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THE FEASIBILITY STUDY ON RAIL-BASED COMMUTER SERVICES IN KLANG VALLEY, MALAYSIA

FINAL REPORT

(APPENDIX)

FEBRUARY 1991

JAPAN INTERNATIONAL COOPERATION AGENCY

(JICA)

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ABBREVIATION

Corridor	: Rawang ~ Seremban MRA route
DMU	: Diesel Multiple Unit
DTP	: Double Tracking Project
EIRR	: Economic Internal Rate of Return
EPU	: Economic Planning Unit
FIRR	: Financial Internal Rate of Return
HPU	: Highway Planning Unit
Jct.	: Junction
JICA	: Japan International Cooperation Agency
JICA M/P 87	: Klang Valley Transportation Study (JICA, 1987)
JICA F/S 89	: Klang Valley Feasibility Study for Transportation Facility Projects in klang Valley (JICA, 1989)
JNR	: Japanese National Railways
JR	: Japan Railway Group; Successor(s) of JNR
K.L.	: Kuala Lumpur (area, station)
KVPS	: Klang Valley Planning Secretariat
LRT	: Light Rail Transit
MRA	: Malaysian Railway Administration
OD	: Origin and Destination
Perspective Plan	: Klang Valley Perspective Plan (KVPS, 1984)
RBCS	: Rail-Based Commuter Service
Review	: Review of Klang Valley Perspective Plan (KVPS, 1988)
R/W	: Right-of-way
S&T	: Signalling and Telecommunication

Chapter 3

SOCIO-ECONOMIC FRAMEWORK

APPENDIX 3-2-1 Region-wide Population Trend

(1) Population Trend during 1960 and 1980

Region	Population (x 1000) 1960	1970	1980	Annual Growth Rate (%) 60/70	70/80	Area (%)	Share
Malaysia	8,036	10,439	13,136	2.7	2.3		
Peninsular Malaysia	6,837	8,810	10,945	2.6	2.2	131,598	100.0
Selangor State & Federal Territory	1,139	1,630	2,346	3.6	3.7	8,199	6.2
- Klang Valley	(720)*	1,266	2,020	(4.4)	4.8	2,843	2.2
Negeri Sembilan	391	482	551	2.1	1.4	6,643	5.0

Source: Year Book of Statistics 1988; and the Klang Valley Perspective Plan (1984)
Note: Population of Klang Valley (*) is for 1957; therefore the Annual Growth Rate (*) also is for 1957 - 1970.

(2) Populaiton Trend After 1980

Region	Population (x 1000) 1980	1987	1989	1990	Annual Growth Rate (%)
Malaysia	13,764	16,526	17,363	-	2.6 (80/89)
Peninsular Malaysia	11,442	13,653	14,303	-	2.5 (80/89)
Selangor State & Federal Territory	2,346	-	-	-	-
- Klang Valley	2,080	-	-	3,154	4.3 (80/90)
Negeri Sembilan	551	645	-	-	2.3 (80/87)

Source : Year Book of Statistics 1988; the Review of Klang Valley Perspective Plan (1988); and Negeri Sembilan State data.
Note : The figures of Malaysia and Peninsular Malaysia were adjusted to the Post Enumeration Survey.
The figure of Klang Valley for 1990 was projected by KVPP in 1988.

APPENDIX 3-2-2 Growth of Gross Domestic Product (GDP), 1985 - 1988 (at constant 1938 prices)

	Growth Rate (%)											Share to GDP (%)		
	1980	1981	1982	1983	1984	1985	1986	1987	1988	1986-88	Plan target 1986-90	1985	1988	Plan target 1990
Agriculture, forestry, liverstock and fishing							4.0	7.4	4.7	5.4	2.6	20.8	21.1	18.1
Mining and quarrying							7.5	0.1	6.6	4.7	3.1	10.5	10.4	9.2
Manufacturing							7.5	12.8	18.0	12.7	6.4	19.7	24.4	20.5
Construction							-14.0	-11.8	2.5	-8.0	5.6	4.8	3.2	5.3
Services							-0.5	4.8	7.2	3.8	6.0	43.5	41.9	46.3
Important duties less imputed bank charges							-	-	-	-	-	0.7	-1.0	0.6
GDP at purchasers' value	7.4	6.9	5.9	36.3	7.1	-1.0	1.2	5.2	8.7	5.0	5.0	100.0	100.0	100.0

Source: Mid-Term Review of the Fifth Malaysia Plan 1986 - 1990, 1989

APPENDIX 3-2-3 Gross Regional Domestic Product (GRDP) of Federal Terriotory, Selangor and Negeri Sembilan by Sector (1986, 1988)

($ million in 1998, prices)

Sector	Year	Negeri Sembilan	Selangor	F.T. K. Lumpur	Malaysia
Agriculture, forestry, liverstock and fishery	1986	636.3	1,018.0	0.0	12,389.0
	1988	692.9	1,095.5	0.0	13,935.0
		(4.4)	(3.7)	(0.0)	(6.1)
Mining and quarrying	1986	15.7	319.4	30.8	6,433.0
	1988	16.6	331.8	31.0	6,865.0
		(2.8)	(1.9)	(0.3)	(3.3)
Manufacturing	1986	539.5	4,216.4	1,246.2	12,111.0
	1988	691.5	5,738.5	1,644.3	16,122.0
		(13.2)	(16.7)	(14.9)	(15.4)
Construction	1986	64.2	397.1	469.1	2,355.0
	1988	57.8	367.7	426.9	2,129.0
		(-5.1)	(-3.8)	(-4.6)	(-4.9)
Electricity, gas and water	1986	47.3	122.0	265.6	1,027.0
	1988	54.3	151.6	319.9	1,222.0
		(7.1)	(11.5)	(9.7)	(9.1)
Transport, storage and communication	1986	94.7	1,008.3	428.7	3,851.0
	1988	107.1	1,160.7	502.9	4,473.0
		(6.3)	(7.3)	(8.3)	(7.8)
Wholesale and retail trade, hotels and restaurants	1986	94.2	990.8	1,825.7	6,147.0
	1988	105.4	1,144.1	2,117.5	6,975.0
		(5.8)	(7.5)	(7.7)	(6.5)
Finance, insurance, real estate and business services	1986	177.0	467.7	1,507.0	5,073.0
	1988	194.6	526.2	1,818.1	5,773.0
		(4.9)	(6.1)	(9.8)	(6.7)
Government sevices	1986	313.4	793.6	1,312.9	7,253.0
	1988	337.7	863.4	1,399.9	7,860.0
		(3.8)	(4.3)	(3.3)	(4.1)
Other services	1986	41.8	269.7	399.9	1,352.0
	1988	43.9	294.6	435.1	1,449.0
		(2.5)	(4.5)	(4.3)	(3.5)
Total	1986	2,024.1	9,603.0	7,485.9	57,991.0
	1988	2,301.8	11,674.1	8,695.6	66,803.0
		(6.6)	(10.3)	(7.8)	(7.3)

Notes: Figures in parentheses are the annual growth rate for 1986 - 88.

Source: Mid-Term Review of the Fifth Malaysia Plan, 1989

APPENDIX 3-2-4 Employment in Klang Valley by District and Sector
(1980, 1985 and 1990)

District	Sector	Employment (x 1000) 1980	1985	1990	Sectorial Share (%) 1985	1990	Annual Growth Rate (%) 80/85	85/90
Federal Territory of Kuala Lumpur	Primary		3.6	2.7	0.6	0.4		-5.6
	Secondary		142.2	164.6	22.9	22.4		3.0
	Tertiary		475.9	566.4	76.5	77.2		3.5
	Total	513.0	621.7	733.7	100.0	100.0	3.9	3.4
Pataling	Primary		6.5	3.0	2.7	0.9		-14.3
	Secondary		105.4	166.9	44.1	49.1		9.6
	Tertiary		126.7	169.8	53.1	50.0		6.0
	Total	195.8	238.8	339.7	100.0	100.0	4.1	7.3
Klang	Primary		10.0	9.5	9.4	6.7		-1.0
	Secondary		38.8	53.2	36.5	37.5		6.5
	Tertiary		57.5	79.2	54.1	55.8		6.6
	Total	105.9	106.3	141.9	100.0	100.0	0.1	5.9
Gombak	Primary		8.0	9.2	14.3	11.3		2.8
	Secondary		31.3	46.6	55.9	57.5		8.3
	Tertiary		16.7	25.3	29.8	31.2		8.7
	Total	37.6	56.0	81.1	100.0	100.0	8.3	7.7
Hulu Langat	Primary		7.2	6.7	21.2	8.9		-1.4
	Secondary		6.7	15.6	19.8	20.6		18.4
	Tertiary		20.0	53.3	59.0	70.5		21.7
	Total	36.7	33.9	75.6	100.0	100.0	-1.6	17.4
Total of Klang Valley	Primary		35.3	31.3	3.3	2.3		-2.4
	Secondary		324.4	446.9	30.7	32.6		6.6
	Tertiary		696.8	894.0	66.0	65.2		5.1
	Total	889.0	1,056.5	1,372.0	100.0	100.0	3.5	5.4

Source : The Review of Klang Valley Perspective Plan, 1988 KVPS.

APPENDIX 3-2-5 Employment in Seremban District by Sector (1987)

District	Sector	Employment	Sectorial Share (%)
(a)Seremban District	Primary	15,100	18.9
	Secondary	21,600	27.1
	Tertiary	43,100	54.0
	Total	79,800	100.0
(b)Remained Area	Primary	79,800	58.8
	Secondary	13,300	9.8
	Tertiary	42,600	31.4
	Total	135,700	100.0
Total of Negeri Sembilan State	Primary	94,900	44.0
	Secondary	34,900	16.2
	Tertiary	85,700	39.8
	Total	215,500	100.0

Source : Negeri Sembilan State Master Plan (Draft), 1989

APPENDIX 3-2-6 Mean Monthly Household Income of Federal Terrritory, Selangor and Negeri Sembilan, 1984 and 1987

	1984		1987	
	Mean income ($)	Ratio to Malaysian average	Mean income ($)	Ratio to Malaysian average
Federal Territory of Kuala Lumpur	1,929	1.76	1,790	1.67
Selangor	1,590	1.45	1,558	1.45
Negeri Sembilan	1,039	0.95	908	0.85
Peninsula Malaysia	1,095	1.00	1,074	1.00

Source : Department of Statistics, Household Income Survey, 1984 and 1987

APPENDIX 3-3-1 Review on Population Scenario for Klang Valley up to 2000

1) Review on Districts (x 1000)

District	1980 Actual	1990 Review	1990 Target	2000 Review	2000 Target	Annual Growth Rate (%) 1980-90		1990-2000	
Federal Territory of Kuala Lumpur	1,036.9	1,550.0	1,489.6	2,200.0	2,150.0	4.10	3.70	3.60	3.70
Pataling	382.3	658.9	712.0	925.8	1,011.4	5.40	6.40	3.40	3.60
Klang	296.1	411.9	417.5	578.7	576.1	3.30	3.50	3.40	3.30
Gombak	175.9	244.6	342.4	343.7	575.4	3.30	6.90	3.40	5.30
Hulu Langat	188.4	289.1	321.6	406.1	447.2	4.30	5.50	3.40	3.40
Klang Valley	2,079.6	3,154.5	3,283.0	4,454.3	4,760.0	4.20	5.00	3.50	3.80

2) Review on Major Growth Centers

	1980 Actual	1990 Review	1990 Target	2000 Review	2000 Target	Annual Growth Rate (%) 1980-90		1990-2000	
Federal Teritory of Kuala Lumpur	1,036.9	1,550.0	1,489.6	2,200.0	2,150.0	4.10	3.70	3.60	3.70
Pataling Jaya	220.1	306.1	280.0	430.1	400.0	3.30	2.40	3.40	3.60
Shah Alam	20.2	155.2	260.0	218.0	370.0	20.40	29.10	3.40	3.60
Klang	203.4	282.9	300.0	397.5	430.0	3.30	4.00	3.40	3.70
Bangi	33.3	73.4	125.0	103.2	180.4	7.90	14.10	3.40	3.70
Selayang	3.5	4.9	60.0	6.9	130.0	3.30	32.70	3.40	8.70
Other Centers	-	-	263.5	-	428.9	-	3.10	-	3.40
Satelite Towns	33.9	47.2	-	66.3	0.0	3.30	-	3.40	-
Rural Areas	0.0	0.0	500.9	0.0	670.7	-	3.20	-	3.40
Other Mukims	528.2	734.8	-	1,032.3	-	3.30	-	3.40	-
Klang Valley	2,079.6	3,154.5	3,283.0	4,454.3	4,760.0	4.20	5.00	3.50	3.80

Source : The Review of Klang Valley Perspective Plan, 1988 KVPS.

APPENDIX 3-3-2 Employment Scenario for Klang Valley up to 2005 by District and Sector

District	Sector	Basic Figures (x1000) 1980	1990	2000 (Target)	Annual Growth Rate (%) 80/90	90/2000	Projected Figure (x1000) 1993	2005	Sectorial Share 1990	1993	2000	(%) 2005
Federal Territory of Kuala Lumpur	Primary		2.7	1.5		-5.7	2.2	1.1	0.3	0.3	0.2	0.1
	Secondary		164.6	228.6		3.3	179.3	260.6	22.4	22.4	22.9	20.6
	Tertiary		566.4	769.7		3.1	619.0	1,005.7	77.3	77.3	77.0	79.4
	Total	513.0	733.7	999.8	3.6	3.1	800.5	1,267.4	100.0	100.0	100.0	100.0
Petaling	Primary		3.0	1.5		-6.7	2.2	0.9	0.5	0.5	0.3	0.1
	Secondary		166.9	219.5		2.8	198.7	240.7	49.4	49.4	44.6	39.9
	Tertiary		169.8	271.1		4.8	201.1	361.1	50.0	50.0	55.1	59.9
	Total	195.8	339.7	492.1	5.7	3.8	402.0	602.7	100.0	100.0	100.0	100.0
Klang	Primary		9.5	8.5		-1.1	9.1	7.7	5.6	5.6	4.2	3.0
	Secondary		53.2	80.5		4.2	61.7	95.8	38.0	38.0	39.5	37.1
	Tertiary		79.2	114.8		3.8	91.4	154.4	56.4	56.4	56.3	59.9
	Total	105.9	141.9	203.8	3.0	3.7	162.2	257.9	100.0	100.0	100.0	100.0
Gombak	Primary		9.2	9.8		0.6	9.7	9.2	9.7	9.7	6.1	4.2
	Secondary		46.6	97.8		7.7	58.3	135.5	58.5	58.5	60.9	61.5
	Tertiary		25.3	53.0		7.7	31.6	75.5	31.7	31.7	33.0	34.3
	Total	37.6	81.1	160.6	8.0	7.1	99.6	220.2	100.0	100.0	100.0	100.0
Hulu Langat	Primary		6.7	4.7		-3.5	6.4	3.3	6.5	6.5	4.1	1.8
	Secondary		15.6	31.6		7.3	20.3	58.2	20.6	20.6	27.7	31.8
	Tertiary		53.3	77.6		3.8	71.7	121.5	72.9	72.9	68.1	66.4
	Total	36.7	75.6	113.9	7.5	4.2	98.4	183.0	100.0	100.0	100.0	100.0
Total of Klang Valley	Primary		31.3	26.0		-1.8	29.6	22.2	1.9	1.9	1.3	0.9
	Secondary		446.9	658.0		3.9	518.3	790.8	33.2	33.2	33.4	33.6
	Tertiary		894.0	1,372.2		4.4	1,014.8	1,718.2	64.9	64.9	69.6	73.1
	Total	889.0	1,372.0	1,970.2	4.4	3.7	1,562.7	2,351.2	100.0	100.0	100.0	100.0

Source : The Review of Klang Valley Perspective Plan, 1988 KVPS.

