Federal Democratic Republic of Nepal
Department of Roads (DOR)
Kathmandu Valley Development Authority (KVDA)

FEDERAL DEMOCRATIC REPUBLIC OF NEPAL
THE PROJECT ON URBAN TRANSPORT IMPROVEMENT FOR KATHMANDU VALLEY

FINAL REPORT

VOLUME III
APPENDICES

MAY 2017

JAPAN INTERNATIONAL COOPERATION AGENCY (JICA)

EIGHT-JAPAN ENGINEERING CONSULTANTS INC.
NIPPON KOEI CO., LTD.
TAMANO CONSULTANTS CO., LTD.

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Volume 3 APPENDICES

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APPENDIX 1 SUPPLEMENTAL TRAFFIC SURVEY

1.1 Summary of Traffic Survey

1.1.1 Type of Traffic Survey

Table 1.1.1 Summary of Traffic Survey

No.	Item	Purpose	Method	Contents of survey
1	Road inventory survey	Update the road inventory 2012.	Travel, and record of distance, road width, number of lanes, road surface condition, major facilities (bridge, bus lay-by, right of way, etc..	Preliminary survey to identify the widened road section for around 400 km Road inventory survey for widened road section around 100km
2	Traffic count survey	To obtain the total number of traffic to confirm the variation from 2012	Count traffic volume at Roadside OD survey points (18) and screen survey points (11).	Survey points: 21 points, 24 hrs, 1 day. 8 points, 16 hrs, 1 day.
3	Bus passengers OD survey	To obtain the information on public transport passengers of their movement and requirement.	Interview (attributes, OD, trip purpose and trip frequency, etc.) to public transport passengers at bus terminals.	Survey place: 3, terminals, 24hrs, 1day (weekday) More than 3,000 passengers
4	Bus Traffic count survey	To capture total number of busses arriving and departing from terminals for bus passenger OD survey.	Count total number of buses.	Survey point: 3, 24hrs, 1day (weekday), departure and arrival.
5	Bus passenger number survey	To capture average number of bus passengers.	Count number of passengers of bus.	Survey point: 3, 24hrs, 1day (weekday), departure and arrival. Sampling Rate 10%
6	Stated preference survey	To obtain the factors for preference of traffic mode selection to enhance use of public transport.	Interview at densely-populated areas in the Katmandu Valley.	Survey place: 5 place More than 1,500 persons
7	Parking survey	To capture parking situation and influence to traffic flow in the city center.	To count the number (place, type, time, fee, etc.) of roadside parking vehicles which cause traffic jam at city center.	Survey place: 5 section 16hrs, 1day (weekday)
8	Traffic accident black spots survey	To obtain the information of traffic accident.	Interview to police and drivers. Reconnaissance and analysis of cause of accidents.	Survey point: 20 points
9	Carrier interview survey	To obtain the operation and administration of distribution of goods.	Interview to carriers at their office.	More than 50 firms
10	Roadside freight OD survey	To obtain the information on goods movement.	Interview to lorry drivers on road side. (OD, type of goods and its amount)	Survey place: 18 points 24hrs, 1day (weekday) Sampling rate: 20%

1.1.2 Zoning

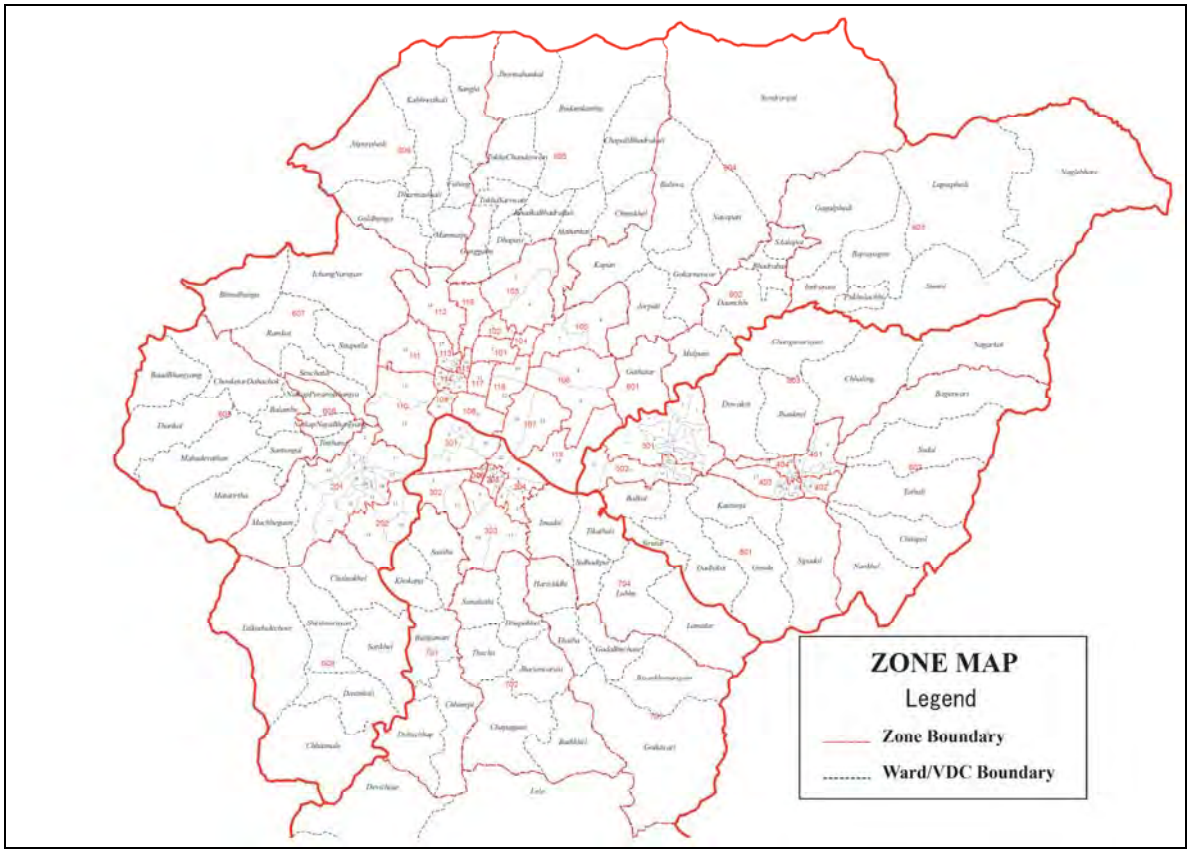


Figure 1.1.1 Zone Map for Traffic Survey

Table 1.1.2 Zone Code Table for Traffic Survey

Large Zone No.	District	Small Zone No.	Ward/VDC
100	KATHMANDU N.P.	101	Ward 1
		102	Ward 2
		103	Ward 3
			Ward 4
		104	Ward 5
		105	Ward 6
			Ward 7
		106	Ward 8
			Ward 9
		107	Ward 10
			Ward 34*
		108	Ward 11
		109	Ward 12
			Ward 21
		110	Ward 13
			Ward 14
		111	Ward 15
		112	Ward 16
		113	Ward 17
			Ward 18
			Ward 26
			Ward 28
		114	Ward 19
			Ward 20
			Ward 22
			Ward 23
			Ward 24
			Ward 25

		115	Ward 27
			Ward 30
		116	Ward 29
		117	Ward 31
		118	Ward 32
		119	Ward 35
200	KIRTIPUR N.P.	201	Ward 1
			Ward 2
			Ward 3
			Ward 4
			Ward 5
			Ward 6
			Ward 7
			Ward 8
			Ward 9
			Ward 10
			Ward 11
			Ward 12
			MACHHEGAUN
		202	Ward 13
			Ward 14
			Ward 15
600	Kathmandu Dist.	601	GOTHATAR
		602	MULPANI
			DAANCHHI
			BHADRABAS
			AALAPOT
		603	INDRAYANI
			PUKHULACHHI
			SUNTOL
			BAJRAYOGINI (SANKHU)
			GAGALPHEDI
			LAPSEPHEDI
			NAGLEBHARE
		604	KAPAN
			JORPATI
			GOKARNESWOR
			BALUWA
			NAYAPATI
			SUNDARIJAL
		605	GONGGABU
			DHAPASI
			KHADKA BHADRAKALI
			MAHANKAL
			TOKHA SARSWOTI
			TOKHA CHANDESWORI
			CHUNIKHEL
			CHAPALI BHADRAKALI
			BUDANILKANTHA
			JHOR MAHANKAL
		606	MANMAIJU
			GOLDHUNGA
			DHARMASTHALI
			FUTUNG
			JITPURPHEDI
			KABHRESTHALI
			SANGLA
		607	ICHANG NARAYAN
			SITAPAILA
			BHIMDHUNGA
			RAMKOT
			SEUCHATAR
		608	NAIKAP NAYA BHANJYANG
			NAIKAP PURANO BHANJYANG
			TINTHANA
		609	BALAMBU

			SATUNGAL
			CHOUKETAR DAHACHOK
			MATATIRTHA
			MAHADEVATHAN
			THANKOT
			BAAD BHANJYANG
		610	CHALNAKHEL
			SATIKHEL
			CHHAIMALE
			DAXINKALI
			SHESHNARAYAN
			TALKUDUDECHOUR
300	LALITPUR N.P.	301	Ward 1
			Ward 2
			Ward 3
			Ward 10
		302	Ward 4
			Ward 13
		303	Ward 5
			Ward 14
			Ward 15
		304	Ward 6
			Ward 7
			Ward 8
			Ward 9
			Ward 17
			Ward 22
		305	Ward 11
			Ward 12
			Ward 16
			Ward 18
			Ward 19
		306	Ward 20
			Ward 21
700	Lalitpur Dist.	701	SAINBU
			KHOKANA
			BUNGAMATI
			CHHAMPI
			DUKUCHHAP
		702	SUNAKOTHI
			DHAPAKHEL
			THECHO
			JHARUWARASI
			CHAPAGAUN
			BADIKHEL
		703	HARISIDDHI
			THAIBA
			GODAMCHAUR
			BISANKHUNARAYAN
			GODAWARI
		704	IMADOL
			TIKATHALI
			SIDDHIPUR
			LUBHU
			LAMATAR
901	Lalitpur South (Outtside KV)	901	LELE
			ASHRANG
			BHARDEV
			BHATTEDANDA
			BUKHEL
			CHANDANPUR
			CHOUGHARE
			DALCHOKI
			DEVICHOUR
			DHUSEL
			GIMDI

			GOTIKHEL
			IKUDOL
			KALESWOR
			MALTA
			MANIKHEL
			NALLU
			PYUTAR
			SANKHU
			THULADURLUNG
			INSTITUTIONAL
400	BHAKTAPUR N.P.	401	Ward 1
			Ward 3
			Ward 4
			Ward 5
		402	Ward 2
			Ward 6
			Ward 7
		403	Ward 11
			Ward 12
			Ward 14
			Ward 16
			Ward 17
		404	Ward 8
			Ward 9
			Ward 10
			Ward 13
			Ward 15
500	MADHYAPUR THIMI N.P.	501	Ward 1
			Ward 2
			Ward 3
			Ward 4
			Ward 5
			Ward 6
			Ward 7
			Ward 8
			Ward 10
			Ward 17
		502	Ward 9
			Ward 11
			Ward 12
			Ward 13
			Ward 14
			Ward 15
			Ward 16
800	Bhaktapur Dist.	801	BALKOT
			SIRUTAR
			DADHIKOT
			KAUTUNJE
			GUNDU
			SIPADOL
		802	NANKHEL
			CHITAPOL
			TATHALI
			SUDAL
			BAGESWORI
		803	CHANGUNARAYAN
			CHHALING
			DUWAKOT
			JHAUKHEL
			NAGARKOT
911	Eastern Outside	911	Taplejung
			Sankhuwasabha
			Solukhumbu
			Eastern Hill

			Panchthar
			Ilam
			Dhankuta
			Terhathum
			Bhojpur
			Okhaldhunga
			Khotang
			Udayapur
			Jhapa
			Morang
			Sunsari
			Saptari
			Siraha
			Sindhuli
			Kavrepalanchok
			Ramechhap
912	North eastern Outside	912	Dolakha
			Sindhupalchok
913	North western Outside	913	Rasuwa
			Nuwakot
914	Western Outside	914	Dhading
			Makwanpur
			Dhanusa
			Mahottari
			Sarlahi
			Rautahat
			Bara
			Parsa
			Chitawan
			Manang
			Mustang
			Gorkha
			Lamjung
			Tanahu
			Syangja
			Kaski
			Myagdi
			Parbat
			Baglung
			Gulmi
			Palpa
			Arghakhanchi
			Nawalparasi
			Rupandehi
			Kapilbastu
			Dolpa
			Jumla
			Kalikot
			Mugu
			Humla
			Pyuthan
			Rolpa
			Rukum
			Salyan
			Surkhet
			Dailekh
			Jajarkot
			Dang
			Banke
			Bardiya
			Bajura
			Bajhang
			Darchula
			Achham
			Doti

			Dadeldhura
			Baitadi
			Kailali
			Kanchanpur
920	India	920	India
990	Unknown		

1.2 Road Inventory Survey

1.2.1 Methodology

The following items shall be collected by conduction field survey. The survey was conducted from 12th October to 28th October, 2014.

