (Sat)	3709	3576	2942	1.04	1.26
	29/4/79 (Sun)	3526	3388	2772	1.04	1.27
					*(1.04)	*(1.24)

\* ( ) is the average ratio.

## A Simple Forecast of the Traffic Volume.

Some results have already been obtained by analysis of the data from the Traffic Census, and a simple forecast of future traffic volume will be done.

If the general condition continues as before, a forecast of the volume of traffic-flow from the present trend can be made. We can assume that this trend will continue into the future.

For this purpose, two methods were chosen:-

- a) apply the annual growth rate for the future.
- b) apply the statistical method of least squares.

In the case of b), a simple function was used like as ' $y = ax + b$ '; in this function 'y' and 'x' indicate 'the number of vehicles' and 'the year' respectively; 'a' and 'b' were the co-efficient estimated.

The results are shown in Table 4 & 5.

TABLE 4 FORECAST OF FUTURE TRAFFIC VOLUME - 1

Stn. No.	Annual growth rate (1970 - 1978)	Traffic volume in future		
		1980	1985	1990
	%			
F6	11.2	6,180	10,500	17,850
F7	17.0	42,460	93,090	204,100
B13	23.0	1,770	4,990	14,040
B14	12.4	3,460	6,210	11,140
B15	13.7*	13,050	24,800	47,120
S6	15.4	9,370	19,180	39,260
O6	8.8	13,290	20,260	30,880
O7	3.9	21,590	26,140	31,650
O8	7.5	19,210	27,580	39,590
O9	11.8	18,170	31,730	55,420
10	7.3	14,320	20,360	28,960
6A	4.5*	15,550	19,380	24,150
B1	12.7	2,640	4,800	8,720
B3	11.1	1,570	2,650	4,490
B4	8.9	4,820	7,380	11,300
B6	8.3	1,202	1,510	2,250
B7	7.6	2,510	3,620	5,220
B8	10.9	4,570	7,670	12,860
B9	7.5	5,730	8,230	11,820
S7	10.6	3,300	5,460	9,040
S8	3.9	12,580	15,230	18,440
S9	17.4	19,970	44,530	99,310
B10	3.4	670	790	940
B11	15.3	3,430	7,000	14,260
B12	18.3	5,200	12,060	27,940

\* 1971 - 1978

TABLE 5 FORECAST OF FUTURE TRAFFIC VOLUME - 2

<u>Stn. No.</u>	<u>Correlative Function</u>	<u>Traffic volume in future</u>		
		<u>1980</u>	<u>1985</u>	<u>1990</u>
F6	$y = 402.06x - 26,007$	6,160	8,170	10,180
F7	$y = 2710.7 x - 183,099$	33,960	47,310	60,860
B13	$y = 89.09x - 6,108$	1,020	1,460	1,910
B14	$y = 199.01x - 13,004$	2,920	3,910	4,910
B15	$y = 925.68x - 61,955$	12,100	16,730	21,360
S6	$y = 588.83x - 39,332$	7,770	10,720	13,660
O6	$y = 738.09x - 45,937$	13,110	16,800	20,490
O7	$y = 839.28x - 45,885$	21,260	25,450	29,650
O8	$y = 902.43x - 54,122$	18,070	22,580	27,100
O9	$y = 1047.8 x - 67,807$	16,030	21,270	26,510
10	$y = 636.11x - 37,531$	13,360	16,540	19,720
6A	$y = 248.08x - 6,104.5$	13,740	14,980	16,220
B1	$y = 179.65x - 11,845$	2,530	3,430	4,320
B3	$y = 47.248x - 2,428.1$	1,350	1,590	1,820
B4	$y = 216.87x - 12,918$	4,430	5,520	6,600
B6	$y = 63.218x - 3,934.4$	1,120	1,440	1,760
B7	$y = 117.02x - 7,189.3$	2,170	2,760	3,340
B8	$y = 276.11x - 17,662$	4,430	5,810	7,190
B9	$y = 240.92x - 14,264$	5,010	6,210	7,420
S7	$y = 180.03x - 11,587$	2,820	3,720	4,620
S8	$y = 453.59x - 23,565$	12,720	14,990	17,260
S9	$y = 1188.6 x - 79,896$	15,190	21,140	27,080
B10	$y = -6.6316x + 1,084.0$	550	520	490
B11	$y = 197.32x - 13,223$	2,560	3,550	4,540
B12	$y = 257.68x - 17,530$	3,080	4,370	5,660