APPENDIX 3-3-3 Employment Scenario for Seremban District up to 2005 by Sector

District	Sector	Basic Figure (Existing) (x1000) 1987	(Master Plan) 1995	2000	2005	Annual Growth Rates (Master Plan) (%) 87/95	95/2000	2000/05	Selected Employment for (x1000) 1993	2005	Sectorial Share by District (%) 1987	1993	2000	2005
(a)Seremban District	Primary	15.1	13.8	13.0	12.2	-1.1	-1.2	-1.3	14.1	12.2	18.9	14.3	10.0	7.7
	Secondary	21.6	36.2	34.3	71.0	6.7	-1.1	15.7	31.8	71.0	27.1	32.3	26.3	44.8
	Tertiary	43.1	55.8	83.3	75.3	3.3	8.3	-2.0	52.7	75.3	54.0	53.4	63.8	47.5
	Total	79.8	105.8	130.6	158.6	3.6	4.3	4.0	98.6	158.5	100.0	100.0	100.0	100.0
- Seremban City	Primary								9.0	7.6		10.7		5.4
	Secondary								30.2	66.2		36.0		47.3
	Tertiary								44.8	66.3		53.3		47.3
	Total								34.0	140.1		100.0		100.0
- Other Zones	Primary								5.1	4.6		34.9		25.0
	Secondary								1.6	4.8		11.0		26.1
	Tertiary								7.9	9.0		54.1		48.9
	Total								14.6	18.4		100.0		100.0
(b)Remained Area	Primary	79.8	74.5	71.6	68.8	-0.9	-0.8	-0.8	75.8	68.8	58.8	51.4	42.9	37.0
	Secondary	13.3	21.1	47.3	40.2	5.9	17.5	-3.2	19.3	40.2	9.8	13.1	28.4	21.6
	Tertiary	42.6	55.6	48.0	77.1	3.4	-2.9	9.9	52.3	77.1	31.4	35.5	28.8	41.4
	Total	135.7	151.2	166.8	186.0	1.4	2.0	2.2	147.4	186.1	100.0	100.0	100.0	100.0
Total of Negeri Sembilan State	Primary	94.9	88.3	84.6	81.0	-0.9	-0.9	-0.9	89.9	81.0	44.0	36.5	28.4	23.5
	Secondary	34.9	57.3	81.6	111.2	6.4	7.3	6.4	51.1	111.2	16.2	20.8	27.4	32.3
	Tertiary	85.7	111.4	131.3	152.4	3.3	3.3	3.0	105.0	152.4	39.8	42.7	44.1	44.2
	Total	215.5	257.0	297.4	344.6	2.2	3.0	3.0	246.0	344.6	100.0	100.0	100.0	100.0

Source : The Negeri Sembilan Master Plan (Draft), 1989

APPENDIX 3-3-4 Population and Employment Distribution within Klang Valley and Seremban District for 1993 and 2005

(x 1000)

Traffic Zone	Population 1993	Population 2005	Employment 1993 1st	1993 2nd	1993 3rd	1993 Total	Employment 2005 1st	2005 2nd	2005 3rd	2005 Total
1	11.3	10.7	0.1	2.9	48.9	51.9	0.0	2.1	78.7	80.9
2	14.4	16.2	0.1	4.3	61.7	66.1	0.0	2.7	91.3	94.1
3	13.9	19.1	0.1	2.0	33.5	35.5	0.0	1.9	48.9	50.8
4	5.3	6.5	0.0	1.5	26.2	27.8	0.0	1.9	37.2	39.1
5	96.8	126.9	0.1	2.4	27.8	30.4	0.1	3.3	35.5	38.9
6	22.4	28.9	0.1	4.1	46.9	51.0	0.1	3.1	71.8	75.0
7	44.1	57.9	0.1	1.9	25.0	27.0	0.1	2.9	32.7	35.6
8	59.6	87.9	0.0	1.6	12.6	14.2	0.0	1.3	19.0	20.3
9	4.8	5.9	0.0	0.6	9.4	10.0	0.0	1.0	17.9	18.9
10	70.1	75.9	0.1	10.5	28.7	39.3	0.1	13.4	41.2	54.7
11	76.8	106.1	0.1	3.8	13.6	17.5	0.0	6.0	26.9	33.0
12	43.1	60.6	0.1	5.6	12.7	18.3	0.0	7.9	23.2	31.1
13	64.1	72.7	0.1	8.6	12.3	21.0	0.0	11.2	23.0	34.2
14	118.2	180.5	0.1	12.1	12.4	24.5	0.0	17.9	26.0	43.9
15	137.0	154.5	0.1	10.5	31.1	41.7	0.1	16.2	45.4	61.6
16	91.2	193.5	0.2	13.1	25.1	38.5	0.1	23.3	57.9	81.3
17	91.8	110.6	0.0	5.7	17.7	23.5	0.0	7.6	25.4	33.0
18	45.7	69.6	0.0	6.6	7.8	14.4	0.0	9.6	10.7	20.3
19	164.7	225.6	0.2	28.7	32.0	60.9	0.1	44.0	64.2	108.4
20	139.5	264.2	0.1	8.4	18.9	27.4	0.0	11.7	27.9	39.6
21	56.1	73.6	0.0	6.6	9.5	16.1	0.0	10.0	14.1	24.1
22	152.7	223.6	0.1	11.4	20.2	31.7	0.0	17.7	30.5	48.3
23	78.5	178.0	0.1	11.2	14.8	26.0	0.1	19.9	36.6	56.5
24	89.4	135.0	0.1	7.7	37.5	45.3	0.1	11.7	54.1	65.9
25	55.7	99.0	0.2	7.4	32.8	40.4	0.1	12.4	65.6	78.1
26	10.5	23.3	2.6	2.5	0.7	5.7	2.7	4.2	1.5	8.5
27	20.1	82.7	2.4	7.0	2.3	11.7	2.0	32.4	10.2	44.6
28	5.0	61.3	1.0	2.5	0.5	3.9	1.1	8.6	1.1	10.8
29	132.6	345.3	1.0	27.1	21.1	49.2	0.3	54.6	49.0	103.9
30	59.3	185.8	1.4	7.5	5.4	14.3	1.3	10.7	10.4	22.4
31	38.3	88.2	1.6	5.7	3.1	10.4	2.0	10.9	6.0	18.9
32	39.5	82.8	0.1	10.0	2.7	12.9	0.2	18.8	4.7	23.6
33	121.5	148.7	0.2	2.6	16.0	18.8	0.1	4.8	28.9	33.7
34	46.3	78.9	2.8	2.3	9.8	14.9	1.5	3.4	16.5	21.4
35	30.5	38.2	0.2	2.9	5.7	8.8	0.1	9.1	11.2	20.4
36	80.9	152.0	0.6	7.5	29.2	37.3	0.4	25.8	50.2	76.4
37	11.4	32.9	0.3	1.0	5.1	6.4	0.1	1.6	5.6	7.3
38	2.2	2.8	0.6	0.3	0.3	1.3	0.3	0.5	0.1	0.9
39	35.0	73.8	1.8	3.7	5.6	11.0	0.9	13.1	9.0	23.0
40	82.2	76.9	0.0	12.0	15.4	27.4	0.0	14.7	24.1	38.8
41	127.5	140.1	0.0	45.1	54.5	99.7	0.0	49.7	89.5	139.1
42	140.3	150.1	0.1	35.2	23.3	58.6	0.0	32.9	39.1	72.0
43	98.5	114.9	0.1	10.2	18.0	28.2	0.0	9.5	27.0	36.5
44	11.7	21.4	0.1	8.7	1.2	10.0	0.0	12.9	2.9	15.8
45	111.3	180.3	0.1	37.7	45.6	83.4	0.0	48.8	92.2	141.1
46	35.5	103.5	0.3	22.6	17.2	40.0	0.1	44.0	39.1	83.2
47	42.0	56.6	0.4	5.8	2.6	8.8	0.2	6.3	4.5	11.0
48	61.5	76.2	0.1	13.2	7.4	20.7	0.0	12.1	15.2	27.3
49	24.5	78.6	0.6	4.3	11.8	16.6	0.3	5.0	20.3	25.5
50	166.5	242.4	0.4	14.3	37.3	52.0	0.1	14.5	61.3	75.8
51	145.4	231.8	0.3	13.0	30.2	43.5	0.0	18.5	49.2	67.7
52	27.0	38.8	2.8	3.7	2.4	9.0	2.8	6.3	4.5	13.6
53	114.9	286.8	5.6	30.6	21.5	57.7	4.8	56.5	39.4	100.8
55	212.6	398.0	9.0	30.2	44.8	84.0	7.6	66.2	66.3	140.1
56	9.9	9.4	0.6	0.4	1.9	2.9	0.5	1.5	2.2	4.2
57	9.8	9.3	1.0	0.3	1.6	2.9	0.9	1.5	1.8	4.2
58	29.5	28.0	3.5	0.9	4.4	8.8	3.2	1.8	5.0	10.0
59	261.8	542.0	75.8	19.3	52.3	147.4	68.8	40.2	77.1	186.1
Total	4092.5	6764.9	119.5	569.4	1119.8	1808.7	103.2	902.0	1870.6	2875.8

Chapter 4

DEMAND FORECAST

TRAFFIC ZONE CODE (1)

A Zone	B Zone	C Zone: For Model Calibration	C Zone: For Planning (Population Data)	C Zone: Traffic Assignment Zone (Master plan)	C Zone: Traffic Assignment Zone (RBCS Project)	Zone Name
1 Kuala Lumpur	1 CPA	1	1	1	1	Jln Tuanku Abdul Rahman
		2	2	2	2	Bukit Nanas
			3	3	2	
		3	4	4	3	Pudu Raya
			5	5	3)	Jln Stadium
			6	6	3)	
			7	7	4	Bukit Perdana
		4	8	8	5	Kg. Bharu
				9	5	
				10	5	
		5	9	11	6	Kelab Lumba Kuda
				12	6	Selangor
		6	10	13	7	Pudu
		7	12	14	8	Jln Loke Yew
			11	15	3	Istana Negara
		8	13	16	4	Taman Tasik Perdana
			14	17	9	Mahameru

TRAFFIC ZONE CODE (2)

A Zone	B Zone	C Zone: For Model Calibration	C Zone: For Planning (Population Data)	C Zone: Traffic Assignment Zone (Master plan)	C Zone: Traffic Assignment Zone (RBCS Project)	Zone Name
1	2	9	15	18	10	Sentul
		10	16	19	10	Kg. Kasipillay
		11	17	20	11	Kg. Cempedak
				21	11	Kg. Padang Balang
				22	11	Kg. Batu
		12	18	23	11	Kg. Cubadak
		13	19	24	12	Kg. Bangkong
				25	12	
		14	20	26	13	Jinjang
				27	13	
			21	28	13	Jinjang
				29	13	
		15	22	30	14	Bukit Kepong Estate
				31	14	
		16	23	32	10	Taman Segambut
			24	33	12	Segambut
		17	25	34	14	Edinburgh Estate
				35	14	Segambut Estate

TRAFFIC ZONE CODE (3)

A Zone	B Zone	C Zone: For Model Calibration	C Zone: For Planning (Population Data)	C Zone: Traffic Assignment Zone (Master plan)	C Zone: Traffic Assignment Zone (RBCS Project)	Zone Name
1 (Cont.)	3	18	26	36	15	Taman Tasik Titiwangsa
		16	27	37	15	Kg. Sungai Merah
				38	15	Kg. Lee Rubber
		20	28	39	16	Mount Estate
		21	29	40	16	Ayer Panas
				41	16	Setapak
				42	16	Hawthornden Estate
				43	16	Gonggang Estate
		22	30	44	15	Kg. Datuk Keramat
				45	15	
	4 Ampang	23	31	46	17	Jln Ampang
				47	17	
			32	48	17	Kg. Pandan
			33	49	17	Kg. Pandan
				50	17	

TRAFFIC ZONE CODE (4)

A Zone	B Zone	C Zone: For Model Calibration	C Zone: For Planning (Population Data)	C Zone: Traffic Assignment Zone (Master plan)	C Zone: Traffic Assignment Zone (RBCS Project)	C Zone: Zone Name
1 (Cont.)	5 Cheras	24	34	51	18	Pudu Ulu
				52	18	Kg. Semerah Padi
				53	18	Cheras Estate
		25	35	54	19	Salak South
				55	19	Bolton Estate
				56	19	Taynton Estate
		26	36	57	20	Sungai Besi
		27	37	58	20	Sungai Besi
				59	20	
1 (Cont.)	6 OUG	28	38	62	21	Jirat Cina
		29	39	60	19	Salak South
				61	19	
		30	40	64	22	Petaling
		31	41	63	21	Petaling Lama
		32	42	65	19	Kg. Bharu, Salak South
			45	66	20	Sungai Besi
		33	43	67	22	Petaling
				68	22	
				69	22	
			44	70	23	Bukit Jalil
				71	23	

TRAFFIC ZONE CODE (5)

A Zone	B Zone	C Zone: For Model Calibration	C Zone: For Planning (Population Data)	C Zone: Traffic Assignment Zone (Master plan)	C Zone: Traffic Assignment Zone (RBCS Project)	C Zone: Zone Name
1 (Cont.)	7 Bangsar/ Damansara	34	47	72	25	Bukit Tunku
			46	73	25	Damansara Heights
		35	48	78	25	Sungai Penchala
		36	49	74	24	Travers
				75	24	Bungsar Estate
				76	24	Kg. Haji Abdullah Hukum
		36	51	79	24	Lembah Pantai
		37	50	77	24	Brickfields
2 Gombak	8 Gombak West	38	52	80	26	Batu Arang
		39	53	81	27	Rawang
		40	54	82	26	Pengkalan Kundang
			55	83	28	Kuang
		41	56	84	29	Dusun Kubong
			57	85	29	Batu Caves
			58	86	31	Ulu Gombak
		42	59	87	30	Dusun Chinchin
				88	30	Sorna Estate
			60	89	29	Dusun Kubong

TRAFFIC ZONE CODE (6)

A Zone	B Zone	C Zone: For Model Calibration	C Zone: For Planning (Population Data)	C Zone: Traffic Assignment Zone (Master plan)	C Zone: Traffic Assignment Zone (RBCS Project)	C Zone: Zone Name
	9 Gombak East	43	61	90	29	Batu Caves
			62	91	31	Hutan Simpan Ulu Gombak
		44	63	92	31	Ulu Klang
		45	64	93	32	Hutan Simpang Ampang
				94	32	Datuk Keramat
3 Hulu Langat	10 Hulu Langat North	46	65	95	33	Ampang
				96	33	
		47	66	97	34	Ulu Langat
		48	67	98	34	Kg. Cheras Baru
	11 Hulu	49	68	99	35	Serdang Lama
			69	100	36	Kg. Sungai Ramal
			70	101	36	Kajang
		50	71	102	37	Bangi
		51	72	103	38	Ulu Semenyih
		52	73	104	39)	Semenyih
			74	105	39)	
			75	106	39	Beranang

TRAFFIC ZONE CODE (7)

A Zone	B Zone	C Zone: For Model Calibration	For Planning (Population Data)	Traffic Assignment Zone (Master plan)	Traffic Assignment Zone (RBCS Project)	Zone Name
4 Petaling	12 Petaling Jaya	53	76	107	40	Petaling Jaya
		54	77	108	40	Petaling Jaya
		55	78	109	40	Damansara
		56	79	110	40	Petaling Jaya
			80	111	41	Sungai Way
		57	81	112	41	Petaling Jaya
		58	82	113	41	Petaling Jaya
		59	83	114	41)	Petaling Jaya
			84	115	41)	
			85	116	41	Petaling
		60	86	117	43	7th Mile Estate
		61	87	118	43	Gaik Liew Estate
		62	88	119	43	Gaik Liew Estate
		63	89	120	42	Subang Jaya
		64	90	121	42	Subang Jaya
		65	91	122	42)	Subang Jaya
			92	123	42)	

TRAFFIC ZONE CODE (8)

A Zone	B Zone	C Zone: For Model Calibration	C Zone: For Planning (Population Data)	C Zone: Traffic Assignment Zone (Master plan)	C Zone: Traffic Assignment Zone (RBCS Project)	Zone Name
4 (Cont.)	13 Shah Alam	66	93	124	44	Batu Tiga
			94	125	45)	Damansara
			95	126	45)	
		67	96	127	45	Kg. Padang Jawa
			97	128	45)	Shah Alam
			98	129	45)	
			99	130	44	Batu Tiga
			100	131	46	Damansara Estate
		68	101	132	45	Ladang Haron
			102	133	45	Kg. Sungai Kandis
			103	134	46)	Kg. Jalan Kebun
			104	135	46)	
			105	136	46	Hutan Simpang Telok
	14 Petaling South	69	106	137	42	Subang Jaya
			107	138	47	Puchong
		70	108	139	47	Puchong Batu Dua Belas
		71	109	140	48	Serdang

TRAFFIC ZONE CODE (9)

A Zone	B Zone	C Zone: For Model Calibration	C Zone: For Planning (Population Data)	C Zone: Traffic Assignment Zone (Master plan)	C Zone: Traffic Assignment Zone (RBCS Project)	Zone Name
4 (Cont.)	15 Petaling North	72	110	141	49	Hutan Simpan Bukit Cerakah
		73	111	142	30	Sungai Buloh
				143	30	Kepong EState
			112	144	49	Subang
		74	113	145	49	Kg. Baru Subang
		75	114	146	49	Razak Estate
5 Klang	16 Klang Central	76	115	147	50)	
			116	148	50 }	Kelang
			117	149	50)	
		77	118	150	50)	Kelang
			119	151	50)	
		78	120	152	51)	Telok Gadong
			121	153	51)	
		79	122	154	51	Telok Gadong
		80	123	155	51	Pelabuhan Kelang
	17 Klang South	81	124	156	50	Kelang
			125	157	52)	Pandamaran
			126	158	52)	
			127	159	52	Pulau Sungai Tengkorak

TRAFFIC ZONE CODE (10)

A Zone	B Zone	C Zone: For Model Calibration	C Zone: For Planning (Population Data)	C Zone: Traffic Assignment Zone (Master plan)	C Zone: Traffic Assignment Zone (RBCS Project)	Zone Name
4 (Cont.)	18 Klang North	82	128	160	53	Kapar
		83	129	161	53	Meru
		84	130	162	53	Sementa
			131	163	53)	Rantau Panjang
			132	164	53)	
		85	133	165	53	Pelabuhan Bharu
6 Bukit Tinggi	19 Bukit Tinggi	86	134	166	54	Bukit Tinggi
7 Secondary Area	20 Sepang	87	135	167	61	Sepang
	21 Kuala Selangor Sabak Bernam	88	136	168	62	Kuala Selangor
		89	137	169	62	Sabak Bernam
	22 Ulu Selangor	90	138	170	63	Ulu Selangor
	23 Kuala Langat	91	139	171	61	Kuala Langat

TRAFFIC ZONE CODE (11)

A Zone	B Zone	C Zone: For Model Calibration	C Zone: For Planning (Population Data)	C Zone: Traffic Assignment Zone (Master plan)	C Zone: Traffic Assignment Zone(RBCS Project)	Zone Name
9 External Area	24 Perak & North	92	140	172	63	Perak & North
	25 Pahang & East Coast	93	141	173	64	Bentong, Temerloh
	26 Negeri Sembilan and South	94	142	174	55	Mukim Seremban
					56	Mukim Labu
					57	Mukim Setul, Lenggeng
					58	Mukim Pantai, Ampang
					59	Other Negeri Sembilan
					60	South

Appendix 4-2-1

Estimation of Trip Production for 1993
-- based on the M/P's Estimation.