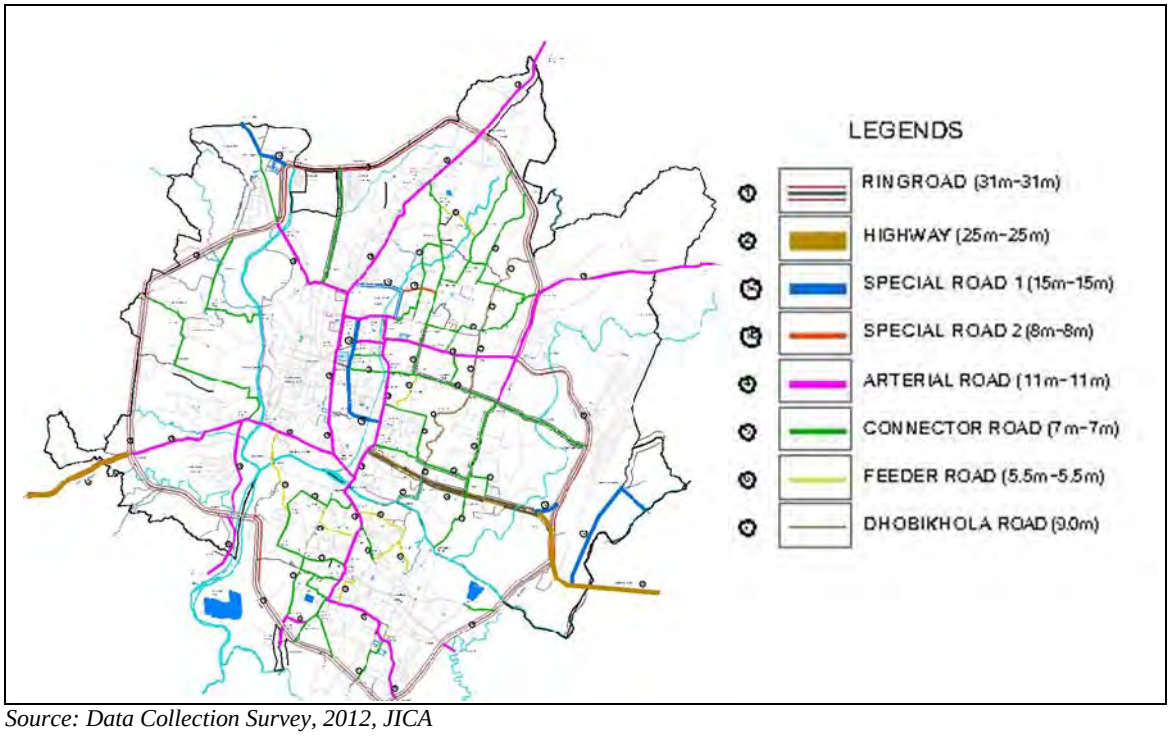
(i) Road information

- Road name, Landmarks on Start and End points, Length of detailed section.

(ii) Section information

- Width of Right of way, Carriageway, Shoulder, Median, Walkway, Margin Area, etc.
- Materials and conditions on road surface.

The roads to be targeted are shown in the figure below.



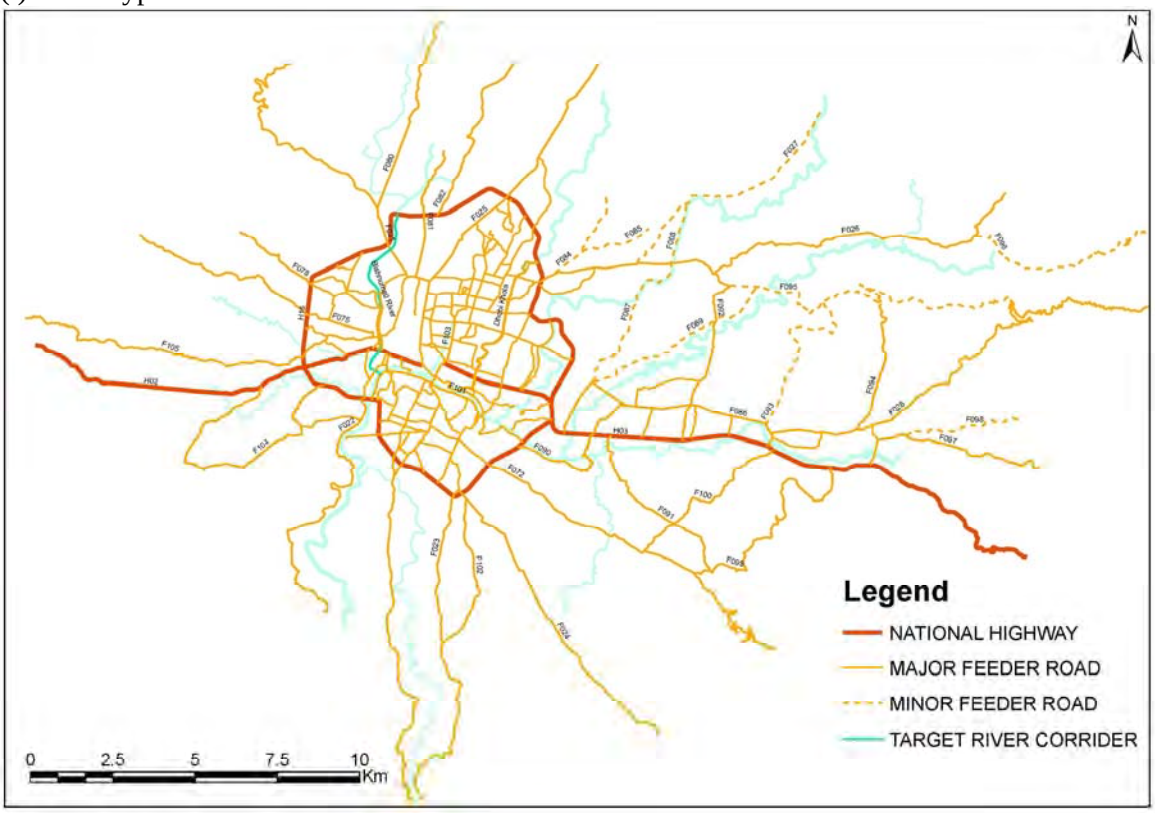
Source: Data Collection Survey, 2012, JICA

Figure 1.2.1 Targeted roads of the Inventory Survey

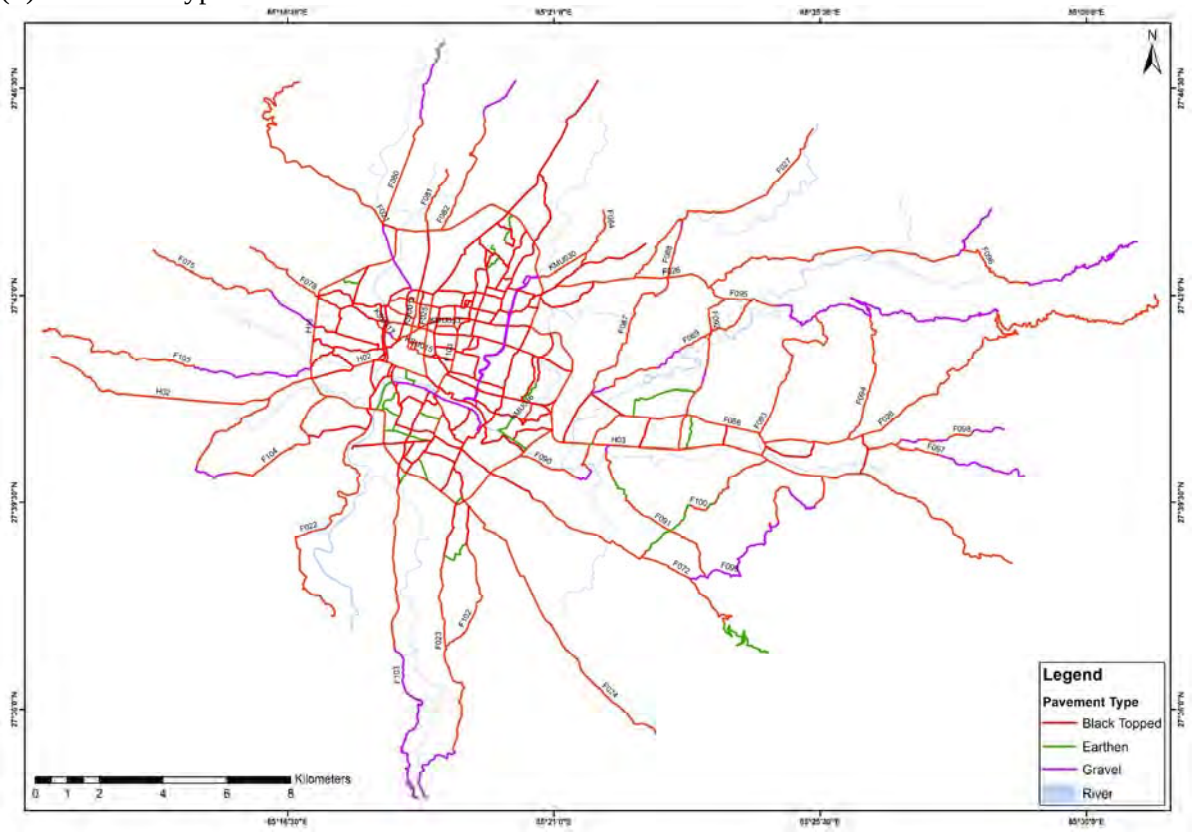
1.2.2 Results

The results of the Inventory Survey are descried on a Map given in the next pages.