		Trip Production by Trip Purpose (for 1993) [(a) x (d)]							Trip Production of All Purposes (a)
		To Work	To School	HB Business	NHB Business	HB Private	NHB Private	(e) To Home	
[Non Car]	Employed	349.4	0.0	14.1	78.1	110.2	134.2	496.1	1182.1
	Student	0.0	221.9	1.1	0.7	50.5	18.5	240.9	533.6
	Others	0.0	0.0	3.3	2.7	90.8	8.2	70.5	175.4
	Total								
[Motor Cycle]	Employed	370.5	0.0	15.9	90.8	130.3	154.4	547.2	1309.1
	Student	0.0	267.4	1.6	1.0	63.9	22.2	292.4	648.4
	Others	0.0	0.0	6.6	3.0	117.9	11.1	92.6	231.3
	Total								
[One Car]	Employed	352.9	0.0	25.8	137.1	171.7	228.2	633.2	1548.8
	Student	0.0	364.6	2.2	1.5	113.7	41.5	424.8	948.3
	Others	0.0	0.0	11.4	8.7	202.7	22.5	162.8	408.0
	Total								
[Multi Car]	Employed	345.5	0.0	38.9	199.9	185.4	227.5	665.1	1662.3
	Student	0.0	133.6	1.6	1.7	47.1	16.4	161.0	361.5
	Others	0.0	0.0	3.8	4.0	88.3	14.1	73.6	183.8
	Total								
[Total]	Employed	1418.3	0.0	94.7	505.8	597.7	744.3	2341.7	5702.4
	Student	0.0	987.5	6.5	4.9	275.2	98.6	1119.1	2491.8
	Others	0.0	0.0	25.1	18.3	499.6	56.0	399.5	998.5
	Total	1418.3	987.5	126.3	529.1	1372.5	898.9	3860.2	9192.7
Total in 1993		To Work	To School	Business		Private		To Home	Total
		1418.3	987.5	655.4		2271.4		3860.2	9192.7
		15.4%	10.7%	7.1%		24.7%		42.0%	100.0%

Appendix 4-2-2
Estimation of Trip Production for 2005

		Trip Production by Trip Purpose (for 2005)							Trip Production of All Purposes (a)
		To Work	To School	HB Business	NHB Business	HB Private	NHB Private	To Home	
[Non Car]	Employed	470.6	0.0	19.0	105.2	148.5	180.8	668.3	1592.4
	Student	0.0	307.4	1.5	0.9	69.9	25.7	333.6	739.1
	Others	0.0	0.0	4.1	3.3	114.0	10.3	88.5	220.3
	Total								
[Motor Cycle]	Employed	629.2	0.0	27.0	154.0	221.3	262.1	929.2	2223.0
	Student	0.0	399.6	2.3	1.6	95.5	33.1	437.0	969.2
	Others	0.0	0.0	9.0	4.0	159.9	15.1	125.5	313.5
	Total								
[One Car]	Employed	1013.9	0.0	74.1	393.8	493.3	655.6	1819.4	4450.1
	Student	0.0	649.1	4.0	2.6	202.5	73.9	756.4	1688.4
	Others	0.0	0.0	18.4	14.0	327.2	36.3	262.9	658.8
	Total								
[Multi Car]	Employed	430.7	0.0	48.4	249.3	231.2	283.6	829.2	2072.5
	Student	0.0	286.8	3.4	3.7	101.0	35.2	345.6	775.8
	Others	0.0	0.0	7.4	7.8	171.8	27.5	143.1	357.7
	Total								
[Total]	Employed	2544.5	0.0	168.6	902.4	1094.3	1382.2	4246.2	10338.0
	Student	0.0	1642.9	11.3	8.8	469.0	167.9	1872.5	4172.4
	Others	0.0	0.0	38.9	29.2	772.9	89.2	620.1	1550.3
	Total	2544.5	1642.9	218.7	940.4	2336.1	1639.3	6738.8	16060.8
Total in 2005		To Work	To School	Business		Private		To Home	Total
		2544.5	1642.9	1159.2		3975.5		6738.8	16060.8
		15.8%	10.2%	7.2%		24.8%		42.0%	100.0%

Appendix 4-3-1 Share Adjustment between Public and Private Mode

The share between public and private modes is adjusted based on latest study.

Share Adjustment Factors of Public and Private Mode

Modes	1995	2005
Walk/Bicycle	2116.3/2055.2=1.03	2853.4/2793.7=1.02
Motorcycle	1477.7/1376.0=1.07	1957.0/1956.1=1.00
Car	3852.7/3871.3=1.00	5705.2/6331.1=0.90
Public	2830.5/2858.7=0.99	4112.3/3490.8=1.18

Note 1: Private modes consist of walk/bicycle, motorcycle and car.

Note 2: Data are based on JICA M/P 87 (denominator) and JICA F/S 89 (numerator).

Appendix 4-3-2 Trip Generation Rate (2005)

Trip Purpose	% (a)		Vehicle Ownership %	V.Own. x Trip P. %	Parameter NEP (b)	NST	POP	DEP	DEP2	DEP3	Weighted Parameters NEP (b)	NST	POP	DEP	DEP2	DEP3
to Work		N	0.188	0.05134	0.98228						0.050434	0	0	0	0	0
2544.5	0.273105	M	0.237	0.06473	1.04118						0.067391	0	0	0	0	0
		C	0.575	0.15704	0.96455						0.151463	0	0	0	0	0
to School		N	0.188	0.03315		0.9958					0	0.033011	0	0	0	0
1642.9	0.176335	M	0.237	0.06473		1.02152					0	0.066118	0	0	0	0
		C	0.575	0.15704		0.97862					0	0.153678	0	0	0	0
HB Business		N	0.188	0.00431			0.2927				0	0	0.001262	0	0	0
213.7	0.022936	M	0.237	0.00544			0.0287				0	0	0.000156	0	0	0
		C	0.575	0.01319			0.05442				0	0	0.000717	0	0	0
NHB Business		N	0.188	0.01898				0.01348		0.05141	0		0	0.000255	0	0.000975
940.4	0.100934	M	0.237	0.02392				0.02568		0.05045	0		0	0.000614	0	0.001206
		C	0.575	0.05804				0.04408		0.21477	0		0	0.002558	0	0.012464
HB Private		N	0.188	0.04714			0.35487				0	0	0.016728	0	0	0
2336.1	0.250737	M	0.237	0.05942			0.45009				0	0	0.026746	0	0	0
		C	0.575	0.14417			0.59239				0	0	0.085407	0	0	0
NHB Private		N	0.188	0.03308				0.0469		0.10214	0	0	0	0.001551	0	0.003378
1639.3	0.175949	M	0.237	0.04170				0.13537		0.00447	0	0	0	0.005644	0	0.000186
		C	0.575	0.10117				0.14003		0.36239	0	0	0	0.014166	0	0.036663
9316.9	1															
											0.269294	0.252809	0.131017	0.024791	0	0.054875
											(x0.433)	(x0.285)	(x0.854)			
										Trip Generation	Population: 0.301891			Employment 2: 0.00734 Employment 3: 0.071708		

where :

NEPN, NEPM, NEPC = Total Night Time Working Population by vehicle ownership type (N: Non Vehicle Owner, M: Motor Cycle Owner, C: Car Owner)
NSTN, NSTM, NSTC = Total night Time Student Population by vehicle ownership type
POPN, POPM, POPC = Night Time Population Aged 6 Years and above by vehicle ownership type
DEP3 = Daytime Employment of tertiary Industry
DEP = Total daytime Employment

Appendix 4-3-3

Trip Attraction Rate (2005)

Trip Purpose	Weight	Parameters of T. Attraction Model on Population					WEIGHTED PARAMETERS				
	(a)	DST (b)	"POP (c)	DEP (d)	DEP2 (e)	DEP3 (f)	DST (b)	"POP (c)	DEP (d)	DEP2 (e)	DEP3 (f)
to Work	%										
2544.5	0.273105				1.05181	0.99865	0	0	0	0.028725	0.272737
to School		DST									
1642.9	0.176335	0.97987					0.17278	0	0	0	0
HB Business											
213.7	0.022936			0.06659		0.02445	0	0	0.00152	0	0.000560
NHB Business											
940.4	0.100934			0.11135		0.26926	0	0	0.01123	0	0.027177
HB Private		DST	POP								
2336.1	0.250737	0.25212	0.25884			0.69345	0.06321	0.06490	0	0	0.173874
NHB Private		DST	POP								
1639.3	0.175949	0.05215	0.03071			0.79656	0.00917	0.00540	0	0	0.140154
9316.9											
							0.24517	0.07030	0.01276	0.28725	0.614503
							(x0.285)	(x0.845)			

Where:

DEP2 = Daytime Employment of Secondary Industry
DEP3 = Daytime Employment of Tertiary Industry
DEP = Total Daytime Employment
DST = Total Daytime Student Population
POP = Night Time Population aged 6 years and above

	Population:	DEP2:	DEP3:
Trip Attraction	0.12992	0.29124	0.62317
Trip Generation	0.30189	0.00773	0.07171
Generation/Attraction	0.43181	0.29897	0.69488

Appendix 4-4-1 Intra/Inter Zonal Trips

(1) Estimation of Intra/Inter Zonal Trips of Seremban District/Remained N. Sembilan State in 1993

(x10^3 Trips/day)

Estimation Procedure		55	56	57	58	59	Total
Population (1993)	(a)	212.6	9.9	9.9	29.5	261.8	523.6
Trip Production Rate per Population (*1,2.3)	(b)	2.554 *1	2.426 *2	2.426 *2	2.426 *2	2.426 *2	2.478 *3
Trips Production (a) x (b)	(c)	543.0	24.0	23.8	71.6	635.2	1,297.6
Inter zonal Trip Rate (*4)	(d)	0.80	0.70	0.80	0.70	0.93 *4	0.85
Inter zonal Trip Rate (*4)	(e)	0.20	0.30	0.20	0.30	0.07 *4	0.15
Inter zonal Trips (c) x(e)	(f)	108.6	7.2	4.8	21.5	46.9 *5	189.0
Inter zonal Trip relating to RBCS Study (*6)	(g)	104.3 56.5%	7.1 3.9%	4.8 2.6%	21.5 11.6%	46.9 25.4%	184.5 100.0%

(Note)
- *1: Trips per Population in Klang Valley in 1993
- *2: 0.95% of *1
- *3: The result of calculation of Zone 55 - 59.
- *4 and *5: Study results of (B-2)
- *5: includes Trips to/from Klang Valley and Seremban District only.
- *6: Appendix 4-4-2 Step 2

(2) Estimation of Intra/Inter Zonal Trips of Seremban District/Remained N. Sembilan State in 2005

(x10^3 Trips/day)

Estimation Procedure		55	56	57	58	59	Total
Population (2005)	(a)	398.0	9.4	9.3	28.0	542.0	986.7
Trip Production Rate per Population (*1,2.3)	(b)	2.693 *1	2.558 *2	2.558 *2	2.558 *2	2.558 *2	2.613 *3
Trips Production (a) x (b)	(c)	1,071.8	24.0	23.8	71.6	1,386.6	2,577.9
Inter zonal Trip Rate (*4)	(d)	0.80	0.70	0.80	0.70	0.91 *4	0.85
Inter zonal Trip Rate (*4)	(e)	0.20	0.30	0.20	0.30	0.09 *4	0.15
Inter zonal Trips (c) x(e)	(f)	214.4	7.2	4.8	21.5	129.9 *5	377.8
Inter zonal Trip relating to RBCS Study (*6)	(g)	205.8 55.7%	7.1 1.9%	4.8 1.3%	21.5 5.8%	129.9 35.2%	369.1 100.0%

(Note)
- *1: Trips per Population in Klang Valley in 2005
- *2: 0.95% of *1
- *3: The result of calculation of Zone 55 - 59.
- *4 and *5 Study results of (B-2)
- *5: includes Trips to/from Klang Valley and Seremban District only.
- *6: Appendix 4-4-2 Step 2.

Appendix 4-4-2 Public/Private Trips between N. Sembilan and Klang Valley

(1) Control-total for N. Sembilan O-D Matrix in 1993

[Step 1]	Control-Total 1 (Total Inter-zonal Trips of N. Sembilan) in 1993			
	Population (in N. Sembilan in 1993)		523.6	
	Tip Production Rate (in 1993) per Population	*1a	2.478	Note: *1a is based on the Klang valley's Figure re-estimated.
	Trip Production in 1993		1,297.6	Note:
	Intra-zonal trip Rate	*1b	85.0%	*1b is estimated based on the 'Seremban Town
	Inter-zonal Trip Rate	*1b	15.0%	Center Traffic Study, 1984' and other data.
	Inter-zonal Trip		189.0	
	Inter-zonal trip related to Klang Valley & N.Sembilan		184.5	

	External Trips to/from Klang Valley		Internal Trips within N. Semblan	
[Step 2]	Control total of Internal/External trips of N.Sembilan			
	Total Inter-zonal Trips of N.Sembilan	184.5	Inter-zonal Trips of N. Sembilan	184.5
	Share of External Trips of N. Sembilan	33.3%*2	Share of Internal Trips of N. Sembilan	66.7%*2
	External Trip of N. Sembilan (K. Valley - N.Sembilan)	61.4	Internal Trips of N. Sembilan (Trips within N. Sembilan)	123.1

Note: *2 is estimated based on Vehicle O-D surveyed in the 'Seremban Traffic Study' above-mentioned; and the gravity parameter study on Seremban-Klang Valley trip (The Study Team).

[Step 3]	Share of Trips between Seremban and N. Sembilan		
1)	Share of Trip between Seremban - K.Valley	66.7% *3	
	Tips between Seremban and Klang Valley	41.0	
2)	Share of Trips between Other N. Sembilan & K. valley	33.3% *3	
	Trips between Other N. Sembilan - k. valley	20.5	

Note: *3 is estimated the Vehicle O-D table (in 1984) surveyed in 'Seremban traffic Study' mentioned above.

[Step 4]	Public Transport Trip					
1)	Private Transport Share (N. Sembilan-K. Valley)	*4a	50.0%	1) Private Transport Share	*4b	85.0%
	Private Transport Trip (N. Sembilan-K. Valley)		30.7	Private Transport Trip		104.6
2)	Public Transport Share (N. Sembilan-K. Valley)	*4a	50.0%	2) Public Transport Share (N. Sembilan-K. Valley)	*4b	15.0%
	Public Transport Share (N. Sembilan-K. Valley)		30.7	Public Transport Trip (N. Sembilan-K. Valley)		18.5

Note: *4a is estimated based on the road traffic survey data (HPU, 1985-1989).
*4b is estimated based on the Vehicle Traffic Data (1984) in "Seremban Traffic Study" above-mentioned.

(2) Control-total for N. Sembilan O-D Matrix in 2005

[Step 1]	Control-Total 1 (Total Inter-zonal Trips of N. Sembilan) in 2005			
	Population (in N. Sembilan in 2005)		986.7	
	Tip Production Rate (in 2005) per Population	*1a	2.613	Note: *1a is based on the Klang valley's Figure re-estimated.
	Trip Production in 2005		2,577.9	Note:
	Intra-zonal trip Rate	*1b	85.3%	*1b is estimated based on the 'Seremban Town
	Inter-zonal Trip Rate	*1b	14.7%	Center Traffic Study, 1984' and other data.
	Inter-zonal Trip		337.8	
	Inter-zonal trip related to Klang Valley & N.Sembilan		369.1	

	External Trips to/from Klang Valley		Internal Trips within N. Semblan	
[Step 2]	Control total of Internal/External trips of N.Sembilan			
	Total Inter-zonal Trips of N.Sembilan	369.1	Inter-zonal Trips of N. Sembilan	369.1
	Share of External Trips of N. Sembilan	33.3%*2	Share of Internal Trips of N. Sembilan	66.7%*2
	External Trip of N. Sembilan (K. Valley - N.Sembilan)	122.9	Internal Trips of N. Sembilan (Trips within N. Sembilan)	246.2

Note: *2 is estimated based on Vehicle O-D surveyed in the 'Seremban Traffic Study' above-mentioned; and the gravity parameter study on Seremban-Klang Valley trip (The Study Team).

[Step 3]	Share of Trips between Seremban and N. Sembilan		
1)	Share of Trip between Seremban - K.Valley	66.7% *3	
	Tips between Seremban and Klang Valley	82.0	
2)	Share of Trips between Other N. Sembilan & K. valley	33.3% *3	
	Trips between Other N. Sembilan - k. valley	40.9	

Note: *3 is estimated the Vehicle O-D table (in 1984) surveyed in 'Seremban traffic Study' mentioned above.

[Step 4]	Public Transport Trip					
1)	Private Transport Share (N. Sembilan-K. Valley)	*4a	50.0%	1) Private Transport Share	*4b	85.0%
	Private Transport Trip (N. Sembilan-K. Valley)		61.5	Private Transport Trip		209.3
2)	Public Transport Share (N. Sembilan-K. Valley)	*4a	50.0%	2) Public Transport Share (N. Sembilan-K. Valley)	*4b	15.0%
	Public Transport Share (N. Sembilan-K. Valley)		61.5	Public Transport Trip (N. Sembilan-K. Valley)		36.9

Note: *4a is estimated based on the road traffic survey data (HPU, 1985-1989).
*4b is estimated based on the Vehicle Traffic Data (1984) in "Seremban Traffic Study" above-mentioned.

Appendix 4-4-3 Parameters of the Gravity Model

The Formulated parameters of Gravity model is shown as follow:

Parameters of the Gravity Model

	Public		Private	
	1993	2005	1993	2005
Coefficient	0.883	0.727	0.745	0.691
G:	134.988	67.890	96.192	39.822
a:	0.550	0.572	0.708	0.772
b:	0.592	0.625	0.740	0.802
c:	1.357	1.193	1.241	1.157

Appendix 4-5-1 Planning Method for Feeder-bus Traffic Demand Forecast

(1) Transport mode selection

Factors in selecting the transport mode (rail and stage-bus) are as follows:

- Travel time
- Fare
- Comfortability
- Safety
- Convenience

In this study, however, it is assumed that all the service levels except travel time are the same. Hence, the commuters are supposed to select their travel mode in accordance with the characteristics of the Theoretical Diversion Curve (Refer to Fig. 4-5-3.)

(2) Access mode

Since, 88 - 92% of the commuters either walk or use feeder-bus for accessing to the station, access times by those two modes are adopted. Other modes such as taxis, bicycles etc. are neglected.

(3) Feeder-bus usage ratio

Feeder-bus usage ratio (P) of each zone is estimated considering the development levels of housing and roads of the relevant areas. In case the area is well developed and the feeder-bus service is available for all potential passengers, the value of P is 100%, while in case feeder-bus is not available, P is 0%, or all potential passengers have to walk to the station.

(4) Centroid

In order to simplify the calculation, the concept of "Centroid" is employed. A Centroid is defined as a representative point of a zone where passengers in a zone are generated or attracted.

All the commuters using public modes are assumed to move from Origin to Destination, that is, from Centroid-to-Centroid by means of either stage-bus or DMU as the main transport mode, with feeder-bus as the access means to them.

(5) Access distance

The distance from the Centroid to the station means the access distance which is measured by the road length in km. Table 1 shows the access distance by zone in the years of 1993 and 2005.