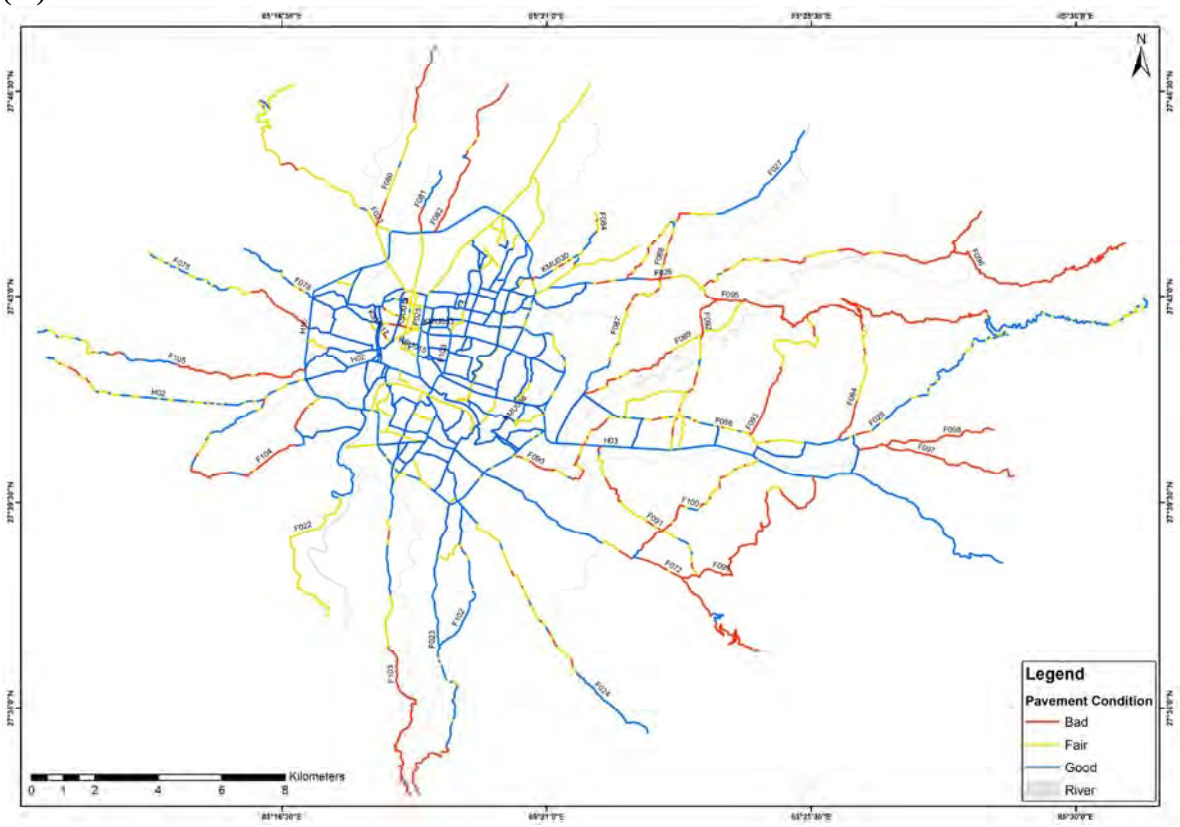
(i) Road Type



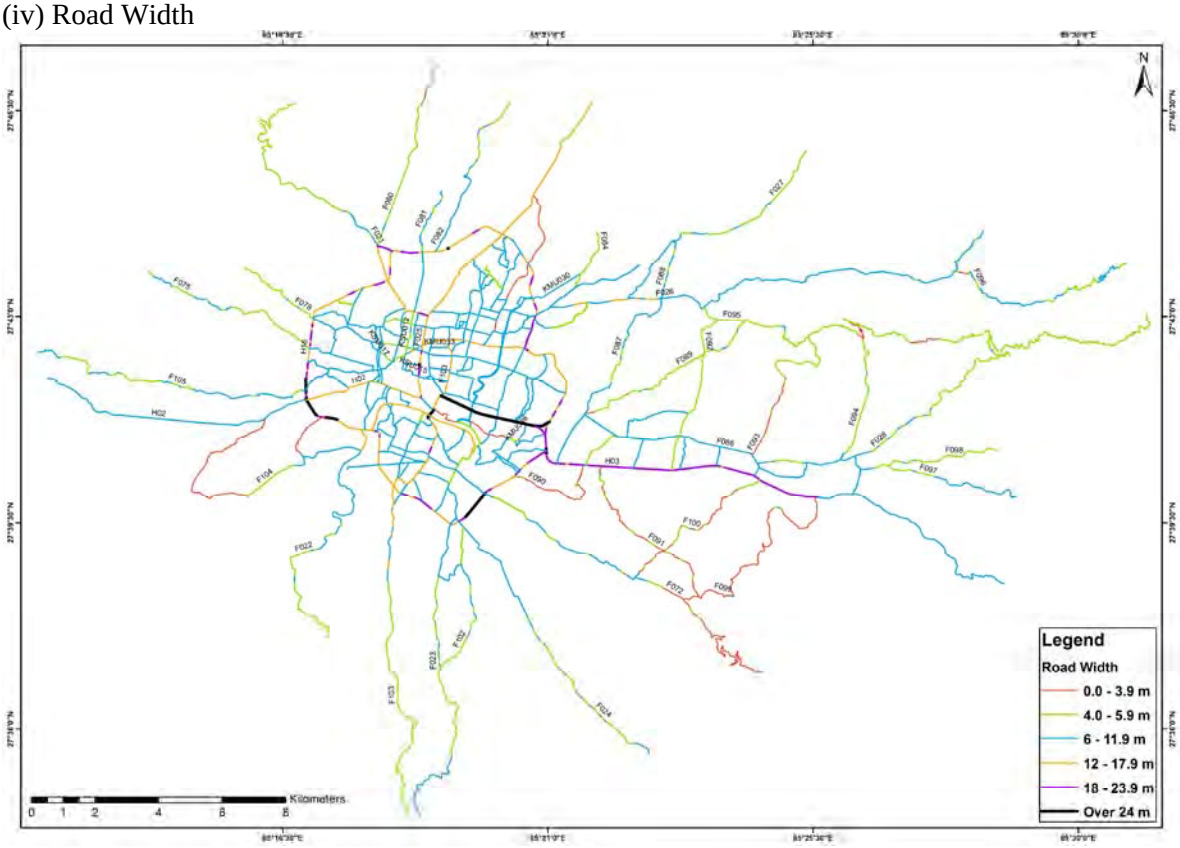
(ii) Pavement Type



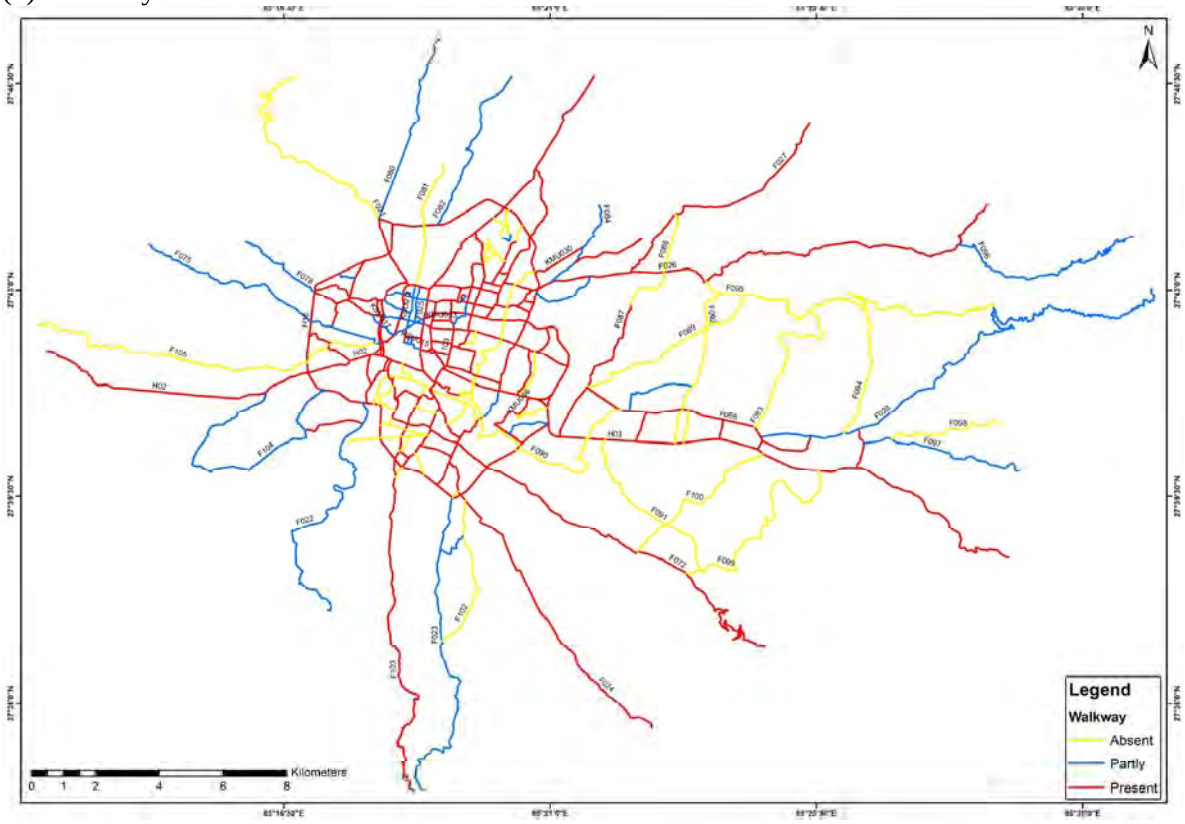
(iii) Pavement Condition



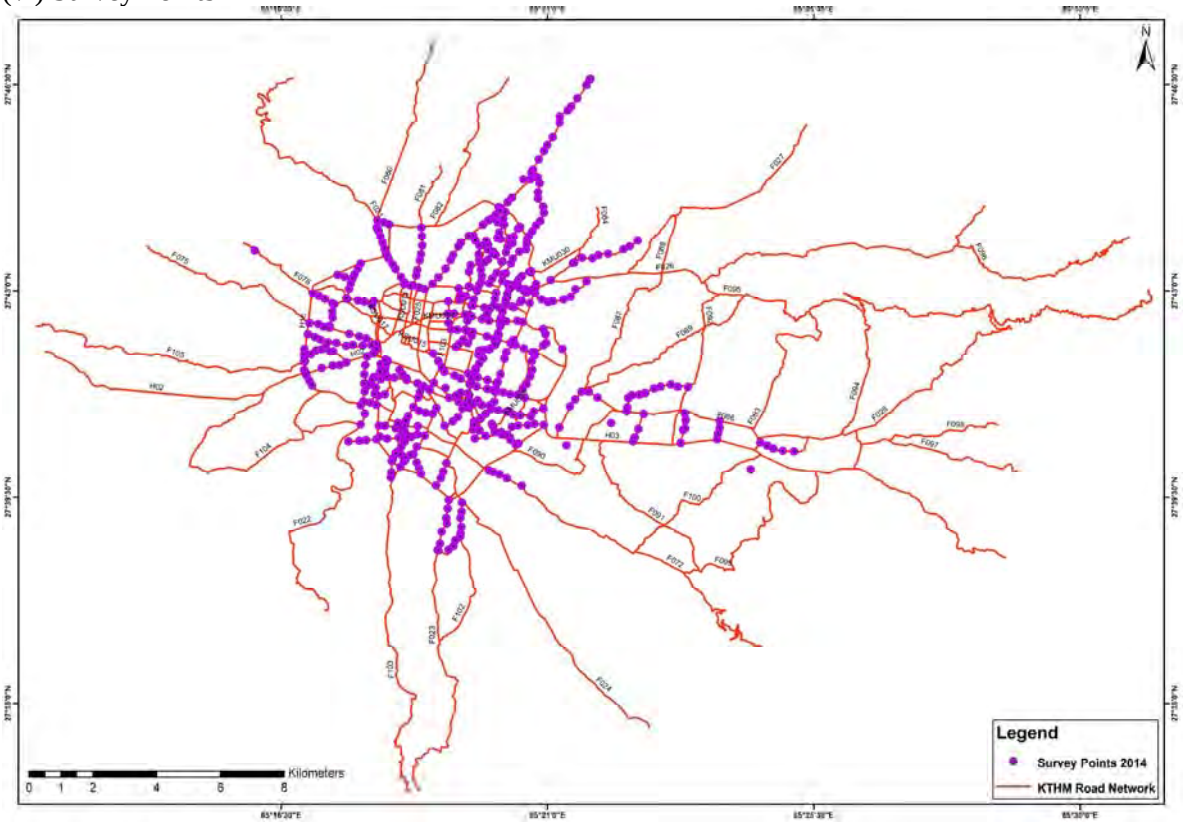
(iv) Road Width



(v) Walkway



(vi) Survey Points



1.3 Traffic Count Survey

1.3.1 Location

SN	Road Name	Location	Survey Date	Survey Hour
TC03	Arniko Highway	Koteshwar, before Jadhibuti junction	Day 1st (3rd Sep.)	TC-24
TC15	Tribhuvan Highway	Kalankisthan (to towards Thankot Road)	Day 1st (3rd Sep.)	TC-24
TC08	Tribhuvan Highway	Thankot Check Post	Day 2nd (4th Sep.)	TC-24
TC11	Arniko Highway	at Sallagari, Bhaktapur	Day 2nd (4th Sep.)	TC-24
TC04	Lubhu Road	Gorkwo, to Lubhu Road, at Bridge	Day 3rd (5th Sep.)	TC-24
TC05	Godawari Road	Satdobato to Godawari Road	Day 3rd (5th Sep.)	TC-24
TC06	Chapagaun Road	to Chapagaun Road	Day 3rd (5th Sep.)	TC-24
TC10-1	Trisuli Road	near Trisuli Bus Park after Bypass	Day 3rd (5th Sep.)	TC-24
TC10-2	Phutung Road	near Trisuli Road	Day 3rd (5th Sep.)	TC-24
TC07	Dakshinkali Road	Balkhu (TU Road)	Day 4Th (7th Sep.)	TC-24
TC12	Bhaktapur Road	Thimi east, before reaching Bhakapur	Day 4Th (7th Sep.)	TC-24
TC13	Nagarkot Road	Kharipati, Nagarkot	Day 4Th (7th Sep.)	TC-24
TC14	Arniko Highway	Jagati, Bhaktapur east	Day 4Th (7th Sep.)	TC-24
TC17	Arniko Highway	near small Bridge after crossing Banepa	Day 4Th (7th Sep.)	TC-24
TC01	Budhanilkantha Road	Basbari	Day 5Th (9th Sep.)	TC-24
TC02	Sankhu Road	Bagmati River Bridge, Jorpati	Day 5Th (9th Sep.)	TC-24
TC09	Sundarijal Road	Arubari, Jorpati, to Sundarijal Road	Day 5Th (9th Sep.)	TC-24
TC16	Airport Entrance	near present security Check Point	Day 5Th (9th Sep.)	TC-24
TC20	Pashupati Road	Dhobi Khola Bridge, Rato Pul	Day 5Th (9th Sep.)	TC-24
TC25	Ring Road	Manahara River Bridge, Balkumari	Day 6Th (10th Sep.)	TC-16
TC26	Lazimpat Road	Lazimpat	Day 6Th (10th Sep.)	TC-16
TC27	Ring Road	Dhobi Khola River Bridge (near Gopi Krishna Hall)	Day 6Th (10th Sep.)	TC-16
TC28	Samakhusi Road	Golphupakha	Day 6Th (10th Sep.)	TC-16
TC21	Amar Chitrakar Road	Bisunumati River Bridge (Dallu)	Day 7 Th(11th Sep.)	TC-16
TC22	Kalamati Road	Bisunumati River Bridge (Teku - Kalimati Road)	Day 7 Th(11th Sep.)	TC-16
TC23	Kalopul Road	Bagmati River Bridge	Day 7 Th(11th Sep.)	TC-16
TC24	Madan Bhandari Road	Dhobi Khola River Bridge	Day 7 Th(11th Sep.)	TC-16
TC18	Naya Bazar Road	Bisunumati River Bridge (near Balaju Juction)	Day 8th (12th Sep.)	TC-24
TC19	Kupondole Road	Bagmati River Bridge (Kupundole)	Day 8th (12th Sep.)	TC-24