Table 1 Access Distance

Zone No.	Station Name	1993	2005 (WITH)
1	JPM/KL	0.5 km	0.5 km
2	JPM/KL	1.6	1.6
3	KL	0.8	0.8
4	KL	0.7	0.7
5	JPM/Mall	1.4	1.4
6	JPM/KL	2.6	2.6
7	KL	2.9	2.9
8	KL	2.6	2.6
9	JPM/Mall	0.7	0.7
10	Mall/Segambut	1.3	1.3
12	Segambut	1.2	1.2
13	Segambut/H2/Kepon	2.9	3.1
14	Kepong/H2	1.2	1.2
15	Mall	4.4	4.4
17	KL/JPM	4.8	4.8
18	Salak South	4.3	4.3
19	Salak South	1.8	1.8
20	Sg. Besi	1.9	1.9
21	Siputeh	1.5	1.5
22	Salak South/Sg.Besi	3.5	3.5
23	Sg. Besi	3.0	3.6
24	Seputeh/KL	2.6	2.6
25	Mall/JPM/KL	4.8	4.8
26	Rawang	14.4	14.4
27	Rawang	1.8	1.8
28	Kuang/H1	1.2	1.2
30	Sg. Buloh/H1	2.5	2.5
35	H3	2.2	1.7
36	Kajang/H3	2.6	3.3
37	Bangi	1.4	1.4
39	Kajang	8.4	8.4
48	Serdang	2.4	2.4
55	Seremban	2.9	2.9
56	Nilai/B. Benar/Labu	1.8	1.8
57	Batang Benar/Nilai	7.8	7.8
58	Seremban	10.4	10.4

Note: In some cases a station represents two zones (eg. Rawang Station is for Zones #26 and #27). In others, two stations represent one zone (eg. JPM and Mall for Zone 5). This shows that, in feeder bus planning, the nearest railway station from inhabited part of the zone is selected free from the zoning. While in the zone-to-zone traffic demand forecast, one zone is represented by one station. In this table, the first station represents the zone where a plural number of

station names are enumerated; e.g. P.Mentri represents zone 5 in forecasting the inter-zonal traffic demand. There are cases where the feeder/access distance changes by lapse of time (eg. in Sg. Besi representing Zone 23, the distance is 3.0 km in 1993 and 3.6 km in 2005).

(6) Access time

There are two access means, walking and walking plus feeder-bus. Access time is the average time calculated dividing the accumulated total access time of all passengers of the zone by the number of passengers. The access time is estimated as follows.

1) Access time to the railway station

$$T_{f1} = (1-P)T_{wf1} + P \times T_{bf1} \quad \cdots\cdots\cdots\cdots\cdots\cdots \quad (A)$$

where:

T_{f1}: Average access time from home to the road close to the station (Q)

P: Feeder-bus usage ratio (Refer to clause (3) of 9-3-4.

T_{wf1}: Access time by walking from home to Q.

T_{bf1}: Access time by walking and feeder-bus from home to Q

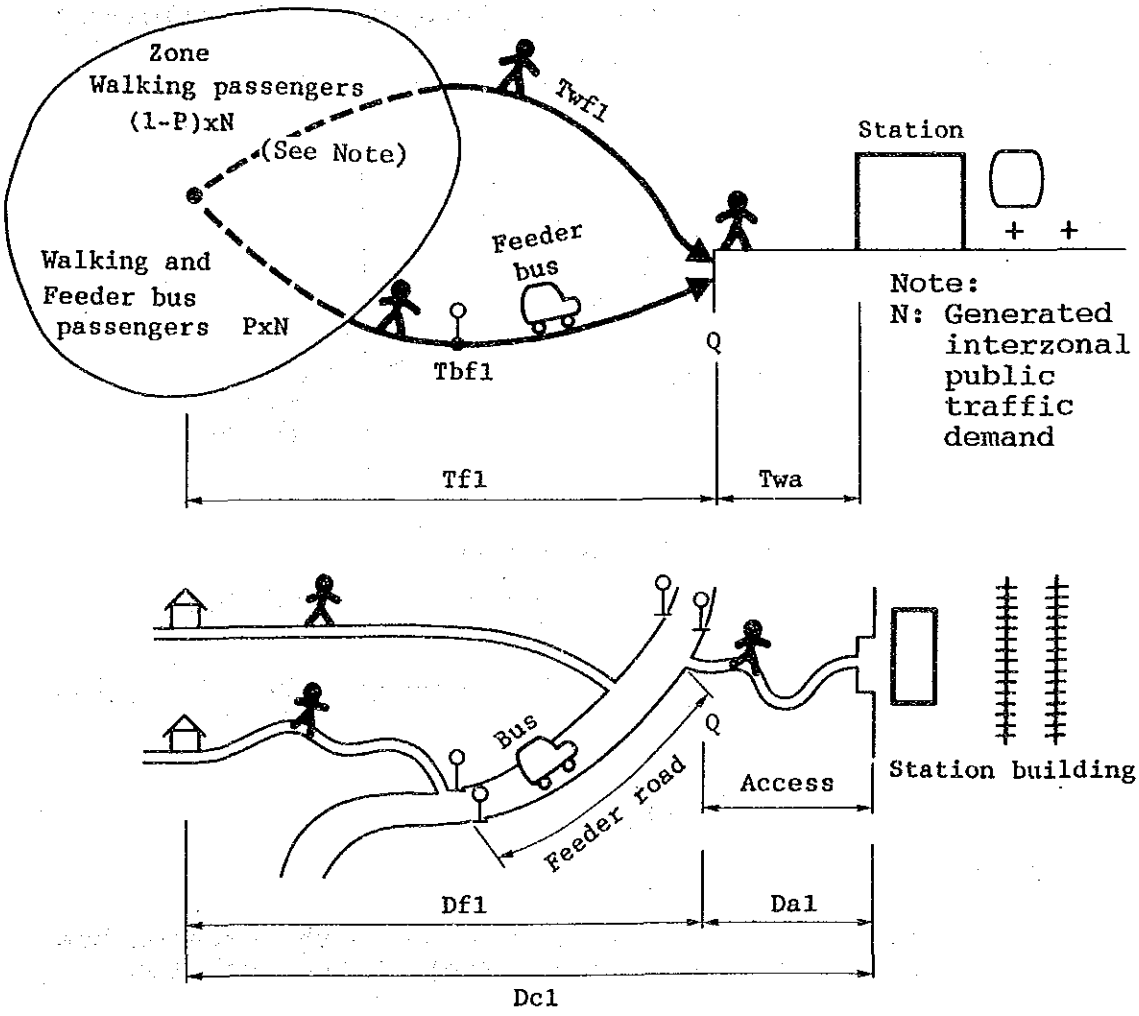


Fig. 1 Access Time to the Railway Station

T_{wa}: Access time from Q to the station

$$Twa = \frac{Da1}{Vw}$$

Da1: Access distance from Q to the station

Vw: Walking speed 4 km/hr.

$$T_{wf1} = \frac{D_{f1}}{Vw}$$

D_{f1}: $D_{c1} - D_{a1}$

D_{c1}: Access distance from home to the station.

Access Time (T_{f1}) is estimated by the above formula (A), which is explained by "Proportional Allotment Method" as shown in the Fig. 2.

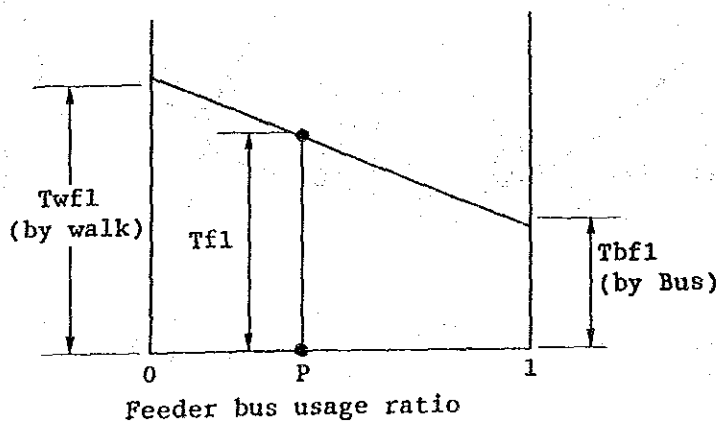


Fig. 2 Proportional Allotment Method (Railway)

Furthermore, T_{bf1} is broken down by the following formula.

$$T_{bf1} = Ft + \frac{Df1}{V_{fb}}$$

Where,

Ft: Walking time (Fta) from home to the feeder-bus stop plus waiting time (Ftb) at the bus stop

Fta: Based on the result of Interview Survey and considering the feeder service level, Fta is assumed as follows:

Fta = 3 minutes for urban area
= 5 minutes for suburban area

Ftb: Ftb is assumed to be a half of the feeder-bus headway time

Headway = 5 minutes for urban area
10 - 30 minutes for suburban area

Consequently, Ft = 5 - 20 minutes

Vfb: Feeder-bus speed (km/hr)

Vfb = 10 km/h for urban area
= 15 km/h for suburban area

2) Access time to the stage bus station

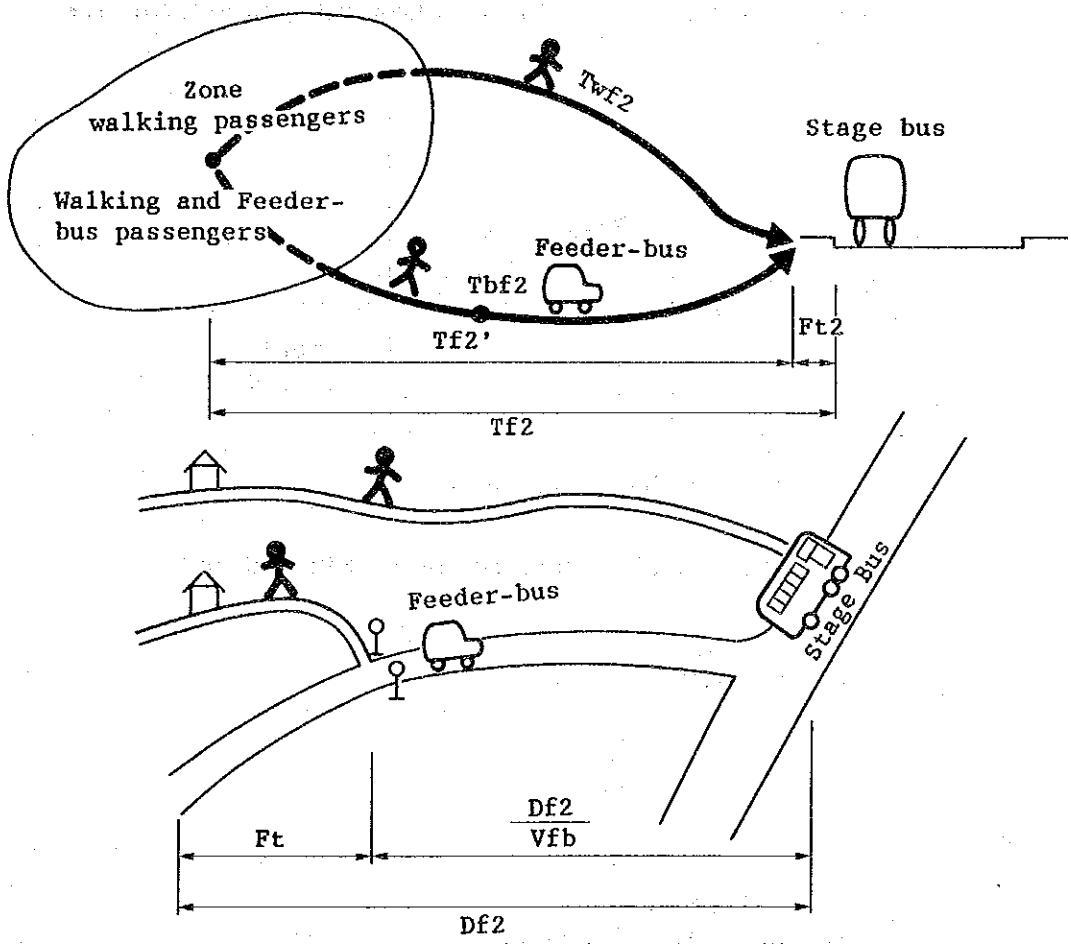


Fig. 3 Access Time to the Stage-bus

$$T'_{f2} = T_{wf2} - (T_{wf2} - T_{bf2}) \times P$$

$$T_{f2} = T'_{f2} + Ft_2$$

Where,

T_{f2}: Access time (T'_{f2}) from home to the stage bus station including the waiting time (Ft2) for stage bus

T_{wf2}: Access time by walking from home to the stage bus station

T_{bf2}: Access time by walking and feeder-bus from home to the stage bus station

P: Feeder-bus usage ratio (Refer to clause (3) of 9-3-4)

Ft_2: Waiting time for stage bus, 6 minutes for urban area, 10 - 20 minutes for suburban area

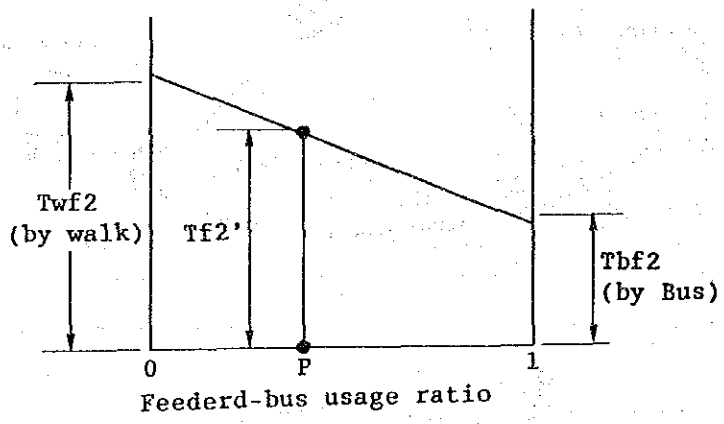


Fig. 4 Proportional Allotment Method (Staged-bus)

$$T_{wf2} = \frac{D_{f2}}{Vw}$$

$$T_{bf2} = Ft + \frac{D_{f2}}{V_{fb}}$$

Where,

D_{f2}: Feeder distance
Vw: Walking speed 4 km/hr
V_{fb}: Feeder-bus speed, 10 km/hr for urban area, 15 km/hr for suburban area

Ft: Walking time from home to the feeder-bus stop plus waiting time at the bus stop 5 - 20 minutes

Access time calculated based on the above formula and method is shown in Table 2.

Based on Table 2, the access time can be summarized as follows:

		1993	2005
Home to Rail Station	Urban Area	7 - 70 mins	7 - 54 mins
	Suburban Area	17 - 209 mins	16 - 187 mins
Home to Stage Bus Station			
	Urban Area	3 - 24 mins	3 - 23 mins
	Suburban Area	12 - 47 mins	12 - 40 mins

The access time to the railway station (Tf Rail) is about 2 to 3 times longer than that to the stage-bus station (Tf Bus) in the urban area, while, about 1.5 to 5 times, in the suburban area. The reason is that the access-road to the stage-bus station is better provided, hence, shorter than that to the railway station.

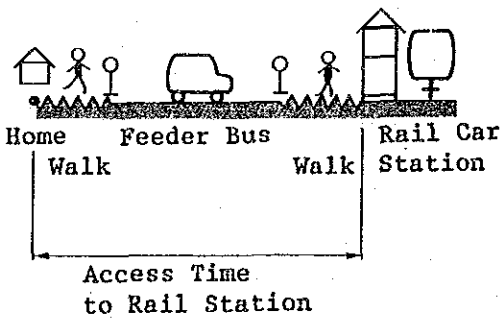
As for the access time by year, Tf Rail in 2005 is smaller by 10 to 20 % compared with that in 1993 while that of Tf Bus by 0 to 15%. This is mainly due to the improvement in the feeder-bus operating headway.

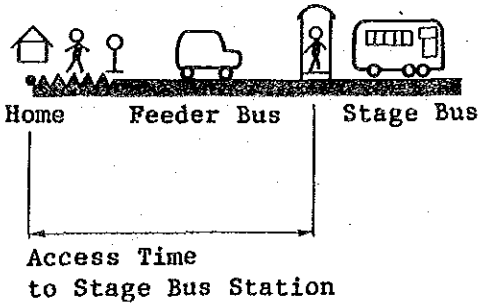
Comparing the urban and suburban area, Tf Rail in the suburban area is about 2 to 3 times longer than that in the urban area, while Tf Bus about 2 to 4 times. This is mainly caused by the fact that the suburban feeder service area is larger than urban feeder service area.

Table 2 Access Time at Peak Hours (minutes)

(N-S Line)	1993		2005		Area
	Rail Sta.	Stage Bus	Rail Sta.	Stage Bus	
1 JPM/KL	7 min	3 min	7 min	3 min	*
2 JPM/KL	23	7	19	7	*
3 KL	11	8	11	8	*
4 KL	10	7	10	7	*
5 JPM/Mall	20	7	16	7	*
6 JPM/KL	37	8	29	8	*
7 KL	41	7	33	7	*
8 KL	37	7	29	7	*
9 JPM	10	7	9	7	*
10 Mall/Segambut	18	8	16	8	*
12 Segambut	17	19	16	18	*
13 Segambut/H2/Kepon	42	23	41	22	*
14 Kepong/H2	17	19	16	18	*
15 Mall	64	24	53	23	*
17 KL/JPM	70	17	54	16	*
18 Salak South	62	14	52	14	*
19 Salak South	26	22	22	21	*
20 Sg. Besi	27	22	22	21	
21 Seputeh	21	12	18	12	
22 Salak South/Sg. Besi	50	18	37	17	
23 Sg. Besi	43	15	31	15	
24 Seputeh/KL	38	10	34	10	*
25 Mall/JPM/KL	70	12	55	12	*
26 Rawang	209	47	187	40	
27 Rawang	26	23	22	21	
28 Kuang/H1	17	17	16	16	
30 Sg. Buloh/H1	36	28	32	25	
35 Kajang/Serdang/H3	32	23	21	21	*
36 Kajang/H3	38	30	36	26	
37 Bangi	20	24	18	22	
39 Kajang	124	30	93	26	
48 Serdang	35	23	27	21	
55 Seremban	42	29	31	26	
56 Nilai/B.Benar/Labu	26	25	26	23	
57 Batang Benar/Nilai	113	23	79	21	
58 Seremban	150	23	103	21	

*: Urban Area





Appendix 4-5-2 Railway User OD Matrix (2005-1) (Trips/day)

	01	02	03	04	05	06	07	08	09	10
01	0	1301	0	4379	5710	1413	569	624	0	1266
02	1300	0	0	0	1666	16522	3793	1130	138	902
03	0	0	0	0	0	715	2926	2641	0	432
04	4356	0	0	0	0	304	404	524	0	452
05	5545	1605	0	0	0	1873	128	41	0	11558
06	1485	16938	717	267	1922	0	2774	752	89	769
07	593	4017	2672	388	133	2996	0	0	141	101
08	648	1150	2506	537	46	778	0	0	163	84
09	0	129	0	0	0	82	130	151	0	335
10	1291	923	452	467	11114	787	98	81	358	0
11	327	329	125	106	43	75	28	10	88	176
12	649	484	216	240	321	415	53	37	190	9423
13	505	617	240	208	85	282	64	26	144	322
14	1169	1044	474	450	182	470	115	36	309	460
15	579	1070	402	246	0	72	65	30	137	0
16	0	0	20	0	0	0	0	0	4	0
17	467	2032	295	127	116	2102	263	80	49	174
18	194	266	119	89	6	96	58	18	41	19
19	2246	3326	3338	1468	217	799	1597	947	491	320
20	880	1133	1139	766	45	21	175	80	308	114
21	514	435	559	270	30	62	247	218	116	57
22	199	187	95	40	10	0	19	7	35	41
23	65	159	191	93	3	0	8	19	56	31
24	769	674	805	345	154	170	285	159	126	194
25	40	0	124	4	0	28	41	13	0	0
26	0	0	0	0	0	0	0	0	0	0
27	845	814	693	418	208	267	114	56	181	237
28	359	303	150	132	45	117	37	12	75	63
29	2689	2342	1206	977	505	987	287	109	675	1419
30	203	185	75	75	20	90	21	6	47	69
31	0	0	0	0	0	0	0	0	0	0
32	341	747	175	174	54	291	75	20	76	59
33	1115	3888	992	610	103	693	188	89	237	253
34	464	1028	503	264	59	182	90	21	86	104
35	93	124	57	44	18	23	22	11	20	19
36	857	1239	665	438	177	219	218	107	244	204
37	51	81	54	29	6	14	9	4	17	20
38	0	0	0	0	0	0	0	0	0	0
39	26	46	26	16	4	4	7	3	10	6
40	72	80	52	32	17	21	17	15	11	12
41	584	627	441	234	145	116	175	113	102	152
42	247	305	186	124	30	15	43	27	61	36
43	132	176	86	64	18	47	26	9	21	27
44	22	30	23	13	2	1	5	3	4	4
45	433	553	412	262	50	40	75	50	94	95
46	52	95	76	46	3	0	8	7	10	13
47	226	236	177	128	12	30	28	12	54	21
48	401	485	542	364	30	17	63	31	136	59
49	97	130	75	49	4	18	5	2	14	9
50	45	50	23	22	0	8	4	0	9	8
51	90	119	52	46	3	9	7	1	17	17
52	0	0	0	0	0	0	0	0	0	0
53	0	0	0	0	0	0	0	0	0	0
54	0	0	0	0	0	0	0	0	0	0
55	529	503	274	291	140	292	222	81	178	235
56	7	7	4	4	2	2	3	1	3	3
57	1	2	1	1	0	0	0	0	1	1
58	6	8	5	6	1	1	2	1	3	4
59	0	0	0	0	0	0	0	0	0	0
TOTAL	33808	52022	21514	15353	23459	33566	15591	8415	5369	30379

Appendix 4-5-2 Railway User OD Matrix (2005-2) (Trips/day)

	11	12	13	14	15	16	17	18	19	20
01	334	649	506	1223	562	0	450	226	2265	940
02	338	486	639	1108	1063	0	1982	308	3398	1205
03	137	224	236	490	409	19	298	137	3438	1191
04	110	231	204	454	234	0	122	92	1432	772
05	38	333	83	155	0	0	110	4	215	40
06	77	422	282	490	71	0	1978	110	817	22
07	28	59	68	111	63	0	260	64	1629	176
08	10	39	28	34	27	0	78	18	953	75
09	91	183	145	324	131	3	47	43	488	320
10	172	9700	295	437	0	0	165	20	315	114
11	0	1936	598	108	603	0	9	2	59	5
12	2187	0	4633	362	148	9	39	8	128	52
13	668	4699	0	11010	102	40	8	1	116	25
14	122	389	11464	0	81	9	30	3	205	27
15	614	151	94	78	0	0	294	19	293	22
16	0	9	38	9	0	0	0	1	3	0
17	8	39	7	25	301	0	0	36	3900	16
18	1	8	0	3	18	1	30	0	0	903
19	54	133	100	186	293	3	4144	0	0	14081
20	5	52	22	23	23	0	17	879	14019	0
21	4	13	10	16	12	0	16	6	1560	202
22	5	19	5	9	5	0	3	2	0	149
23	2	21	10	20	1	0	1	2	787	0
24	62	55	103	154	108	18	70	53	1335	2311
25	55	67	360	1470	0	0	13	19	0	45
26	0	0	0	0	0	0	0	0	0	0
27	163	270	872	961	213	116	51	25	372	160
28	9	47	100	118	22	6	11	0	57	5
29	13745	1512	3314	2252	1722	848	95	25	629	125
30	28	86	982	4307	17	5	4	0	47	6
31	0	0	0	0	0	0	0	0	0	0
32	1	22	9	9	27	0	215	15	169	12
33	14	104	80	70	320	0	2337	0	0	34
34	2	22	15	9	286	22	53	99	685	0
35	4	11	16	15	21	3	8	14	277	192
36	53	103	152	181	205	51	46	80	2065	1445
37	2	2	14	13	11	12	2	67	216	206
38	0	0	0	0	0	0	0	0	0	0
39	2	2	4	11	5	0	0	1	58	40
40	5	2	16	52	21	9	8	10	103	162
41	54	34	101	205	114	23	46	59	629	541
42	12	10	43	129	14	0	9	9	115	41
43	6	7	33	266	23	7	6	8	62	69
44	1	1	4	2	0	0	0	0	9	2
45	26	35	109	148	25	0	12	9	228	45
46	2	4	8	1	1	0	1	1	21	1
47	1	6	10	11	11	7	7	1	96	17
48	6	32	31	26	17	0	8	46	1188	4271
49	2	4	49	31	2	0	0	1	12	3
50	0	2	0	5	1	1	0	0	8	1
51	2	6	13	10	4	0	0	0	25	2
52	0	0	0	0	0	0	0	0	0	0
53	0	0	0	0	0	0	0	0	0	0
54	0	0	0	0	0	0	0	0	0	0
55	83	146	216	157	134	96	60	82	609	114
56	1	2	4	3	1	0	0	1	13	2
57	0	1	2	1	0	0	0	0	3	1
58	1	4	6	5	1	0	0	1	6	1
59	0	0	0	0	0	0	0	0	0	0
TOTAL	19347	22394	26133	27297	7473	1308	13143	2607	45057	30191

Appendix 4-5-2 Railway User OD Matrix (2005-3) (Trips/day)

	21	22	23	24	25	26	27	28	29	30
01	513	209	66	709	38	0	774	375	2817	222
02	436	197	160	630	0	0	773	314	2481	200
03	558	99	193	735	121	0	684	155	1276	82
04	258	40	92	333	4	0	376	127	980	78
05	28	9	3	144	0	0	186	38	454	19
06	60	0	0	160	29	0	247	119	1033	94
07	233	20	8	275	45	0	111	36	293	19
08	197	7	15	155	14	0	56	10	103	6
09	114	36	58	106	0	0	163	77	695	52
10	51	37	28	181	0	0	223	60	1381	67
11	5	5	2	61	56	0	167	9	13796	27
12	13	16	21	48	72	0	265	44	1525	81
13	13	6	12	98	382	0	879	100	3342	968
14	18	10	20	151	1486	0	1027	126	2092	4238
15	12	5	1	109	0	0	224	20	1965	17
16	0	0	0	18	0	0	117	6	852	5
17	16	3	1	70	14	0	49	9	93	3
18	5	2	2	49	18	0	25	1	21	0
19	1406	0	779	1377	0	0	370	53	604	44
20	209	145	0	2313	44	0	166	6	126	5
21	0	0	298	0	0	0	42	2	59	3
22	0	0	0	317	0	0	78	5	72	3
23	328	0	0	136	0	0	67	6	69	5
24	0	318	133	0	0	0	236	59	501	34
25	0	0	0	0	0	0	375	96	571	91
26	0	0	0	0	0	0	0	0	0	0
27	42	74	63	240	384	0	0	4758	714	642
28	2	6	6	62	96	0	4780	0	80	146
29	59	72	63	489	571	0	716	75	0	3432
30	3	2	4	31	86	0	652	154	3226	0
31	0	0	0	0	0	0	0	0	0	0
32	5	1	1	57	41	0	55	2	35	3
33	15	2	0	190	58	0	197	15	211	16
34	7	12	11	177	75	0	53	2	72	3
35	13	28	31	61	30	0	32	4	46	7
36	93	218	253	548	310	0	309	37	516	62
37	6	71	44	63	34	0	29	4	46	5
38	0	0	0	0	0	0	0	0	0	0
39	2	7	6	11	5	0	20	1	34	4
40	112	45	24	4879	58	0	44	29	106	17
41	742	0	0	10948	112	0	198	87	628	47
42	56	199	20	992	15	0	111	17	170	20
43	46	3	3	612	297	0	157	45	165	30
44	3	20	3	71	0	0	2	0	5	0
45	61	310	81	1292	111	0	91	6	200	52
46	7	30	3	200	0	0	7	0	14	0
47	27	0	0	455	47	0	25	1	28	1
48	71	68	101	942	36	0	91	5	94	7
49	1	5	0	23	0	0	24	0	64	0
50	1	6	0	40	14	0	26	1	16	0
51	5	18	5	97	21	0	48	2	35	2
52	0	0	0	0	0	0	0	0	0	0
53	0	0	0	0	0	0	0	0	0	0
54	0	0	0	0	0	0	0	0	0	0
55	97	75	174	208	235	1	118	27	294	39
56	2	1	3	2	1	0	1	0	4	1
57	0	0	1	0	0	0	1	0	2	0
58	1	0	1	2	1	0	4	1	7	1
59	0	0	0	0	0	0	0	0	0	0
TOTAL	5952	2437	2793	30867	4961	1	15471	7126	44013	10900

Appendix 4-5-2 Railway User OD Matrix (2005-4) (Trips/day)

	31	32	33	34	35	36	37	38	39	40
01	0	366	1140	453	92	833	44	0	25	69
02	0	799	4071	1059	119	1192	70	0	43	76
03	0	185	1067	533	59	625	42	0	24	56
04	0	181	622	260	43	413	26	0	17	30
05	0	51	96	55	16	154	5	0	3	17
06	0	304	710	181	22	209	12	0	3	18
07	0	76	190	93	19	208	7	0	6	20
08	0	20	87	18	11	97	3	0	3	15
09	0	83	247	83	20	236	15	0	11	10
10	0	60	244	106	17	189	18	0	5	12
11	0	1	15	3	4	54	2	0	2	6
12	0	23	101	19	10	100	2	0	1	3
13	0	11	92	21	16	160	13	0	9	15
14	0	12	81	10	18	192	14	0	16	54
15	0	25	297	276	22	201	10	0	5	23
16	0	0	0	22	4	52	12	0	0	10
17	0	214	2241	50	7	45	2	0	0	10
18	0	14	0	94	14	76	58	0	1	8
19	0	161	0	676	275	2044	218	0	64	110
20	0	13	34	0	198	1475	195	0	40	162
21	0	5	16	7	13	100	6	0	2	123
22	0	1	2	12	28	224	72	0	7	46
23	0	1	0	11	32	264	45	0	6	25
24	0	59	200	177	60	534	60	0	12	5006
25	0	42	59	73	29	301	31	0	5	61
26	0	0	0	0	0	0	0	0	0	0
27	0	54	198	51	32	306	28	0	19	42
28	0	2	16	2	4	38	3	0	1	27
29	0	35	216	75	48	512	44	0	33	107
30	0	3	16	3	6	64	5	0	4	16
31	0	0	0	0	0	0	0	0	0	0
32	0	0	0	268	14	117	4	0	4	14
33	0	0	0	349	31	286	19	0	9	37
34	0	251	329	0	241	859	52	0	2	16
35	0	14	31	237	0	0	622	0	0	15
36	0	118	290	842	0	0	3466	0	0	143
37	0	5	20	52	621	3413	0	0	273	15
38	0	0	0	0	0	0	0	0	0	0
39	0	4	8	2	0	0	282	0	0	2
40	0	13	38	15	14	139	16	0	2	0
41	0	50	161	119	55	570	34	0	15	9603
42	0	10	25	19	19	171	11	0	2	3576
43	0	12	35	16	21	196	10	0	4	5973
44	0	0	2	1	2	15	6	0	0	5
45	0	13	35	25	34	301	79	0	7	203
46	0	1	3	3	2	20	6	0	0	14
47	0	1	6	5	8	59	23	0	1	141
48	0	6	15	48	334	2845	683	0	78	81
49	0	1	9	3	10	90	6	0	1	20
50	0	0	1	0	5	42	5	0	1	10
51	0	1	4	2	10	85	16	0	2	19
52	0	0	0	0	0	0	0	0	0	0
53	0	0	0	0	0	0	0	0	0	0
54	0	0	0	0	0	0	0	0	0	0
55	0	98	65	69	119	529	60	0	123	138
56	0	1	0	1	3	14	2	0	2	2
57	0	0	0	0	1	3	0	0	0	1
58	0	1	1	1	2	10	1	0	0	3
59	0	0	0	0	0	0	0	0	0	0
TOTAL	0	3401	13136	6500	2784	20662	6465	0	893	26208

Appendix 4-5-2 Railway User OD Matrix (2005-5) (Trips/day)

	41	42	43	44	45	46	47	48	49	50
01	540	235	125	20	427	52	236	393	97	41
02	593	295	169	28	551	91	243	479	136	48
03	409	179	83	22	399	75	184	530	81	18
04	219	114	57	10	243	44	124	339	44	16
05	124	27	12	2	47	3	11	24	2	0
06	107	14	41	1	39	0	31	16	18	6
07	172	38	22	5	73	7	26	61	7	3
08	111	28	9	3	47	7	10	29	1	0
09	97	57	18	3	89	10	57	130	15	7
10	138	33	21	5	93	12	20	54	8	6
11	58	11	5	1	27	2	1	6	2	1
12	34	9	4	1	36	4	6	28	4	2
13	101	47	41	4	116	8	10	33	50	1
14	203	136	268	2	157	1	12	29	29	5
15	113	15	21	0	24	1	10	15	3	1
16	24	0	6	0	0	0	6	0	0	1
17	50	9	5	0	11	1	6	7	0	0
18	56	8	5	0	9	1	1	45	1	0
19	640	117	58	8	219	18	87	1200	12	6
20	531	42	68	2	46	1	17	4456	4	1
21	744	54	43	3	61	7	25	68	1	1
22	0	205	3	22	328	30	0	69	5	7
23	0	21	3	4	87	3	0	104	0	1
24	11003	924	573	67	1247	192	453	904	22	32
25	112	15	310	0	123	0	47	34	0	13
26	0	0	0	0	0	0	0	0	0	0
27	196	107	146	2	91	7	23	88	23	23
28	87	18	46	0	6	0	1	5	0	1
29	607	169	160	6	206	14	25	88	66	15
30	49	20	30	0	52	0	1	7	0	0
31	0	0	0	0	0	0	0	0	0	0
32	49	9	11	0	13	1	1	6	1	0
33	155	25	32	2	35	3	5	14	10	1
34	119	21	15	1	27	3	4	48	3	0
35	58	17	18	2	33	2	7	325	11	3
36	571	168	187	16	300	18	54	2854	85	37
37	37	12	10	6	76	6	23	722	6	5
38	0	0	0	0	0	0	0	0	0	0
39	14	2	3	0	6	0	1	76	1	1
40	9688	3380	6440	5	194	13	138	78	19	9
41	0	3165	1384	139	2552	522	0	249	126	128
42	3420	0	0	608	10190	2200	998	29	1852	144
43	1458	0	0	0	51	0	35	59	3	5
44	152	636	0	0	2767	0	48	2	21	117
45	2711	10447	47	2763	0	8191	774	37	668	3782
46	547	2291	0	0	7975	0	0	2	19	448
47	0	996	35	46	758	0	0	76	3	7
48	256	30	58	2	39	2	73	0	6	2
49	130	1907	3	23	730	19	3	5	0	18
50	142	153	5	129	3639	427	7	2	20	0
51	375	399	6	408	5846	60	8	4	49	23588
52	0	0	0	0	1	0	0	0	0	0
53	0	0	0	0	0	0	0	0	0	0
54	0	0	0	0	0	0	0	0	0	0
55	630	198	169	32	125	36	19	127	101	83
56	8	2	2	0	1	0	0	3	1	1
57	2	0	1	0	0	0	0	1	0	0
58	7	1	2	0	1	0	0	1	1	1
59	0	0	0	0	0	0	0	0	0	0
TOTAL	37647	26806	10780	4403	40213	12094	3871	13961	3637	28636

Appendix 4-5-2 Railway User OD Matrix (2005-6) (Trips/day)