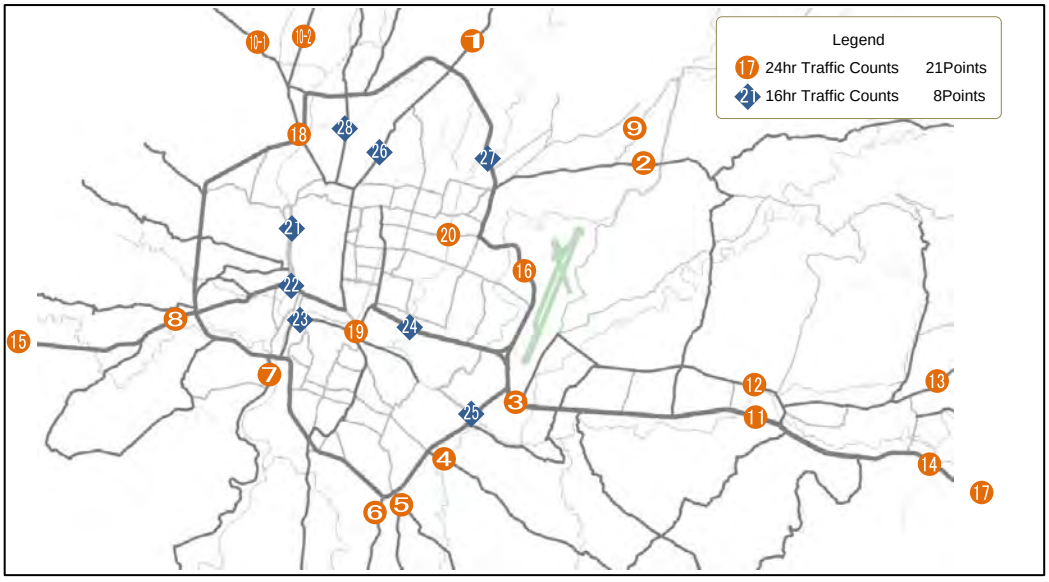


Figure 1.3.1 Location Map of Traffic Count Survey

1.3.2 Results

Comparison of total Vehicle Numbers

Table 1.3.1 Summary of total vehicle number for TC01 to TC20 (24hr Survey)

Location	Small Size						Large Size			Other		Total
	1	2	3	4	5	6	7	8	9	10	11	
	Passenger / 4-Wheel Drive vehicle / Taxi	Taxi	Light Truck	Tempo	Micro Bus	Mini Bus	Large Size Bus	Medium Goods Vehicle (MGV)	Heavy Goods Vehicle (HGV)	Bicycle	Motorcycle	
TC01 Basbari Road	2,245	2,860	727	1,043	1,533	339	91	190	108	928	12,037	22,101
TC02 Sankhu Road	340	340	340	340	340	340	340	340	340	340	340	3,740
TC03 Jatibuti Road	9,235	4,082	2,882	130	1,864	5,333	788	1,401	996	2,532	50,523	79,766
TC04 Lubuhu Road	929	1,018	1,054	799	659	542	341	381	92	1,045	8,205	15,065
TC05 Godabari Road	2,253	3,824	1,215	7	1,473	1,000	316	590	193	1,621	17,991	30,483
TC06 Chapagaun Road	1,281	2,009	514	511	735	432	126	365	210	1,339	10,498	18,020
TC07 Dakshinkali Road	1,490	1,866	716	0	1,082	730	235	507	98	615	11,959	19,298
TC08 Talankisthan Road	2,886	3,093	1,294	515	2,645	1,240	1,268	758	1,856	715	17,049	33,319
TC09 Sundari Jal	737	531	271	0	929	669	2	98	17	853	6,797	10,904
TC10-1Trsuli Road	321	541	177	0	145	223	4	317	45	458	3,457	5,688
TC10-2 Phutung Road	771	309	260	3	296	479	96	249	190	740	5,595	8,988
TC11 Sallagari Road	3,426	1,090	1,481	1	247	3,154	480	1,398	1,661	454	25,170	38,562
TC12 Bhaktapur Road	567	189	345	1	74	508	250	301	69	708	5,100	8,112
TC13 Nagarkot Road	238	594	282	56	74	225	129	285	68	737	5,112	7,800
TC14 Armiko Highway Jagati	2,136	287	956	14	114	675	502	1,162	1,969	208	9,677	17,700
TC15 Thankkot Check Post	1,140	399	212	0	906	503	1,088	202	2,054	3	2,989	9,496
TC16 Panauti Road	260	267	458	0	11	323	68	392	284	256	3,282	5,601
TC17 Amiko Highway	889	1,227	1,143	0	269	1,350	263	1,464	785	574	7,892	15,856
TC18 Nayabazar Road	4,732	5,129	1,779	0	1,914	568	95	521	193	3,092	27,688	45,711
TC19 Kopundole Road	22,226	8,643	1,212	1,890	3,340	1,229	427	284	56	3,591	72,378	115,276
TC20 Pasupati Road	1,939	5,119	1,820	258	1,480	772	441	98	83	1,029	18,172	31,211

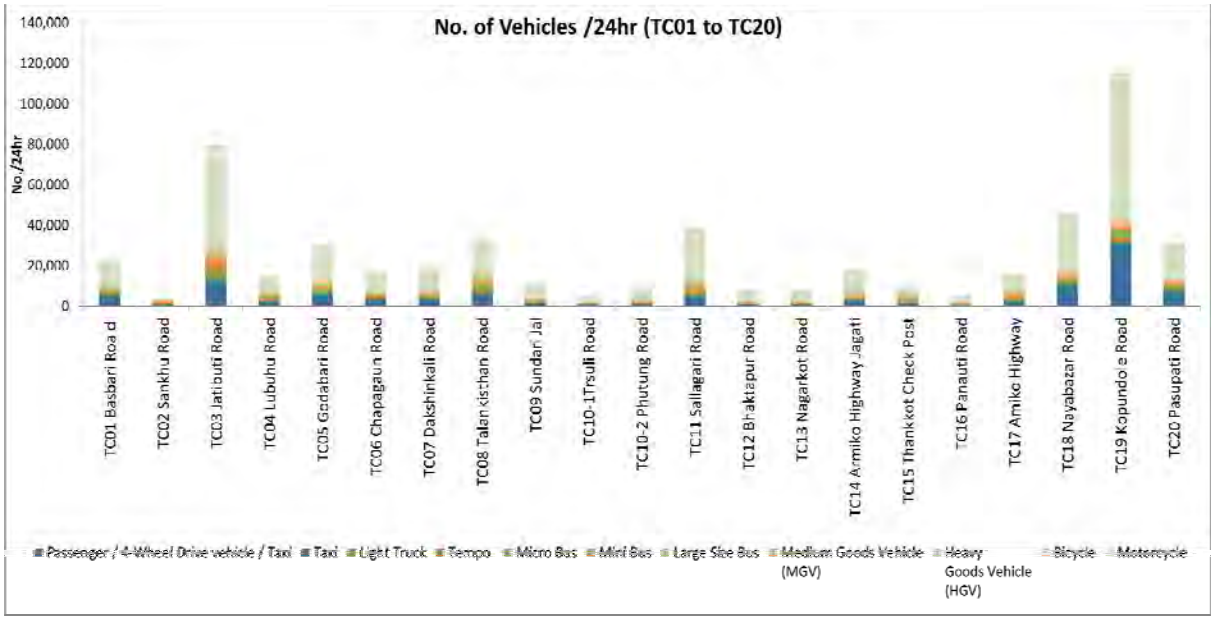


Figure 1.3.2 Total No. of Vehicles and Components at 24hr Survey Points

Table 1.3.2 Summary of Total Vehicle Number for TC21 to TC28 (16hr Survey)

Location	Small Size						Large Size			Other		Total
	1	2	3	4	5	6	7	8	9	10	11	
	Passenger / 4-Wheel Drive vehicle / Taxi	Taxi	Light Truck	Tempo	Micro Bus	Mini Bus	Large Size Bus	Medium Goods Vehicle (MGV)	Heavy Goods Vehicle (HGV)	Bicycle	Motorcycle	
TC21 Amat Chitrakar Road	1,610	3,284	1,209	2	482	310	27	238	86	1,846	21,869	30,963
TC22 Kalimati Road	10,665	3,979	2,278	1,283	3,985	2,420	418	201	252	3,893	49,495	78,869
TC23 Kalopur Road	1,873	870	620	252	100	65	34	32	343	1,071	14,904	20,164
TC24 Madan Bhandari Road	11,946	10,537	1,695	2,933	3,833	3,922	459	330	124	2,854	60,797	99,430
TC25 Balkmari Road	3,259	1,339	1,295	1,352	1,365	2,374	899	1,075	1,142	998	15,850	30,948
TC26 Lazimpat Road	3,429	6,994	500	1,045	1,776	539	111	93	32	1,722	32,266	48,507
TC27 Ring Road Dhobi Khol	4,872	6,416	950	6	4,091	3,171	148	523	340	1,454	23,661	45,632
TC28 Samakhusi Road	1,498	2,482	279	0	2,326	90	2	31	1	1,331	11,259	19,299