	51	52	53	54	55	56	57	58	59	TOTAL
01	91	0	0	0	616	8	2	7	0	34052
02	119	0	0	0	579	9	2	9	0	51949
03	51	0	0	0	325	5	2	6	0	22156
04	42	0	0	0	324	5	2	6	0	15160
05	2	0	0	0	132	2	0	1	0	23395
06	9	0	0	0	331	2	0	1	0	33799
07	7	0	0	0	241	3	1	3	0	15827
08	1	0	0	0	85	1	0	1	0	8324
09	16	0	0	0	217	3	1	4	0	5332
10	15	0	0	0	239	3	1	4	0	30120
11	2	0	0	0	76	1	0	1	0	19036
12	6	0	0	0	146	2	1	4	0	22225
13	14	0	0	0	203	3	2	6	0	25938
14	10	0	0	0	138	2	1	4	0	27601
15	4	0	0	0	128	1	0	1	0	7715
16	0	0	0	0	95	0	0	0	0	1314
17	0	0	0	0	61	0	0	0	0	13014
18	1	0	0	0	70	1	0	1	0	2457
19	23	0	0	0	561	12	3	6	0	44894
20	2	0	0	0	99	2	0	1	0	30104
21	4	0	0	0	94	2	0	1	0	6131
22	18	0	0	0	68	1	0	0	0	2453
23	6	0	0	0	160	3	1	1	0	2858
24	97	0	0	0	219	2	0	2	0	31076
25	22	0	0	0	247	2	0	1	0	4939
26	0	0	0	0	1	0	0	0	0	1
27	45	0	0	0	114	1	1	4	0	15554
28	1	0	0	0	24	0	0	1	0	7129
29	37	0	0	0	256	3	1	6	0	43669
30	2	0	0	0	33	0	0	1	0	10743
31	0	0	0	0	0	0	0	0	0	0
32	1	0	0	0	89	1	0	1	0	3295
33	4	0	0	0	60	0	0	0	0	12908
34	2	0	0	0	65	1	0	1	0	6466
35	9	0	0	0	116	3	1	1	0	2769
36	78	0	0	0	502	13	3	10	0	20850
37	14	0	0	0	68	2	0	2	0	6520
38	0	0	0	0	0	0	0	0	0	0
39	2	0	0	0	124	2	0	0	0	891
40	18	0	0	0	153	2	1	3	0	26409
41	364	0	0	0	650	8	2	7	0	37160
42	385	0	0	0	193	2	0	1	0	26911
43	6	0	0	0	170	2	1	2	0	10510
44	373	0	0	0	34	0	0	0	0	4411
45	5510	1	0	0	117	1	0	1	0	40652
46	63	0	0	0	33	0	0	0	0	12038
47	8	0	0	0	17	0	0	0	0	3865
48	4	0	0	0	123	3	1	1	0	13858
49	46	0	0	0	93	1	0	1	0	3743
50	24120	0	0	0	78	0	0	1	0	29078
51	0	0	0	0	59	0	0	0	0	31597
52	0	0	0	0	0	0	0	0	0	1
53	0	0	0	0	0	0	0	0	0	0
54	0	0	0	0	0	0	0	0	0	0
55	64	0	0	0	0	52	7	0	0	8554
56	0	0	0	0	52	0	1	0	0	174
57	0	0	0	0	7	1	0	0	0	36
58	0	0	0	0	0	0	0	0	0	113
59	0	0	0	0	0	0	0	0	0	0
TOTAL	31718	1	0	0	8685	173	38	115	0	861774

Appendix 4-5-3 Bus User OD Matrix (2005-1) (Trips/day)

	01	02	03	04	05	06	07	08	09	10
01	0	1259	4595	4224	2555	2018	289	385	4606	236
02	1258	0	2154	797	1621	6072	656	416	109	293
03	4368	2113	0	2823	613	431	1490	1817	678	79
04	4201	928	3509	0	712	231	238	503	2693	129
05	2481	1562	604	700	0	5547	98	27	379	5619
06	2122	6225	432	202	5691	0	977	350	57	714
07	301	695	1361	230	103	1055	0	18367	63	35
08	399	423	1723	516	30	361	18563	0	131	33
09	4654	102	738	2844	393	52	58	122	0	62
10	240	300	83	134	5404	731	34	32	67	0
11	295	325	88	118	179	335	38	11	59	250
12	234	245	78	109	192	310	24	20	80	3149
13	32	70	16	21	18	96	8	5	10	32
14	329	412	139	160	101	345	43	15	95	194
15	1766	2881	658	586	8934	2024	239	66	268	9490
16	5744	3774	1431	1588	3924	2623	422	209	963	3165
17	1030	2427	453	262	340	10082	1306	737	99	192
18	69	35	22	20	3	55	16	8	12	5
19	1539	2018	2502	1334	222	1742	1320	1503	429	195
20	1437	1143	881	559	119	981	398	176	288	138
21	449	324	550	354	29	319	241	294	137	21
22	815	674	533	442	81	344	137	50	210	98
23	694	581	441	304	86	260	155	70	156	111
24	613	513	806	460	130	271	281	216	178	88
25	2684	1831	3018	1545	2475	1278	462	548	547	4200
26	205	234	145	100	17	77	17	4	55	36
27	358	474	330	227	132	201	56	34	102	126
28	156	193	75	77	31	100	19	7	46	33
29	1812	1907	755	876	574	1326	204	102	437	879
30	120	153	49	58	19	96	14	5	38	47
31	347	420	203	144	65	202	38	8	64	82
32	674	868	181	163	199	875	78	12	92	178
33	3068	5553	1220	777	467	3440	456	100	352	451
34	447	683	379	223	68	231	85	25	75	75
35	75	73	28	20	20	67	22	10	12	13
36	710	834	385	268	195	594	238	152	152	161
37	24	32	19	9	4	18	6	2	7	10
38	20	31	9	6	0	6	0	0	2	8
39	87	115	53	35	15	69	29	19	21	14
40	28	29	23	17	9	23	9	9	5	3
41	282	289	250	159	111	259	130	86	67	54
42	379	294	203	164	67	207	80	36	86	41
43	93	106	64	56	16	78	20	8	23	15
44	54	53	35	23	7	27	14	6	17	11
45	931	809	517	376	146	455	187	77	238	182
46	550	480	276	216	55	190	102	32	127	78
47	231	191	122	100	18	139	39	11	50	19
48	786	626	550	336	88	443	165	74	161	85
49	196	199	104	80	10	100	8	3	44	20
50	70	58	24	26	0	38	6	1	18	13
51	259	228	84	86	11	140	24	3	53	38
52	36	35	15	14	0	11	3	0	8	4
53	1595	1597	919	733	111	636	205	50	372	252
54	0	0	0	0	0	0	0	0	0	0
55	439	358	173	175	143	558	223	79	120	189
56	15	12	6	6	4	17	7	2	4	6
57	13	10	5	6	4	12	6	2	4	5
58	59	50	24	26	17	57	27	10	15	25
59	388	343	177	185	116	340	174	63	121	174
TOTAL	52261	48197	34217	26099	36694	48595	30184	26979	15302	31855

Appendix 4-5-3 Bus User OD Matrix (2005-2) (Trips/day)

	11	12	13	14	15	16	17	18	19	20
01	302	235	32	344	1715	5340	992	79	1552	1527
02	334	246	73	437	2860	3610	2366	40	2061	1220
03	95	81	16	144	669	1391	458	26	2576	925
04	121	104	21	162	558	1432	252	21	1301	563
05	157	198	17	87	9643	3635	324	2	220	107
06	342	315	96	360	1990	2531	9486	63	1784	1040
07	37	26	9	41	229	415	1296	17	1346	398
08	12	21	5	15	60	201	723	8	1514	164
09	61	78	11	99	258	873	93	13	426	299
10	244	3242	30	185	10073	2970	182	5	192	138
11	0	2214	313	197	6080	10069	35	1	84	16
12	2500	0	2994	110	311	1069	36	3	72	31
13	351	3037	0	3543	146	1439	4	0	60	14
14	221	118	3688	0	196	1579	26	1	117	16
15	6199	318	133	190	0	15842	3034	31	807	202
16	9383	1080	1379	1520	14747	0	615	56	1390	457
17	34	36	4	22	3109	612	0	43	7577	284
18	0	2	0	1	29	58	36	0	19463	3754
19	77	75	51	106	809	1397	8049	19325	0	13480
20	15	31	12	13	212	467	303	3656	13422	0
21	6	8	4	11	36	168	52	6	1938	219
22	13	30	8	13	100	297	58	7	1455	375
23	31	25	11	30	117	346	85	20	1143	831
24	65	74	54	199	238	814	168	48	4752	5076
25	792	1288	970	8804	2028	4020	396	128	2918	1399
26	4	15	106	124	25	136	4	0	31	2
27	186	86	647	509	365	1417	44	11	247	109
28	14	15	85	67	51	299	10	0	42	4
29	6805	1958	2077	11928	3230	17103	161	16	650	172
30	50	37	1093	3376	53	372	4	0	41	5
31	175	52	42	12	305	10195	36	3	108	13
32	29	39	10	21	3742	2497	225	15	299	77
33	106	137	61	87	6374	1748	4909	119	1538	394
34	4	16	7	7	640	476	107	114	774	4125
35	6	5	6	7	52	124	20	20	155	113
36	74	50	72	89	453	1104	190	246	1828	1340
37	1	0	5	5	14	61	3	64	80	75
38	0	0	2	0	11	19	0	26	30	33
39	9	2	5	15	38	65	1	27	180	149
40	4	1	5	47	26	96	11	6	189	246
41	49	31	42	233	215	761	75	40	1569	1711
42	31	17	53	512	110	415	36	14	453	479
43	8	9	21	644	49	265	11	6	191	161
44	8	5	19	132	17	66	2	1	46	33
45	143	107	305	1842	292	1132	54	20	735	465
46	48	42	89	354	108	445	19	6	315	148
47	2	8	12	33	28	141	17	1	179	81
48	22	25	22	19	139	339	94	183	1375	5685
49	13	15	202	901	40	392	1	1	43	17
50	1	6	1	34	7	76	0	0	17	3
51	14	22	43	144	56	381	1	1	103	24
52	0	2	0	3	2	18	0	0	9	1
53	65	125	192	412	264	1344	31	2	609	118
54	0	0	0	0	0	0	0	0	0	0
55	103	79	114	89	237	757	110	99	689	135
56	2	2	3	2	7	18	3	3	18	4
57	2	2	3	2	5	12	2	2	16	3
58	10	10	16	13	24	58	11	10	77	13
59	77	93	139	106	153	351	68	70	484	90
TOTAL	29457	15895	15430	38402	73345	103258	35329	24725	81290	48563

Appendix 4-5-3 Bus User OD Matrix (2005-3) (Trips/day)

	21	22	23	24	25	26	27	28	29	30
01	448	856	705	565	2562	204	328	162	1898	131
02	325	711	587	479	1821	231	450	200	2021	166
03	548	556	445	736	2958	147	326	78	799	54
04	338	440	302	443	1495	97	205	74	879	60
05	28	72	79	122	2550	15	117	26	515	18
06	313	357	263	255	1290	74	186	102	1389	101
07	226	146	149	272	505	17	54	18	208	13
08	265	51	58	212	582	3	33	7	97	5
09	136	216	162	149	479	54	92	47	450	42
10	19	89	100	81	4329	32	118	32	855	47
11	6	13	31	63	808	5	190	13	6830	48
12	8	25	26	64	1377	15	85	14	1975	35
13	5	8	12	51	1030	105	652	85	2095	1078
14	11	16	31	196	8898	136	543	72	11080	3321
15	37	98	104	238	2068	24	384	48	3686	52
16	170	302	314	834	4234	121	1424	274	17185	364
17	51	60	71	165	426	3	42	9	159	4
18	6	8	15	44	121	0	11	0	13	0
19	1748	1417	1131	4901	3082	28	246	38	625	39
20	226	367	763	5078	1387	4	113	4	174	4
21	0	3499	4897	9993	635	0	31	1	74	3
22	3813	0	27969	1724	782	4	108	10	115	5
23	5388	27799	0	1600	741	2	111	13	201	13
24	9660	1727	1569	0	3269	77	274	86	620	62
25	595	768	698	2996	0	601	1405	845	5623	1132
26	0	3	2	81	589	0	2393	1819	182	316
27	30	103	105	278	1436	2406	0	2749	5193	336
28	2	10	14	92	842	1767	2762	0	183	82
29	74	116	183	605	5623	194	5210	173	0	10150
30	4	5	13	57	1068	342	341	87	9539	0
31	4	7	12	85	274	2	192	5	7312	6
32	12	24	35	94	552	1	111	5	471	6
33	57	106	139	387	1432	14	221	20	535	24
34	13	51	69	279	443	1	41	1	77	3
35	8	31	27	62	114	3	17	2	42	4
36	89	356	325	832	993	32	185	24	477	46
37	3	47	23	56	54	0	14	2	29	3
38	0	7	2	3	18	0	2	0	7	0
39	7	45	35	65	74	0	31	1	79	8
40	40	520	406	2205	302	25	47	36	100	27
41	367	31177	29752	6481	1171	92	255	143	588	97
42	92	673	774	1896	976	87	380	121	487	189
43	29	290	265	489	12361	124	354	168	308	149
44	6	32	30	127	183	3	40	8	96	111
45	100	483	458	1777	2959	68	758	142	1413	1487
46	48	180	208	906	875	14	290	34	498	103
47	32	478	521	338	391	1	70	2	41	5
48	95	191	214	2177	747	5	74	5	146	7
49	5	52	73	564	940	216	675	241	782	15664
50	1	8	1	44	156	4	128	14	71	5
51	11	37	45	168	627	21	455	36	297	48
52	0	2	3	23	48	0	23	1	10	0
53	66	144	0	2210	3113	43	937	46	899	126
54	0	0	0	0	0	0	0	0	0	0
55	118	137	266	273	532	54	81	20	266	32
56	3	4	7	9	15	1	2	1	7	1
57	3	3	5	7	11	1	1	1	6	1
58	13	14	28	30	49	4	10	3	33	3
59	82	81	168	189	308	26	91	21	241	31
TOTAL	25784	75018	74689	54150	86705	7550	23719	8189	89981	35867

Appendix 4-5-3 Bus User OD Matrix (2005-4) (Trips/day)

	31	32	33	34	35	36	37	38	39	40
01	349	724	3135	436	73	689	21	18	81	26
02	431	928	5814	703	71	802	28	25	107	28
03	217	190	1311	402	29	362	15	8	48	25
04	137	169	792	220	19	252	8	5	37	16
05	54	187	435	62	17	170	3	0	12	9
06	197	917	3520	229	64	569	14	4	65	20
07	38	80	461	87	19	226	5	0	24	10
08	8	13	97	23	10	139	2	0	17	10
09	62	100	366	74	12	147	5	2	25	5
10	78	181	435	76	12	149	9	10	11	4
11	187	35	112	5	6	75	2	0	9	4
12	48	39	131	14	5	48	0	0	1	2
13	43	12	71	10	7	75	4	3	12	5
14	14	26	100	8	8	94	5	0	23	47
15	301	3511	5919	619	53	445	12	11	44	27
16	10418	2560	1780	464	133	1141	64	19	65	112
17	37	223	4707	103	18	182	2	0	1	13
18	3	15	110	108	20	232	56	25	28	5
19	95	284	1480	765	155	1808	80	32	200	204
20	14	82	400	4357	116	1368	71	34	149	247
21	3	12	57	13	8	96	3	0	9	43
22	7	28	107	53	32	365	48	8	46	527
23	13	37	156	74	28	341	23	2	33	426
24	81	98	406	279	61	811	53	4	70	2263
25	265	561	1443	430	112	963	49	16	72	320
26	2	1	15	1	3	33	1	0	0	25
27	178	109	223	40	17	183	13	2	29	45
28	5	4	22	1	3	24	2	0	1	35
29	6948	466	547	79	44	474	28	7	77	101
30	6	8	26	2	4	47	3	0	8	25
31	0	4556	391	23	16	129	5	1	10	12
32	4763	0	6414	412	31	251	6	7	30	17
33	374	6528	0	644	84	827	27	15	104	53
34	25	386	608	0	1287	12751	134	114	197	18
35	13	30	85	1267	0	13748	161	38	2248	14
36	124	255	840	12510	13671	0	1566	309	20148	137
37	4	6	27	136	161	1541	0	154	2217	9
38	1	7	15	109	39	315	144	0	28	0
39	11	29	94	192	2260	20115	2294	25	0	5
40	12	16	56	17	13	134	10	0	5	0
41	75	101	413	147	75	793	28	2	72	4780
42	23	45	174	43	48	419	15	1	16	3290
43	16	21	71	23	25	242	8	1	14	2157
44	3	3	18	2	6	56	13	2	4	79
45	55	66	251	64	105	981	162	15	122	1163
46	14	21	113	23	68	541	56	1	37	487
47	1	3	21	8	40	317	60	0	35	235
48	17	41	155	204	119	1751	163	14	176	142
49	8	4	41	7	23	219	11	0	8	163
50	1	0	2	0	13	130	11	0	11	36
51	10	8	39	7	54	472	48	0	51	134
52	0	0	1	0	5	41	4	0	3	12
53	30	38	164	39	127	1092	176	0	80	844
54	0	0	0	0	0	0	0	0	0	0
55	71	171	129	109	82	292	21	18	408	129
56	2	4	4	3	3	11	0	0	7	4
57	1	4	3	2	2	10	3	0	12	3
58	4	17	13	10	12	40	3	0	32	15
59	31	111	78	67	65	267	23	5	162	107
TOTAL	25928	24071	44398	25805	19593	69795	5781	957	27541	18674

Appendix 4-5-3 Bus User OD Matrix (2005-5) (Trips/day)