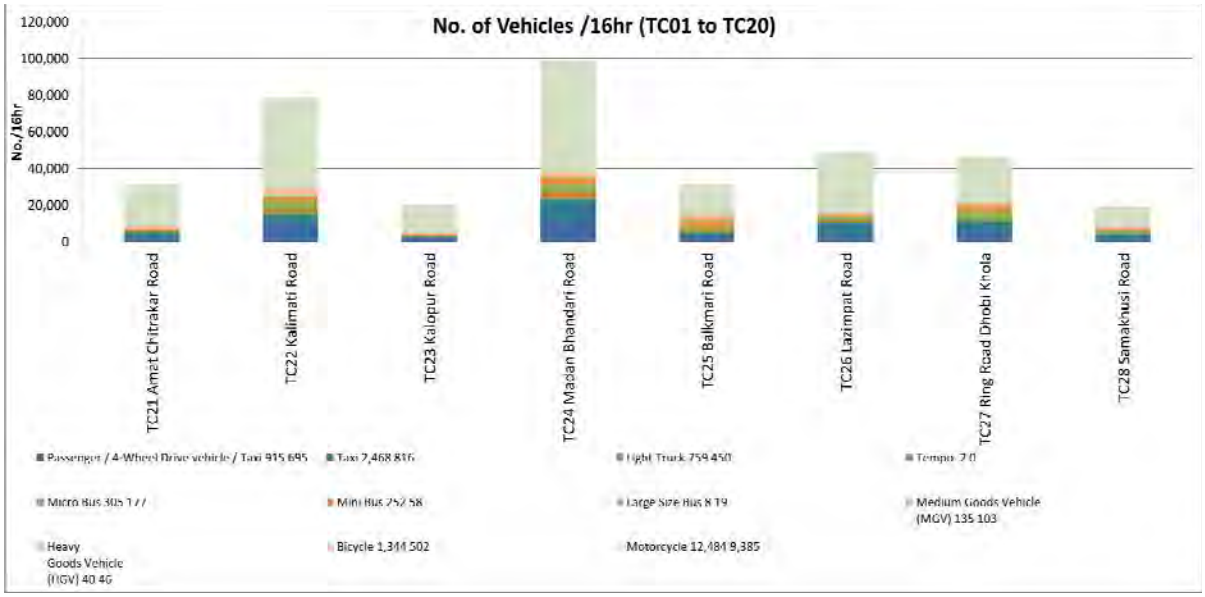
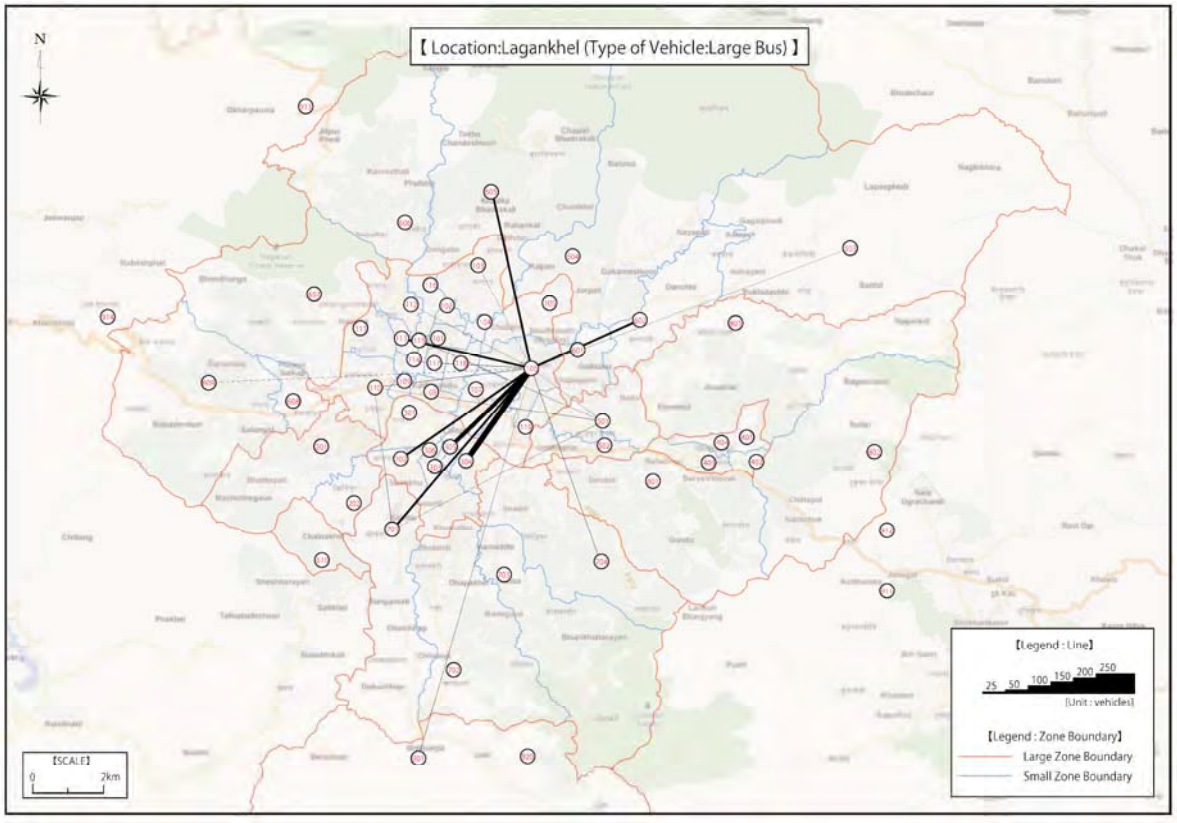
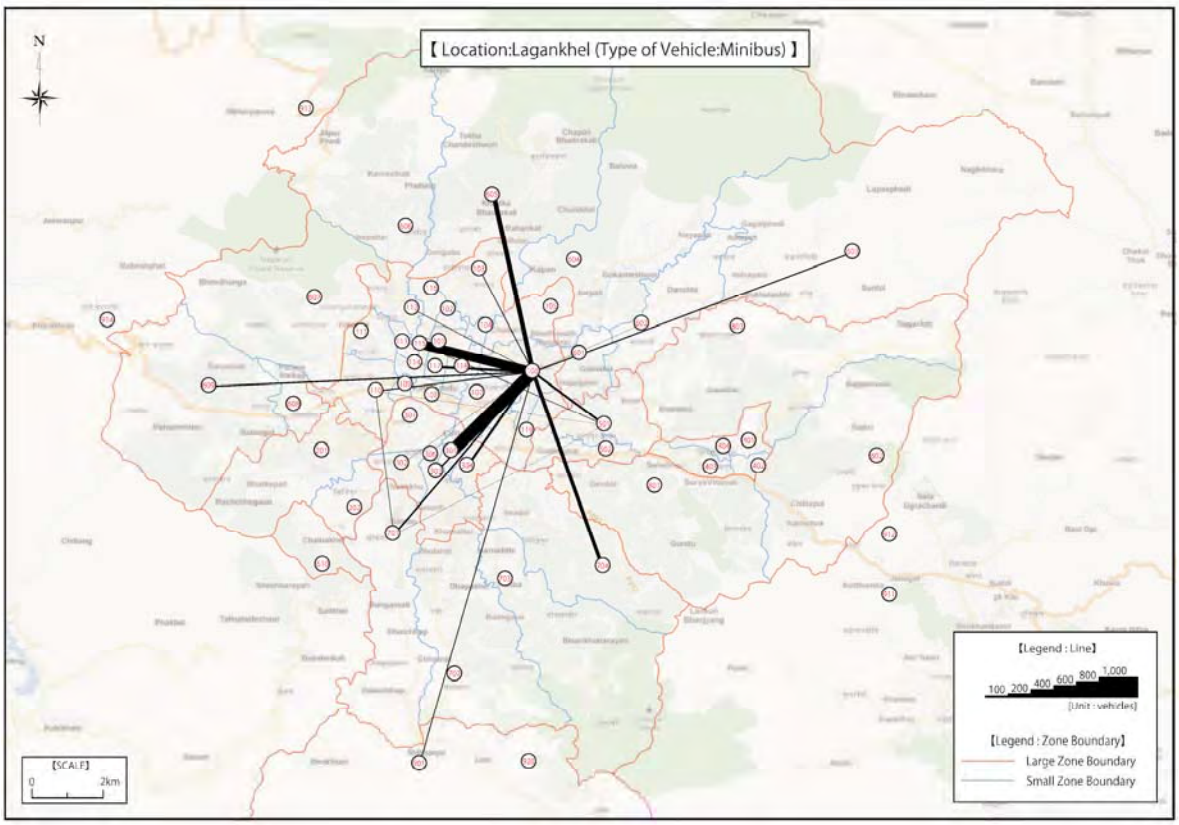


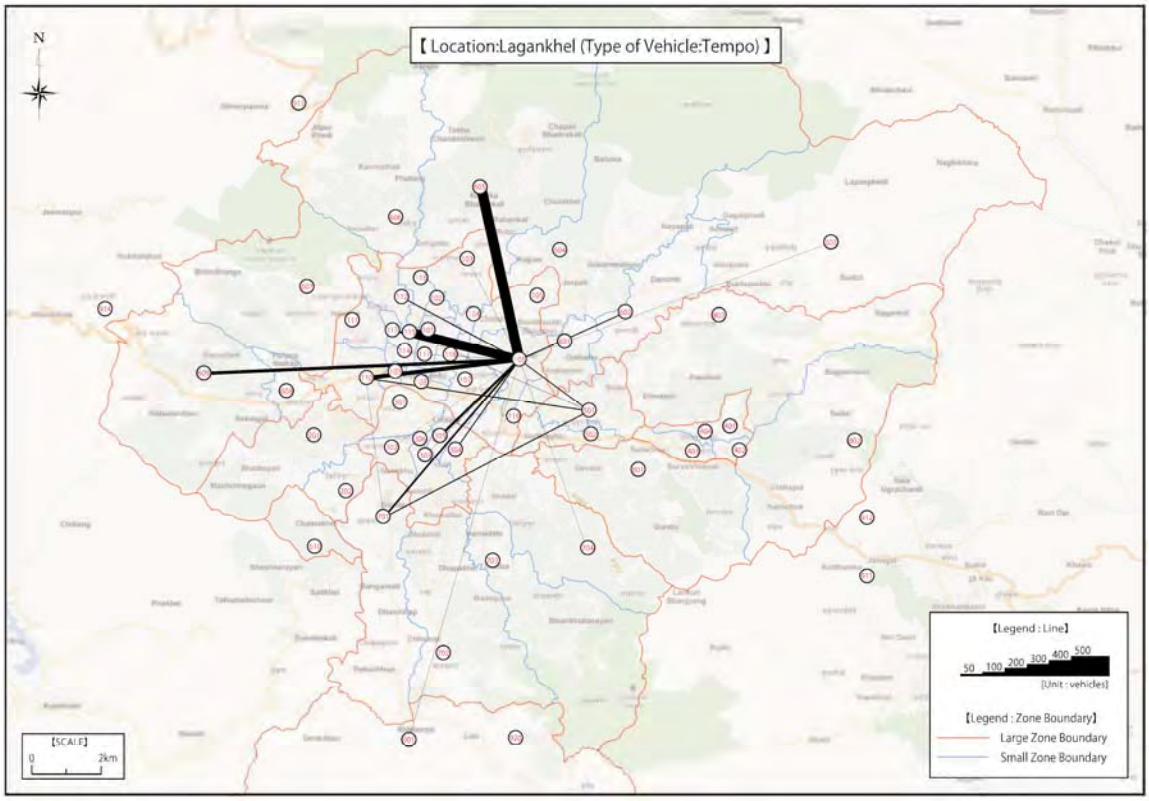
Figure 1.3.3 Total Number of Vehicles and Components at 16hr Survey Points

1.4 Bus OD Survey

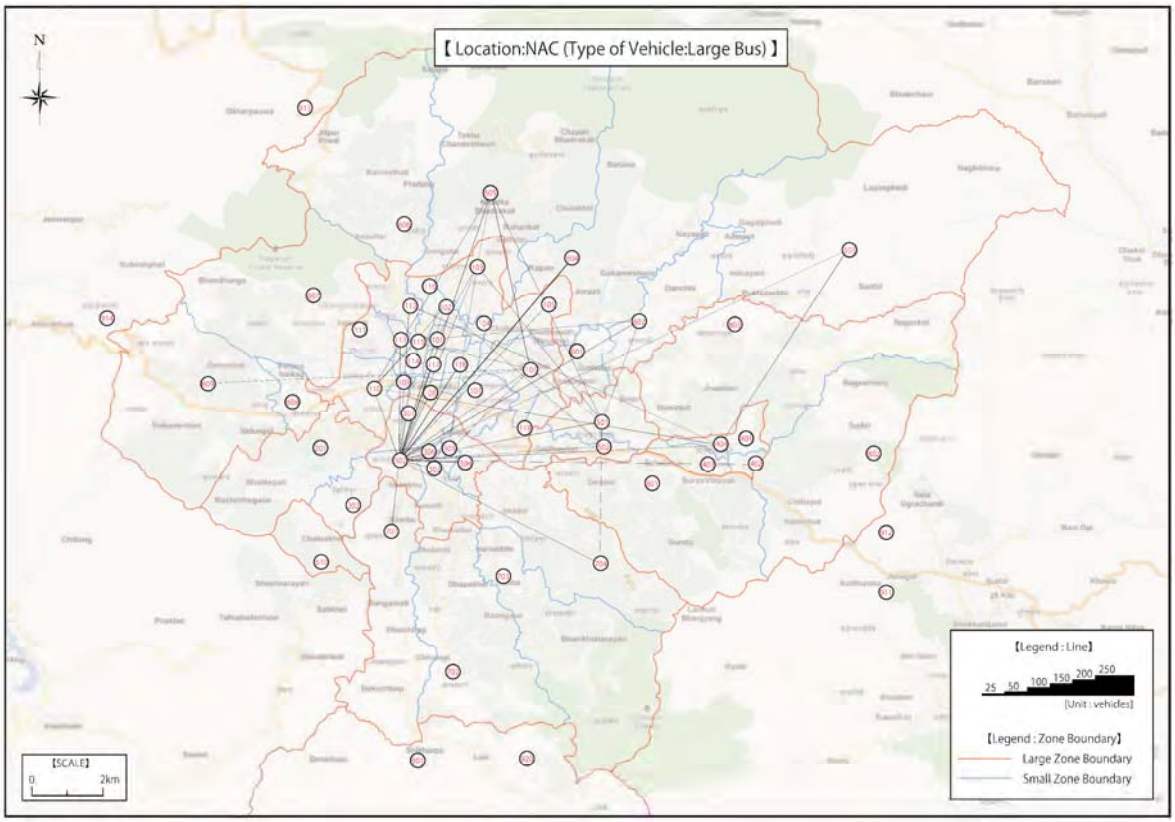
1.4.1 Lagankhel

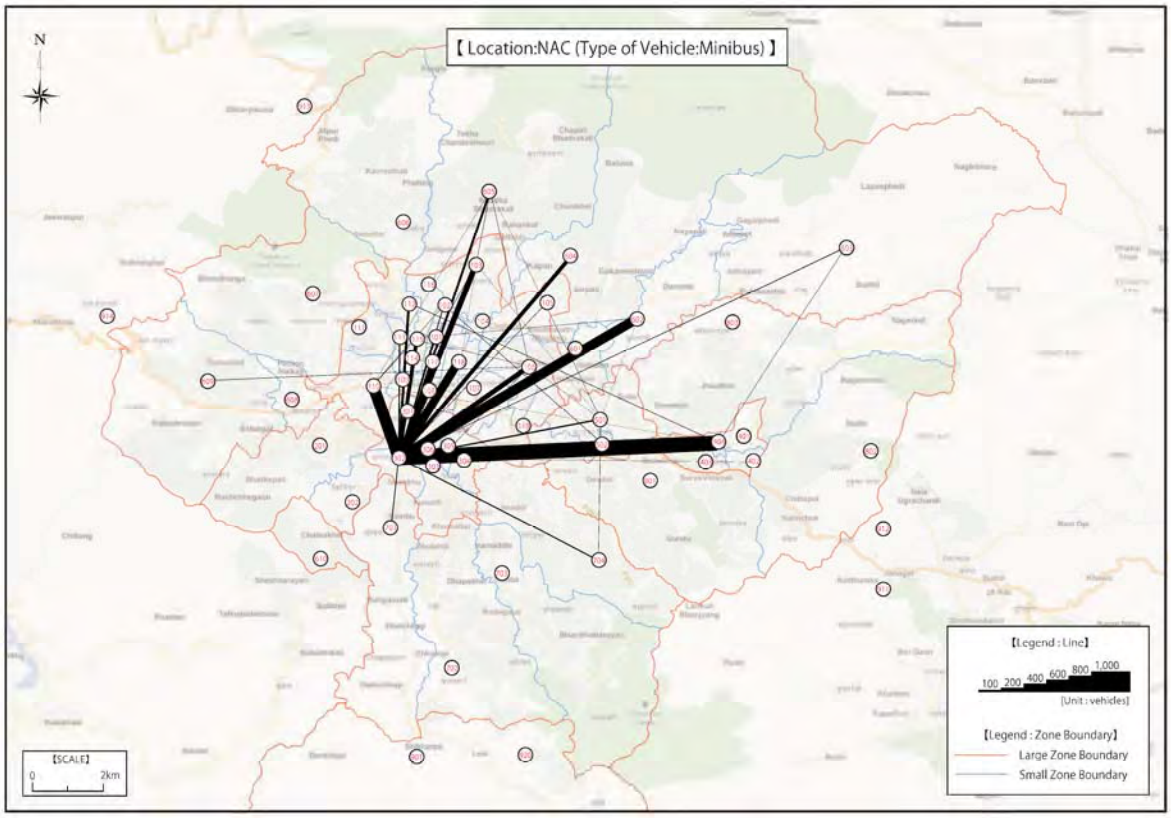


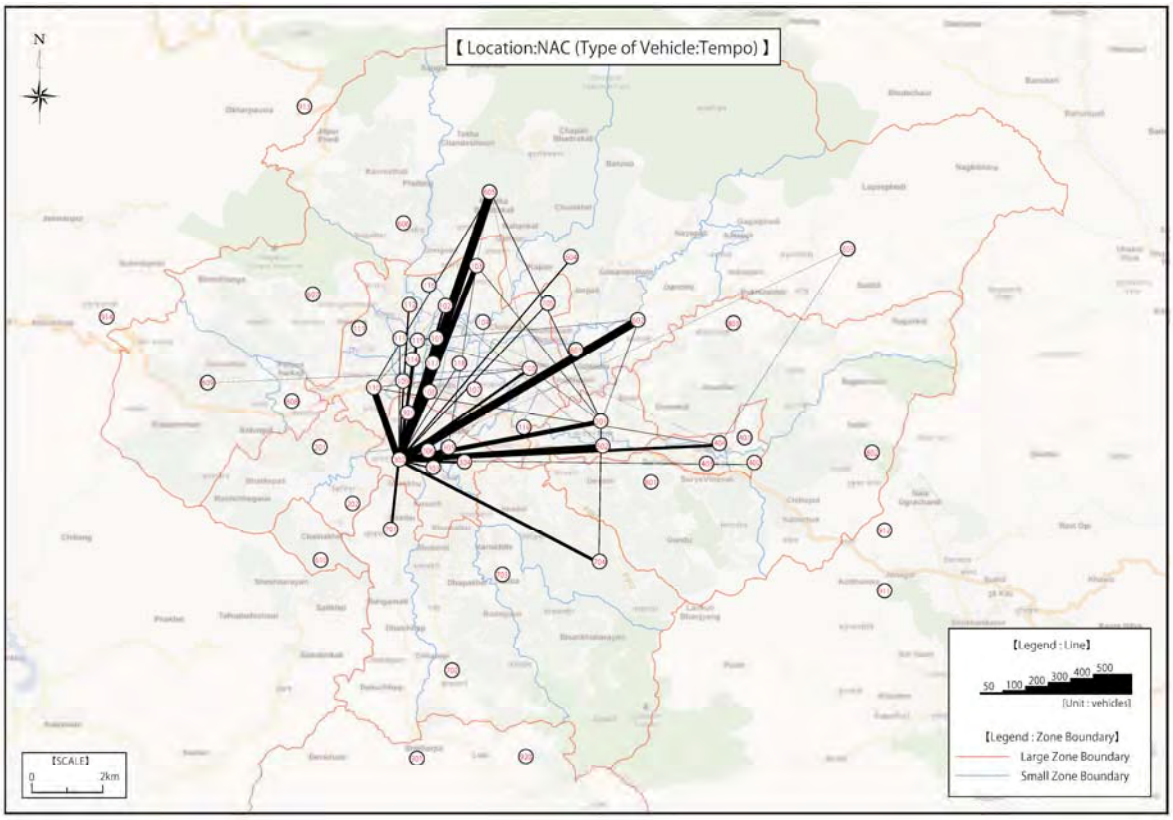



N
【Location:Lagankhel (Type of Vehicle:Tempo)】
【Legend : Line】
50 100 200 300 400 500
[Unit : vehicles]
【Legend : Zone Boundary】
Large Zone Boundary
Small Zone Boundary
【SCALE】
0 2km

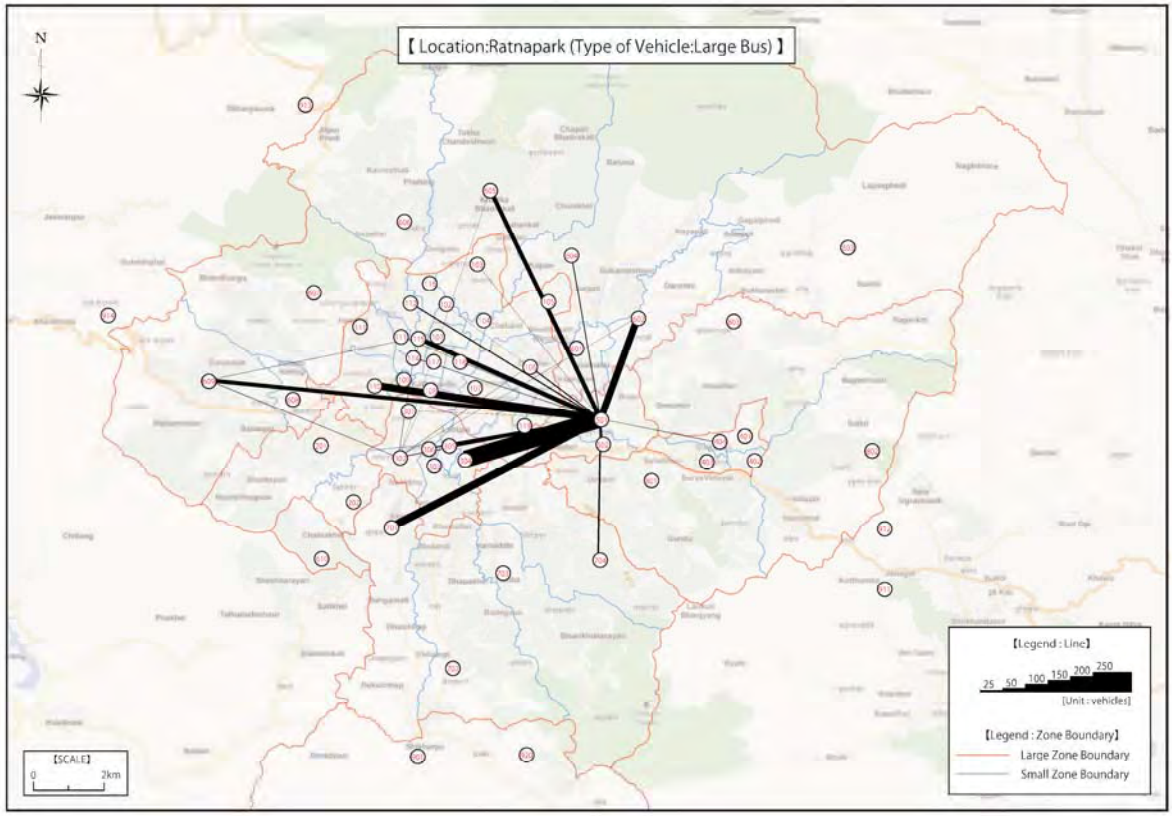
1.4.2 NAC

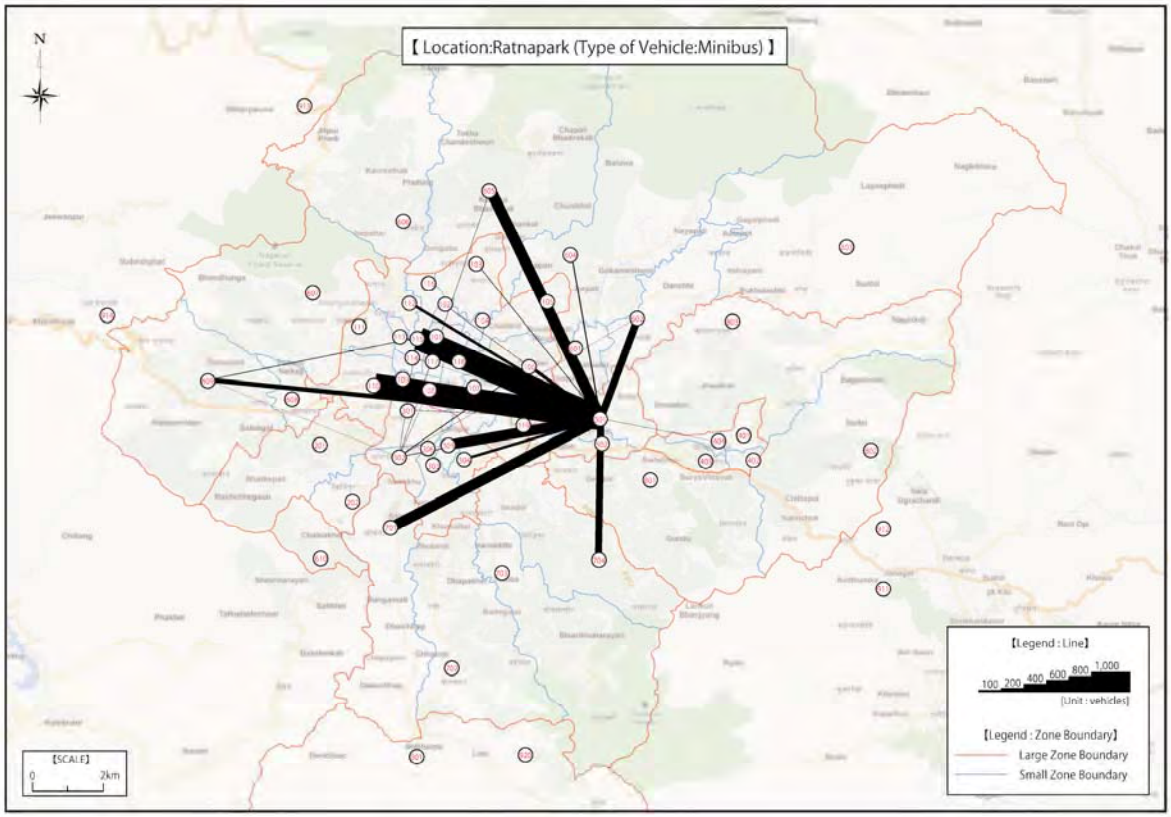

N
【Location:NAC (Type of Vehicle:Large Bus)】
【Legend : Line】
25 50 100 150 200 250
[Unit : vehicles]
【Legend : Zone Boundary】
Large Zone Boundary
Small Zone Boundary
【SCALE】
0 2km