	41	42	43	44	45	46	47	48	49	50
01	261	362	88	48	917	549	241	771	195	63
02	273	283	103	49	803	459	196	619	207	54
03	232	196	62	35	501	269	127	538	112	19
04	148	150	51	20	350	208	97	312	72	19
05	95	61	11	5	139	51	15	71	6	0
06	238	203	69	25	449	179	141	436	100	32
07	127	71	16	14	180	89	36	157	11	5
08	84	37	9	5	74	32	10	68	2	0
09	63	80	19	13	225	126	51	154	46	14
10	49	38	11	14	177	76	18	77	18	10
11	53	29	7	7	149	47	1	22	16	2
12	32	14	6	5	107	43	7	22	14	4
13	41	59	26	19	326	96	12	23	206	2
14	232	537	650	137	1955	355	36	21	846	32
15	213	114	43	19	292	102	27	128	50	7
16	799	389	235	62	1112	382	126	326	399	60
17	82	39	8	2	52	17	14	85	1	0
18	38	13	4	1	20	8	1	178	1	0
19	1595	458	180	42	707	274	163	1390	43	13
20	1678	488	159	33	470	150	78	5931	21	5
21	367	90	27	6	102	45	29	93	6	1
22	30620	694	281	35	513	179	500	194	50	8
23	28971	797	274	35	486	194	538	219	78	2
24	6513	1766	458	121	1715	873	337	2087	544	36
25	1173	999	12913	200	3282	876	394	712	929	142
26	93	92	125	3	70	14	1	5	190	4
27	252	367	328	41	755	285	64	70	648	114
28	143	124	174	8	141	35	2	5	232	11
29	568	481	299	97	1451	491	37	137	797	65
30	102	189	150	108	1503	113	5	7	16369	6
31	76	23	13	3	59	15	1	16	7	2
32	100	42	19	3	62	25	2	36	5	1
33	397	175	66	20	247	103	21	145	45	4
34	149	46	22	2	69	22	8	203	7	1
35	79	45	22	5	102	62	35	116	26	9
36	793	412	231	63	974	502	286	1757	205	112
37	30	15	8	12	157	55	61	172	10	10
38	2	1	1	1	14	1	0	14	0	0
39	67	18	11	4	108	38	29	172	7	9
40	4821	3111	2326	78	1112	463	229	136	153	33
41	0	6404	1186	142	2291	1369	1978	844	860	97
42	6921	0	12680	374	6066	4071	1959	299	3320	75
43	1249	13225	0	187	2940	773	308	151	843	94
44	155	391	169	0	2142	1593	227	25	244	68
45	2433	6218	2753	2139	0	36540	2746	355	3152	2573
46	1433	4224	787	1528	35574	0	1344	128	546	4268
47	1990	1957	307	217	2689	1337	0	393	121	22
48	870	309	149	26	374	133	376	0	30	12
49	890	3420	906	267	3441	543	122	28	0	55
50	109	79	97	75	2475	4060	22	11	63	0
51	455	344	354	344	6300	3406	66	45	284	27319
52	60	45	30	19	653	478	2	4	6	5862
53	3513	4228	2105	1351	21090	3492	127	171	716	40816
54	0	0	0	0	0	0	0	0	0	0
55	780	372	192	99	351	487	73	111	226	223
56	24	10	6	3	8	10	3	4	5	5
57	19	8	4	2	7	7	2	3	5	4
58	87	35	23	7	31	36	7	13	21	21
59	548	229	147	55	203	226	34	82	138	137
TOTAL	103185	54606	41400	8235	108562	66464	13372	20292	33254	82562

Appendix 4-5-3 Bus User OD Matrix (2005-6) (Trips/day)

	51	52	53	54	55	56	57	58	59	TOTAL
01	260	33	1701	0	511	17	14	68	452	52247
02	229	31	1703	0	412	13	12	55	394	48446
03	82	12	1003	0	206	7	6	30	210	33694
04	76	13	740	0	194	6	6	26	206	26361
05	8	0	100	0	135	4	4	17	109	36729
06	138	11	676	0	634	20	14	63	385	48519
07	24	3	204	0	243	8	6	29	189	29994
08	3	0	50	0	82	2	2	10	66	27070
09	49	9	400	0	146	5	4	21	146	15432
10	34	4	235	0	192	6	5	24	177	32118
11	16	0	69	0	94	2	2	10	71	29746
12	22	2	118	0	79	2	2	10	93	16061
13	47	0	214	0	108	3	3	15	132	15597
14	155	4	483	0	79	2	2	10	93	38053
15	59	2	260	0	225	7	5	24	146	73072
16	335	15	1362	0	744	17	11	57	346	103225
17	1	0	31	0	112	3	2	11	68	35453
18	1	0	2	0	84	2	2	10	60	24833
19	96	8	604	0	636	16	15	72	448	81291
20	28	2	129	0	118	3	3	13	79	48597
21	10	0	64	0	113	3	3	13	79	25594
22	38	2	157	0	125	3	3	14	74	74981
23	47	3	0	0	243	6	5	24	154	74574
24	169	24	2286	0	288	9	8	30	199	53977
25	644	42	3303	0	556	15	11	52	322	86790
26	24	0	42	0	51	1	1	4	24	7547
27	427	21	942	0	79	2	1	10	89	23631
28	35	1	53	0	18	1	1	3	18	8180
29	310	9	917	0	233	6	6	26	211	90212
30	51	1	132	0	27	1	1	3	27	36010
31	10	0	36	0	68	2	1	4	30	25922
32	9	0	36	0	154	4	3	17	101	24135
33	38	1	172	0	118	4	2	11	71	44588
34	5	0	44	0	102	3	2	10	63	25817
35	45	4	123	0	80	3	2	10	64	19594
36	437	33	1079	0	277	11	9	40	254	69529
37	45	4	178	0	24	0	4	5	26	5741
38	0	0	0	0	18	0	0	0	6	958
39	57	1	78	0	412	7	11	32	165	27544
40	127	13	873	0	142	5	4	15	118	18516
41	440	52	3559	0	806	25	19	89	568	103751
42	332	36	4297	0	364	10	8	35	224	54497
43	374	27	2173	0	193	6	4	23	147	41676
44	314	17	1324	0	105	3	2	11	58	8246
45	5937	616	20442	0	330	8	6	27	191	108108
46	3586	466	3687	0	438	9	6	32	205	66458
47	65	2	142	0	67	2	2	4	31	13369
48	47	3	183	0	107	3	3	13	79	20377
49	264	4	722	0	208	5	4	20	128	33112
50	27935	6568	39223	0	212	5	4	20	131	82124
51	0	5704	17865	0	252	6	5	21	140	67193
52	6265	0	238	0	81	2	2	7	37	14128
53	16878	192	0	0	549	10	8	36	247	115335
54	0	0	0	0	0	0	0	0	0	0
55	273	89	654	0	0	41	91	495	16267	28902
56	6	2	12	0	41	0	7	4	375	754
57	5	2	9	0	91	7	0	4	382	756
58	22	7	43	0	496	4	4	0	725	2467
59	151	40	294	0	16264	375	383	726	0	25898
TOTAL	67085	14135	115466	0	28766	752	756	2465	259002	347529

Appendix 4-5-4 Reallocation of Commuter Traffic

The number of commuters at each station was estimated expediently assuming only one traffic flow between the centroid and its nearest station as shown in Fig. 1.

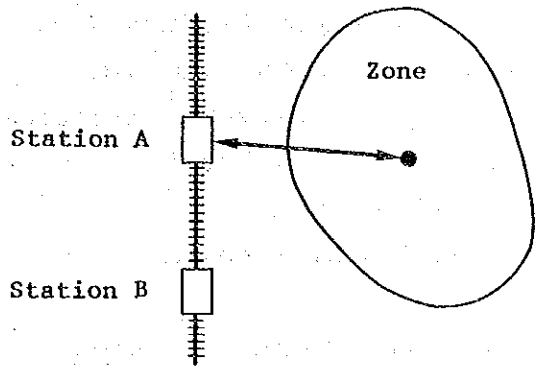


Fig. 1 Traffic Flow Between Zone and Station (1 flow)

In fact, a commuter living in a Zone will choose his railway station not necessarily in the same Zone. He might make access to an adjacent station B in another Zone, if the feeder bus access and other conditions are better. The trips assigned to a zone is thus reallocated to other zones (Refer to Fig. 2).

Reallocation of traffic demand has been made among the related railway stations, considering the housing development and population density.

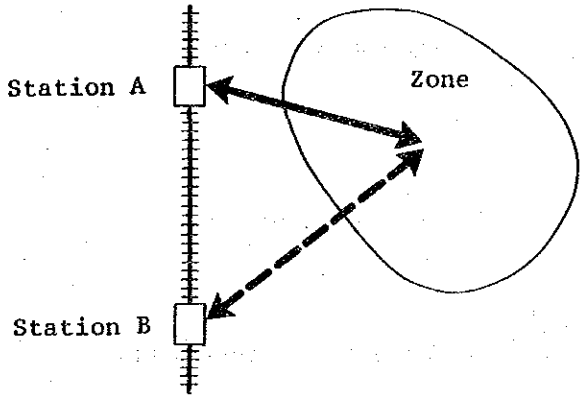


Fig. 2 Traffic Flow Between Zone and Station (2 flows)

Appendix 4-6-1 Estimation of transport Capacity by DTP : C_2

1.Preconditions

Train consist : 3 DMUs/train
Total pass. km : 1.68 million (without case in 1993)
Max. sectional traffic : 40,900 pass./day
Number of train/morning peak hours/one direction : 4 trains
Max. carring capacity during peak hours : 189 pass./DMU (= 107 x 177%)
Max. carring capacity during off-peak hours : 86 pass./DMU (= 107 x 80%)
Number of train/off-peak hours/one direction : 13 trains

2.Max. sectional traffic demand in 1993

(1) Peak hours (KL-bound)

$$40{,}900 \times 0.63 \times \frac{1}{2} \times 0.65 = 8{,}400 \text{ pass./one.direction}$$

(Peak Ratio) (Morning Time) (Main Direction)

(2) Off-peak hours

$$40{,}900 \times 0.37 \times \frac{1}{2} = 7{,}567 \text{ pass./one.direction}$$

3.Transport capacity in 1993

(1) Peak hours

$3 \times 4 \times 189 = 2{,}268$ pass./one.direction

(2) Off-peak hours

$3 \times (8.5 + 4.5) \times 86 + 3354$ pass./one.direction

4 Transport capacity in 1993

(1) Peak hours

$$1.68 \times 0.63 \times \frac{2268}{8400} = 0.2857 \text{ million pass.km/day}$$

(2) Off-peak hours

$$1.68 \times (1 - 0.63) \times \frac{3354}{7567} = 0.2755 \text{ million pass.km/day}$$

(3) Total

$0.2857 + 0.2755 = 0.5612$ million pass.km/day

Chapter 5

RAILWAY COMMUTER TRANSPORT

Appendix 5-1-1 Signal Aspect System and Indicated Speed

(1) Signal aspect system

For the sections where commuter trains are operated with high density, increase in train speed will necessitate introduction of multi-aspect signals on the basis of the 3-aspect system.

The signal aspect system can be classified into the following five types.

Table 1 Signal Aspect System

Aspect / Type	Stop	Alerm	Caution	Retard-ation	Proceed
2 aspects	o				o
3 aspects	o		o		o
4 aspects	o		o	o	o
	o	o	o		o
5 aspects	o	o	o	o	o

The 4-aspect system is further divided into the following two types:

a) 3 aspects plus retardation aspect signal

b) 3 aspects plus caution aspect signal

While a) is used to control trains operated at high speeds, b) is designed to prevent overrun accidents during high-density operations.
As the DTP assumes that DMUs will be operated at the maximum speed of 120 km/h, signals should be planned to handle both high-speed and high-density operations.

For high density operations, in addition to the planned full overlapping (R_1, R_0) system, the ATS will be installed as a supplementary system to prevent train accidents such as collisions.

(2) 4-aspect system

The 4-aspect system has the following advantages over the 3-aspect system for sections where trains are operated at high speed with high density.

Table 2 Comparison of 3-aspect and 4-aspect Systems;

Item	3-aspect system	4-aspect system
Distance for signal identification	x	o
Minimum headway	△	o
Integration of aspect system	x	o

(Note) o: Good △: Fair x: Poor

a. Distance for signal identification and speed indication by signals

(a) Distance for signal identification

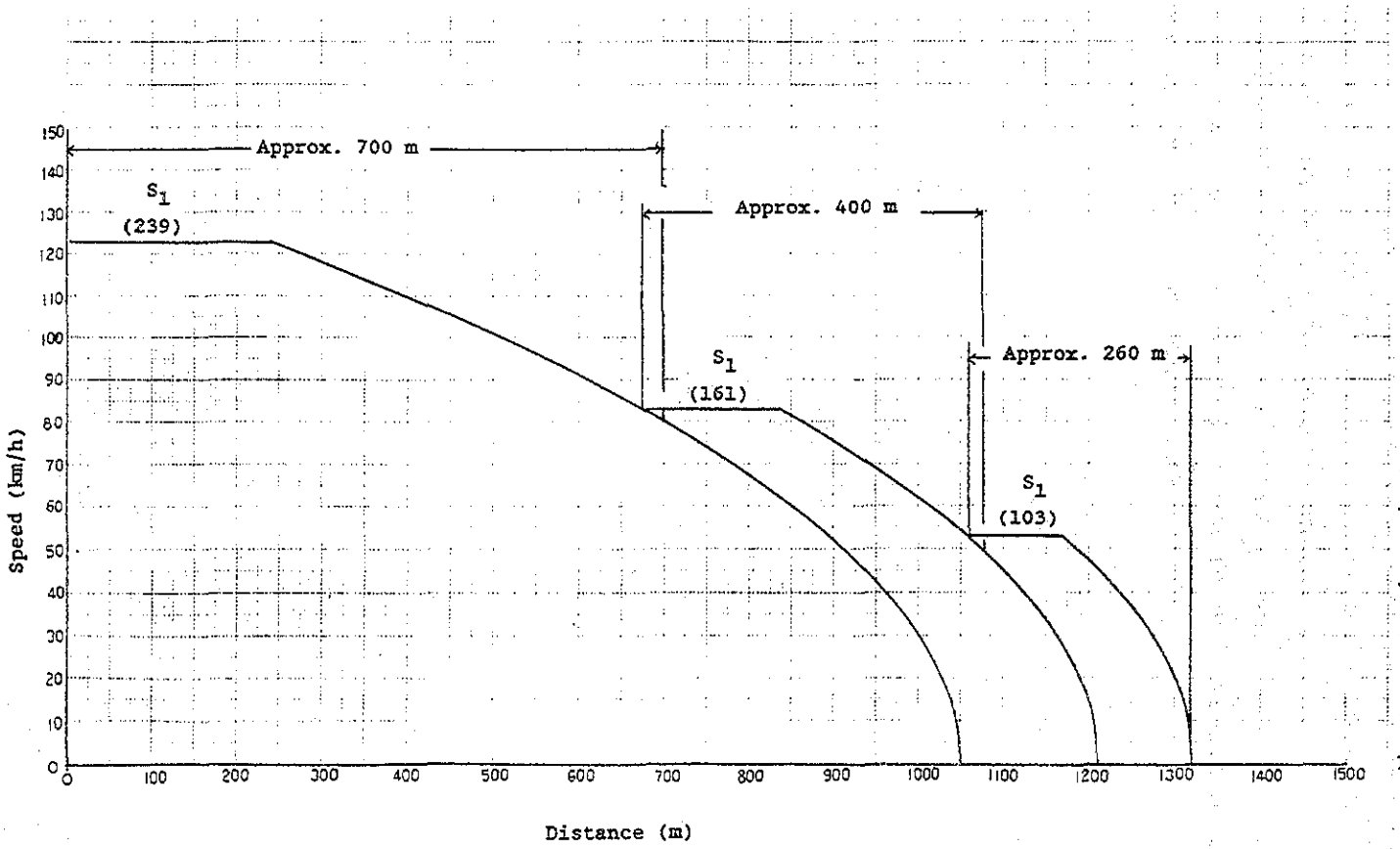
Color signals are designed to be visible from a point 750m apart.

(b) Speed indication by retardation aspect signal

Thus, speed indication should be made in such a way that a train running at the maximum speed of 120 km/h could slow down by ordinary brakes to an indicated speed at a point approximately 50m before the signal instructing the retardation.

Assuming that DMUs proposed under the DTP have the following braking performance and also require the following idle running time in braking, the retardation aspect signal should indicate 80 km/h.

Planned maximum speed : 120 km/h
Signal aspect system : G, YY, Y, R_1, R_0
Idle running time in braking : 7 seconds (4 seconds for functioning of on-board equipment, and 3 seconds for braking by driver)
Brake deceleration speed : Normal brake 2.6 km/h/sec
Emergency brake 2.88 km/h/sec



$$S_1 = \frac{t.v}{3.6}$$

S_1 : Idle running distance (m)
t : Idle running time (sec)(7 sec)
Functioning of on-board equipment 4 sec
Braking by driver 3 sec
v : Initial speed on braking (km/h)

$$S_2 = \frac{V_1^2 - V_2^2}{7.2\ D}$$

S_2 : Actual brake distance (m)

V_1 : Initial speed on braking (km/h)

V_2 : Final speed on braking (km/h)

D : Deceleration on braking (km/h/sec)
(2.6 km/h/sec)

Reliable range of speedometer

Fig. 1 Operation Speeds and Braking Distances of DMU

(c) Speed indication by caution aspect signal

Considering that most of turnouts are of the #15 type which limits the speed of trains entering stations to 48km, speed indication by caution aspect signals should be established at 50km/h. This is also suitable as an intermeidate speed between deceleration and stop signals.

b. Unification of signal aspect system

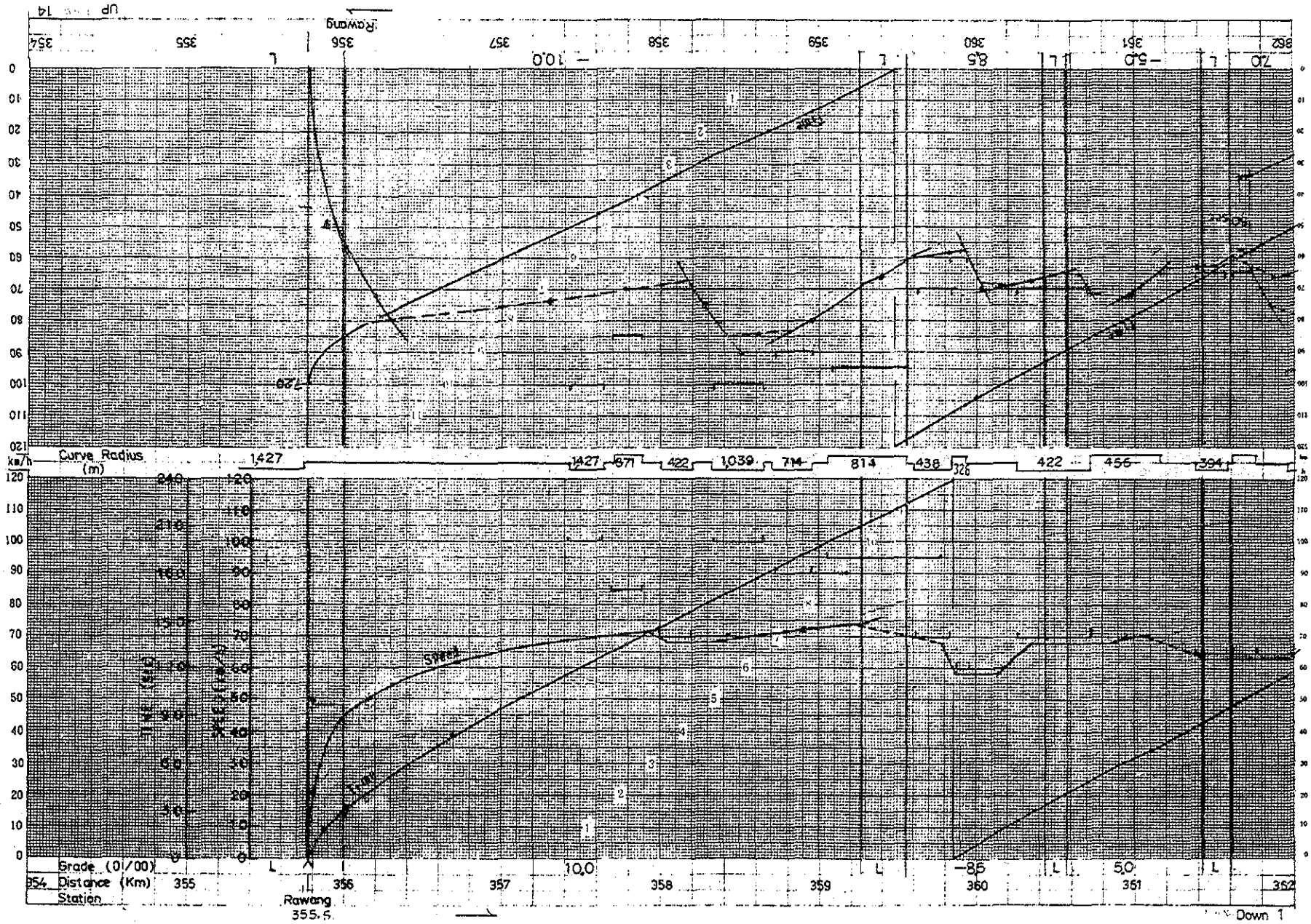
From the standpoint of smooth equipment handling, it is not desirable for train drivers to see deceleration signal (YY) or caution signal (Y) after proceed signal (G); the mixed use of different signal-aspect systems is not preferable.