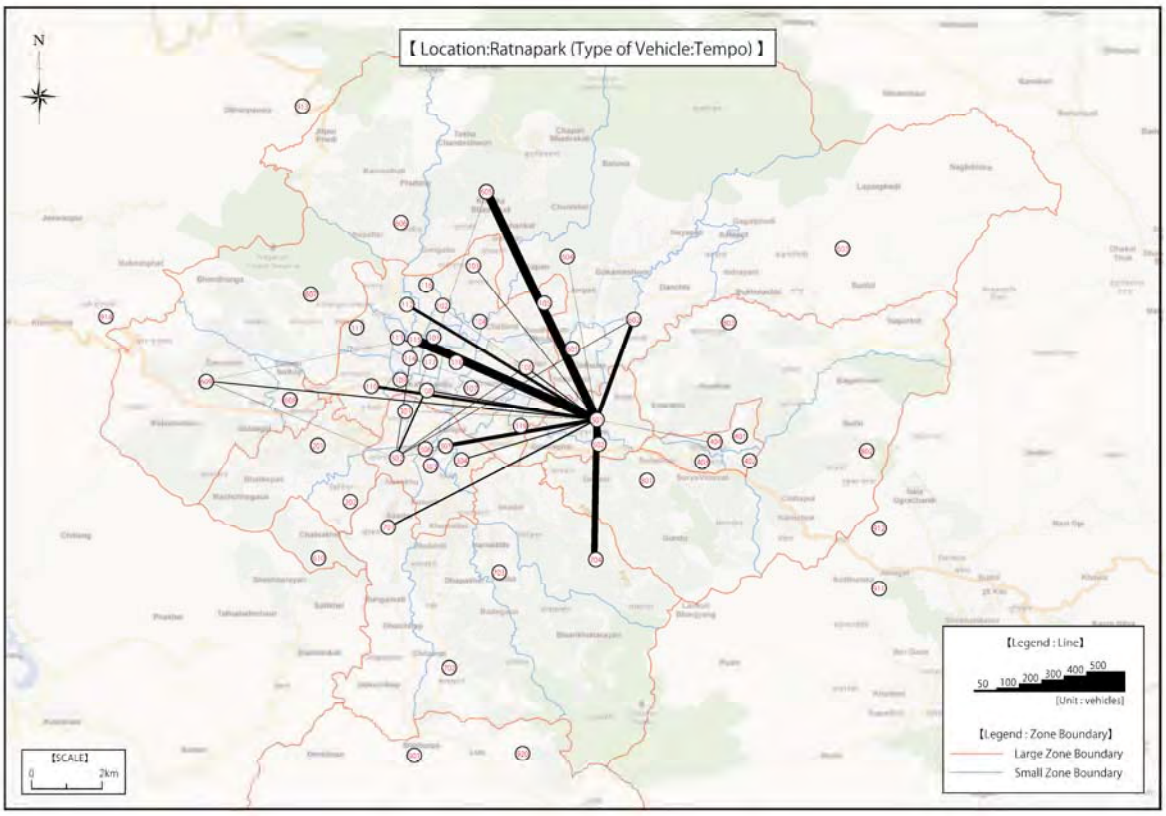

【Location:NAC (Type of Vehicle:Minibus)】
N
【Legend : Line】
100 200 400 600 800 1,000
[Unit : vehicles]
【Legend : Zone Boundary】
Large Zone Boundary
Small Zone Boundary
【SCALE】
0 2km


【Location:NAC (Type of Vehicle:Tempo)】
N
【Legend : Line】
50 100 200 300 400 500
[Unit : vehicles]
【Legend : Zone Boundary】
Large Zone Boundary
Small Zone Boundary
【SCALE】
0 2km