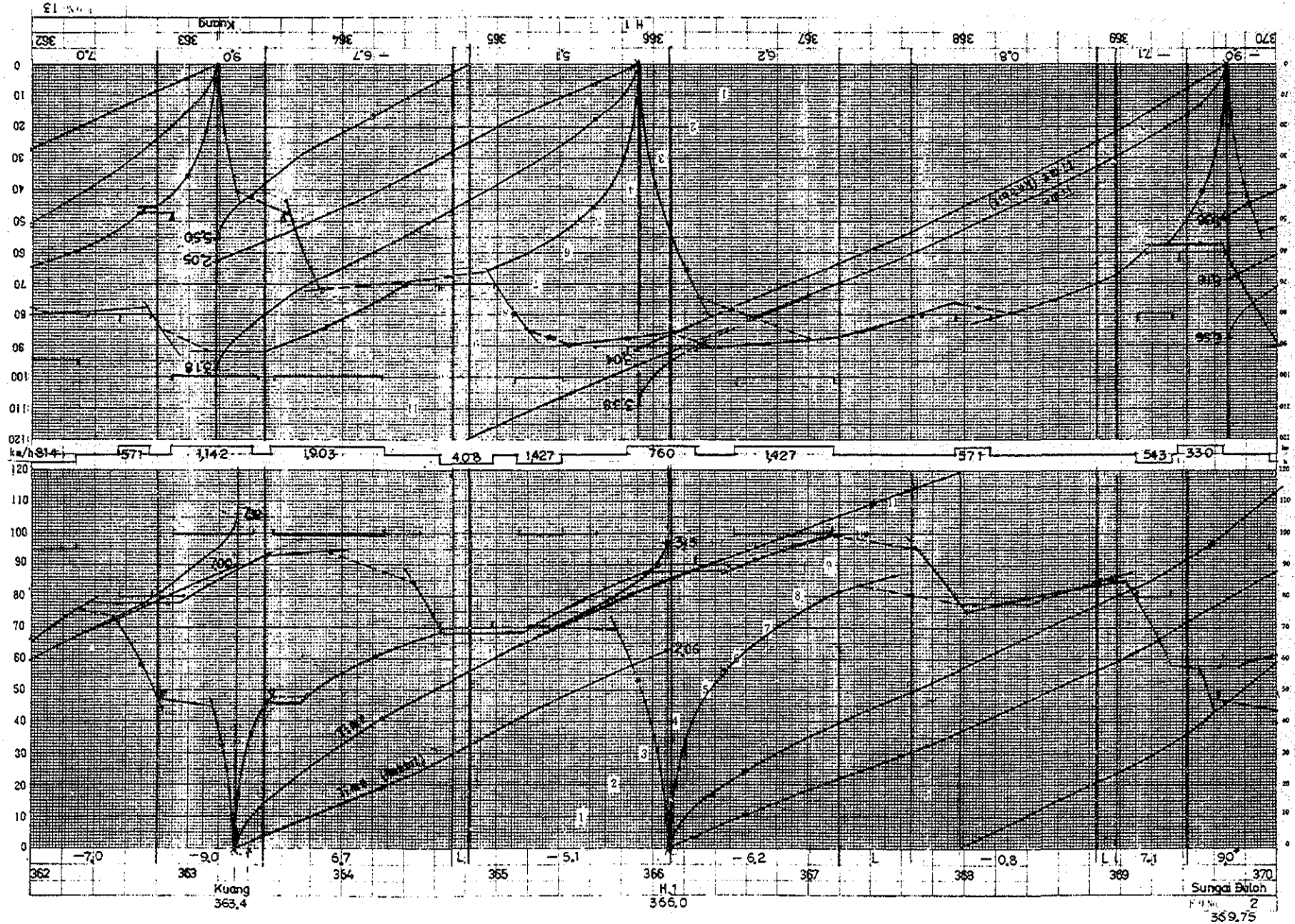
c. Application of speed indicated by signal aspect

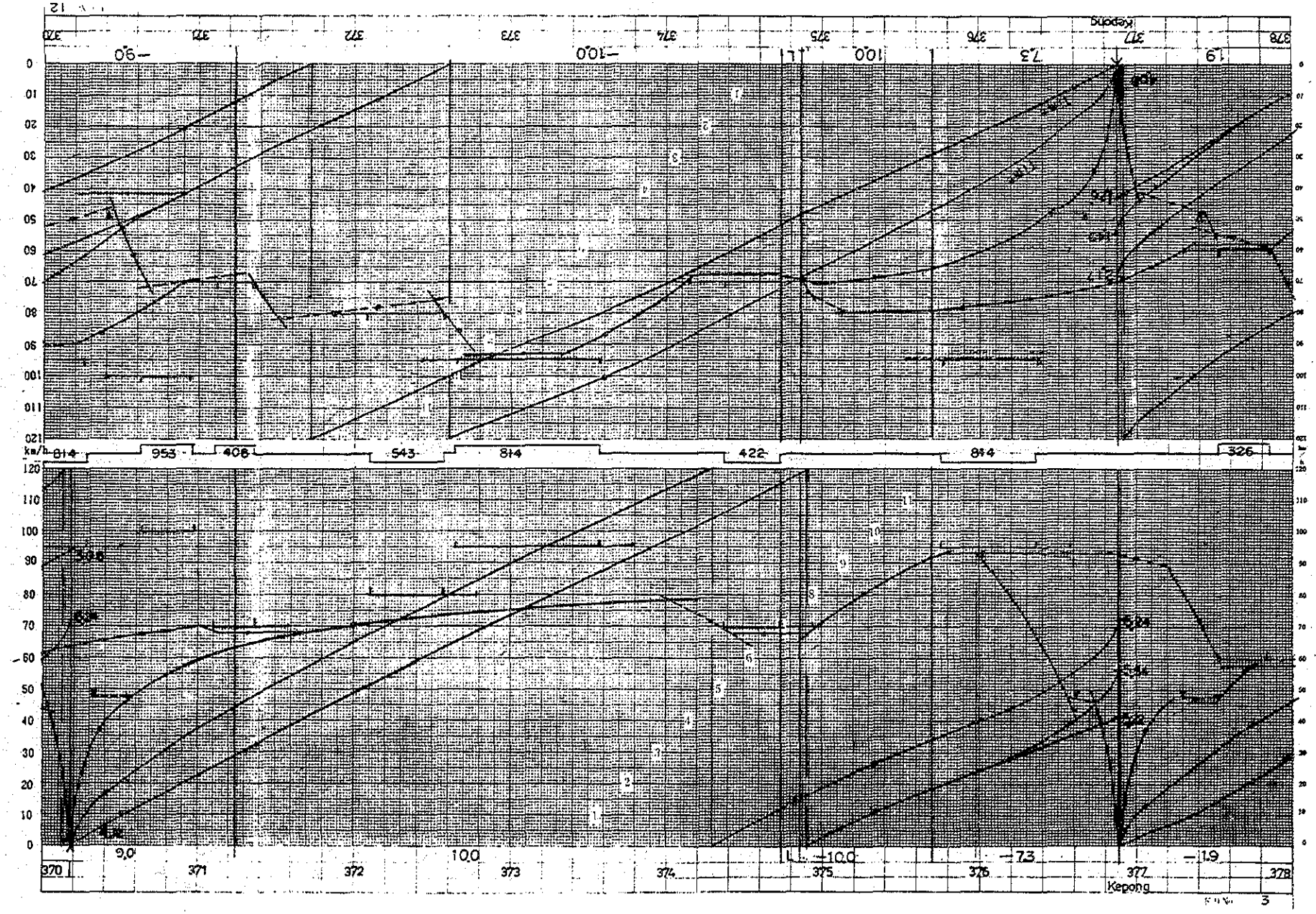
Speed indicatied by signals should be used only for restriction of speeds governed by the relative position of the preceding train, e.g., control of headway between DMU trains and prevention of overrunning. Thus, speed restrictions due to ground conditions (curve, turnout, roadbed, etc.) should be observed by memories of drivers or by wayside signs.

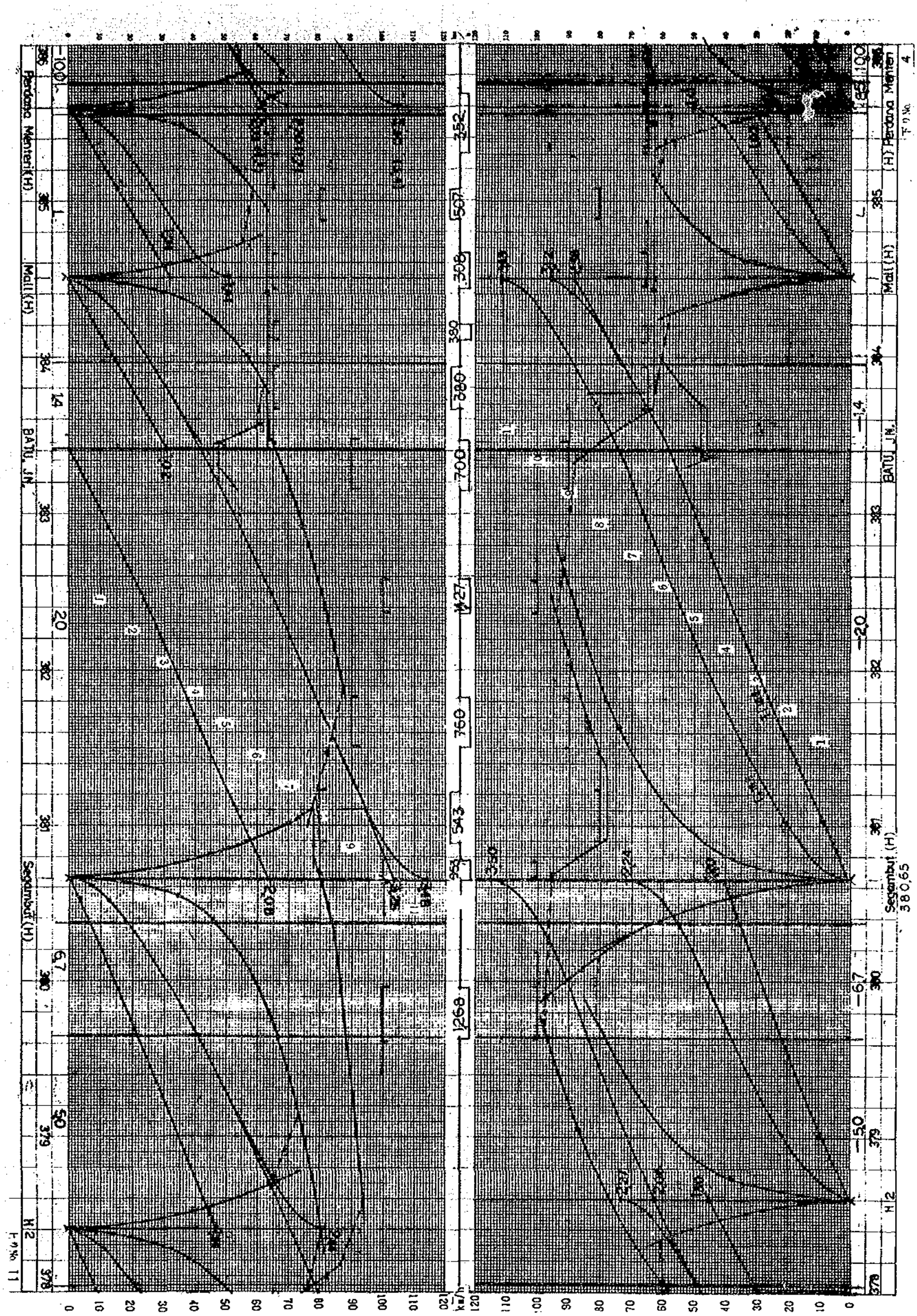
Also, speed indication by signals should be applicable to DMU trains only. For non-DMU trains, retardation aspect is indicated before a caution signal, thereby facilitating signal identification. In this case, it is recommended to provide drivers with training on accurate positions for brake handling.

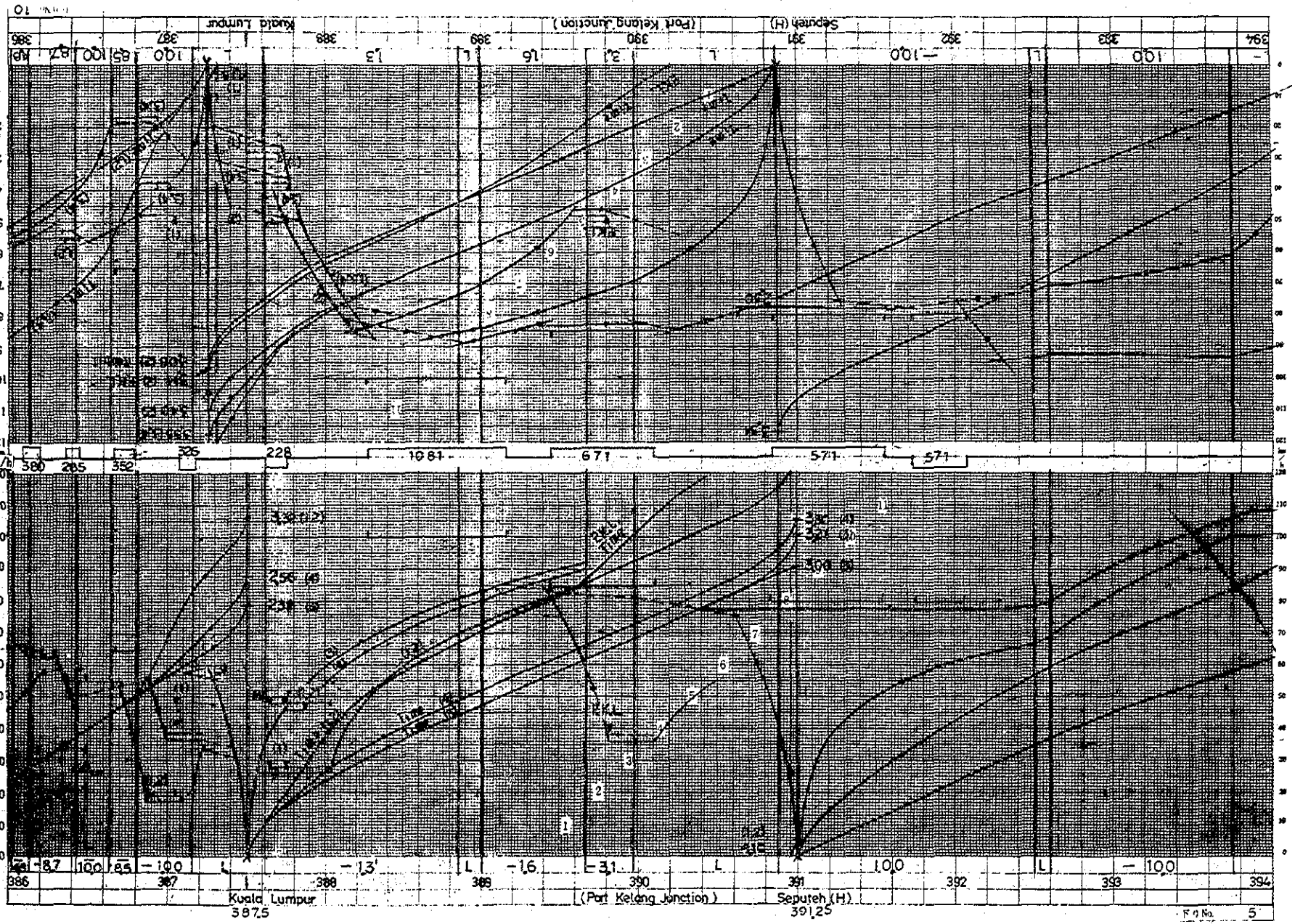
Appendix 5-2-1 DMU Train Operation Curve Between Rawang - Seremban




Kuang
363,4
H.1
366,0
Sungai Buloh
369,75
km/h
571
1,142
1,903
408
1427
760
1427
571
543
330


km/h
814
953
406
543
814
422
814
326
370
371
372
373
374
375
376
377
Kepong
378
9.0
10.0
10.0
7.3
1.9


Perdana Menteri (H)
Mall (H)
BATU JN.
Segambut (H)
380,65
H 2
km/h
252
507
308
380
700
427
360
543
1268


Kuala Lumpur
387.5
(Port Kelang Junction)
Seputeh (H)
391.25
km/h
380
285
352
325
228
1081
671
571
571
386
387
388
389
390
391
392
393
394