1.4.3 Ratnapark

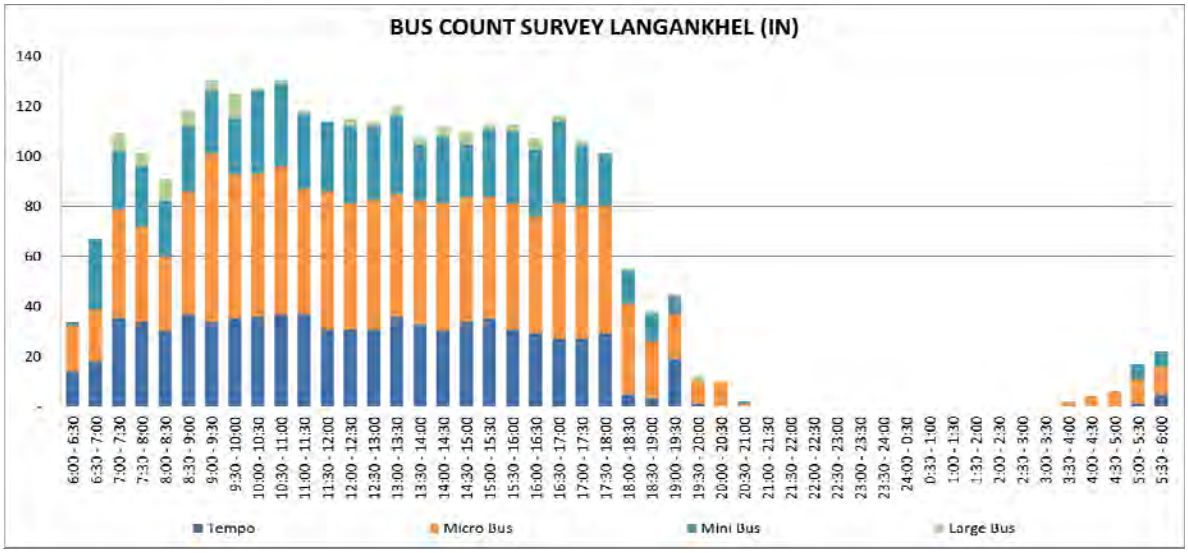


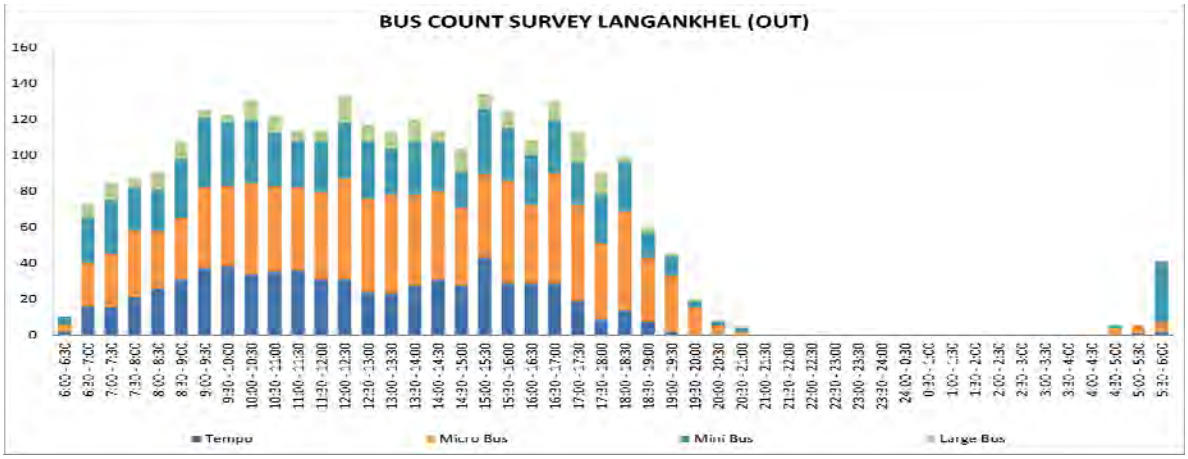




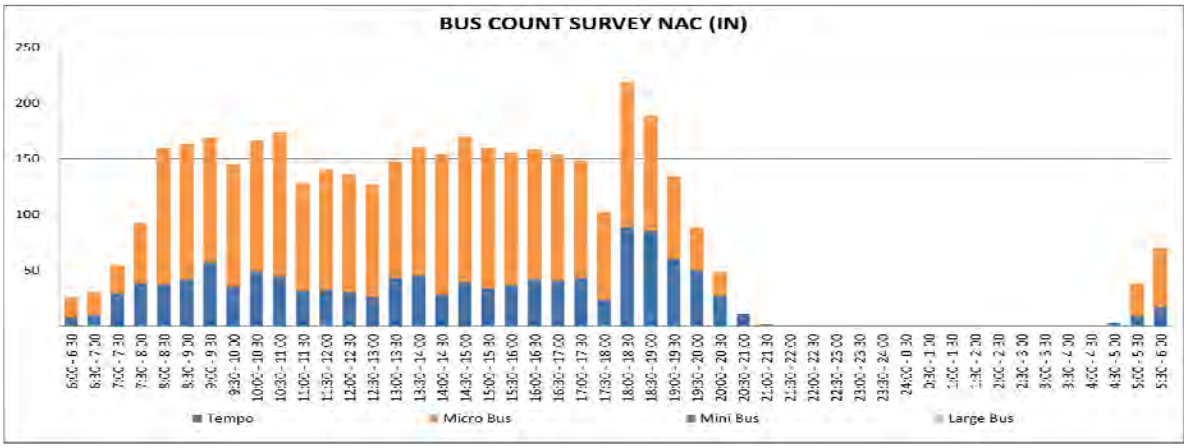
1.5 Bus Traffic Count Survey

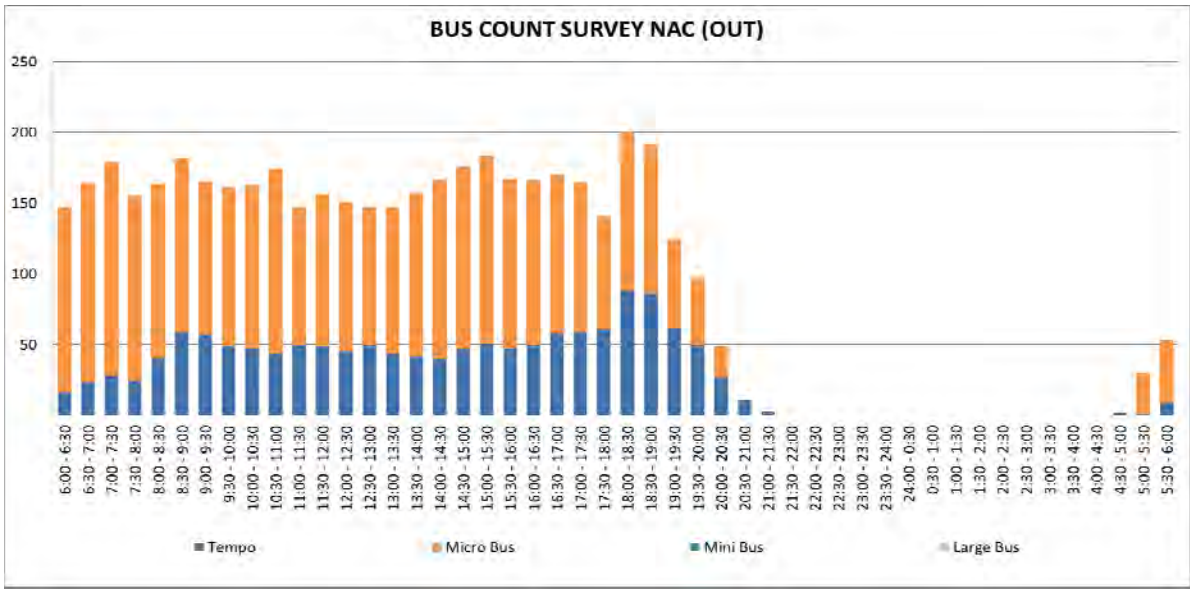
1.5.1 Lagankhel



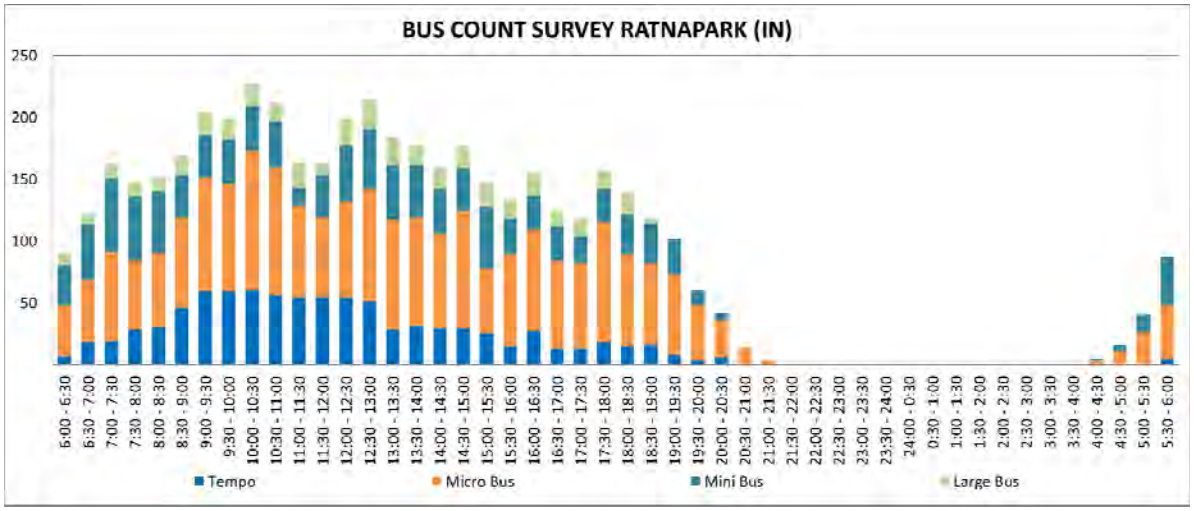

BUS COUNT SURVEY LANGANKHEL (OUT)
Tempo
Micro Bus
Mini Bus
Large Bus

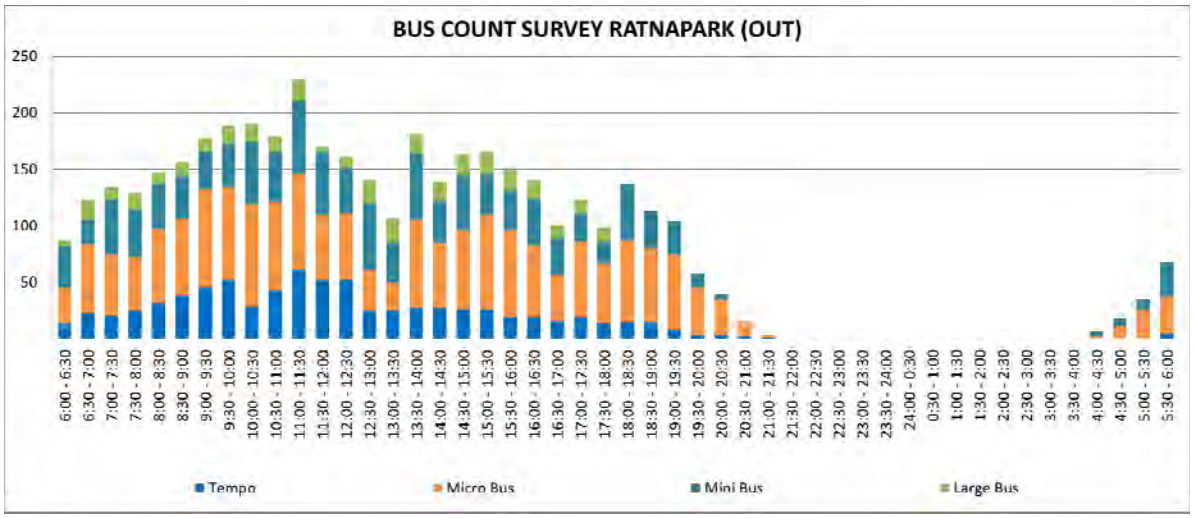
1.5.2 NAC


BUS COUNT SURVEY NAC (IN)
Tempo
Micro Bus
Mini Bus
Large Bus


BUS COUNT SURVEY NAC (OUT)
Tempo
Micro Bus
Mini Bus
Large Bus

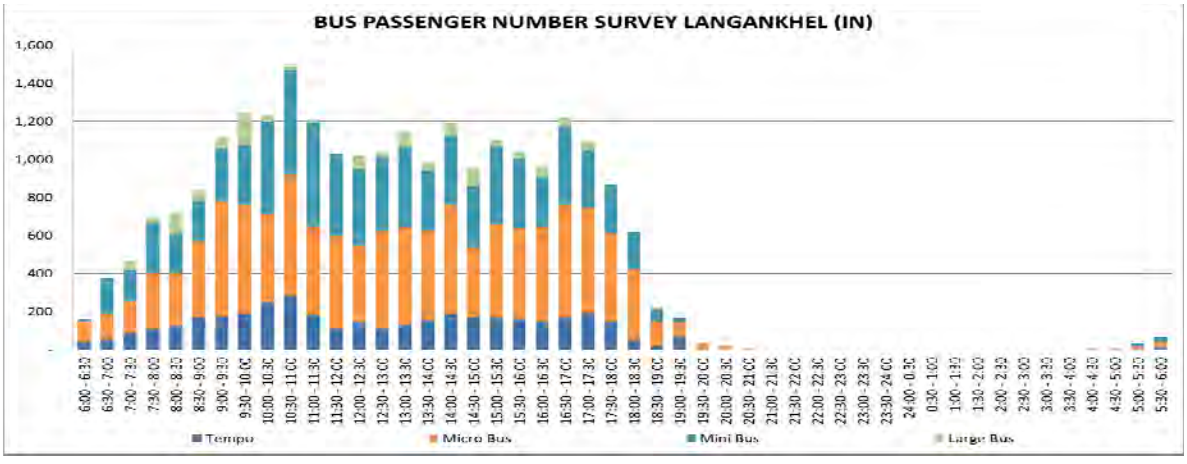
1.5.3 Ratnapark

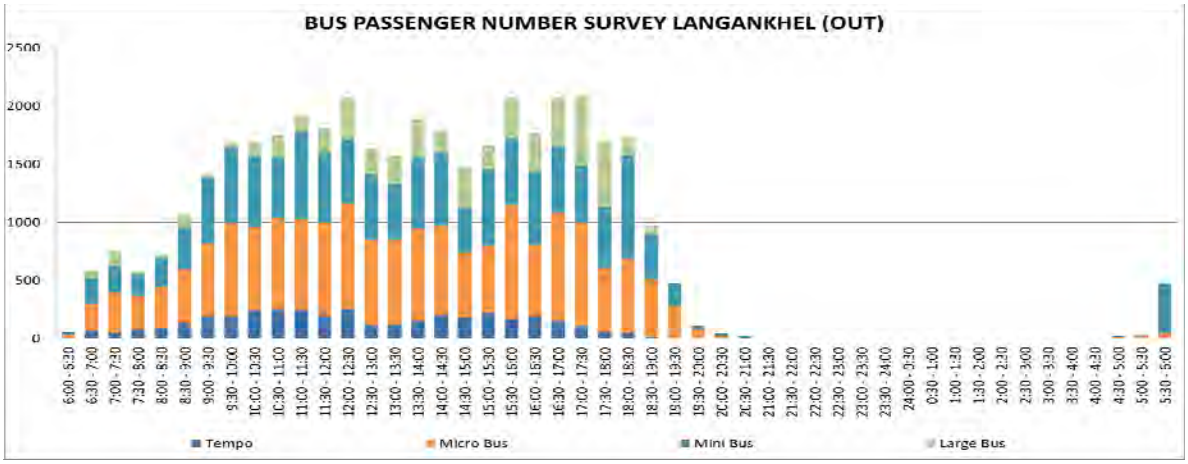




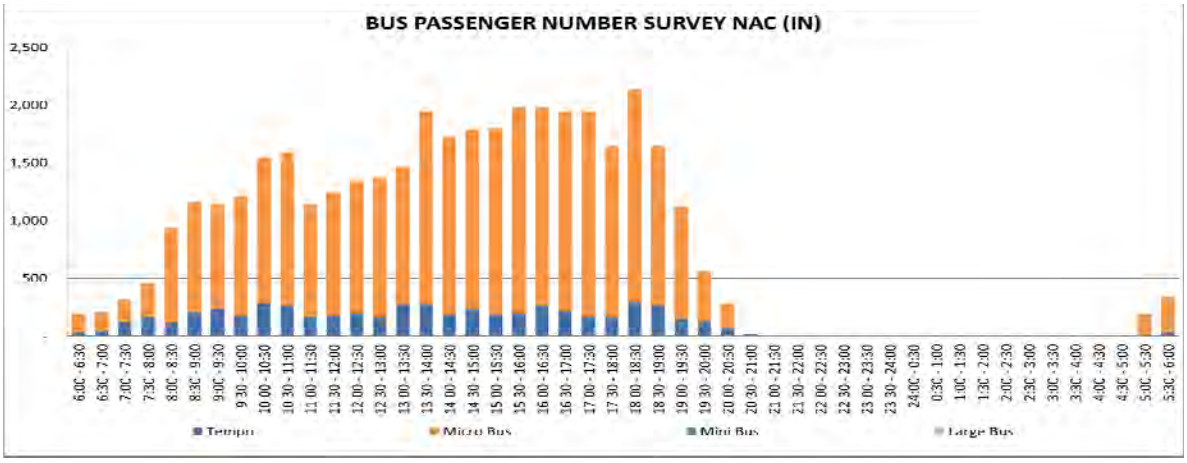
1.6 Bus Passenger Number Survey

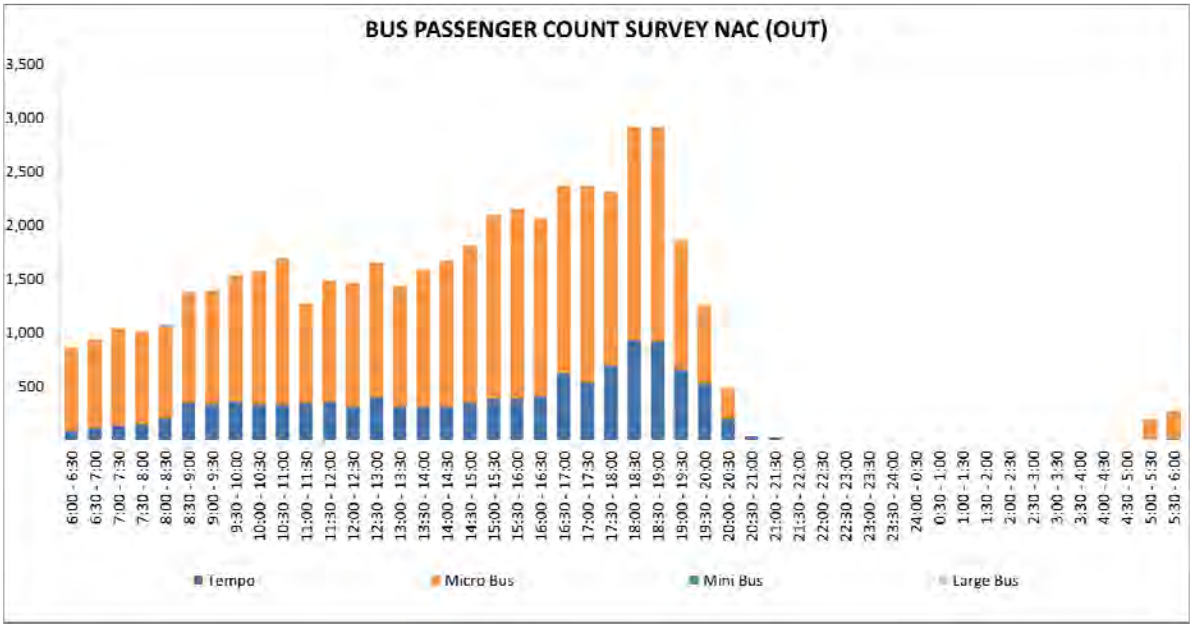
1.6.1 Lagankhel



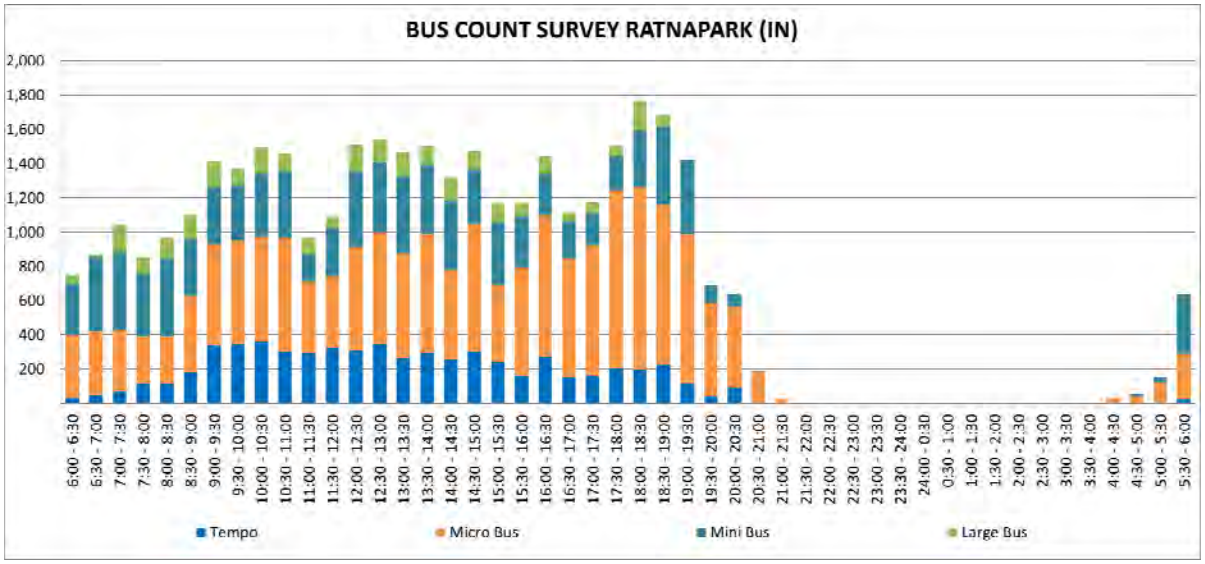

BUS PASSENGER NUMBER SURVEY LANGANKHEL (OUT)
Tempo
Micro Bus
Mini Bus
Large Bus

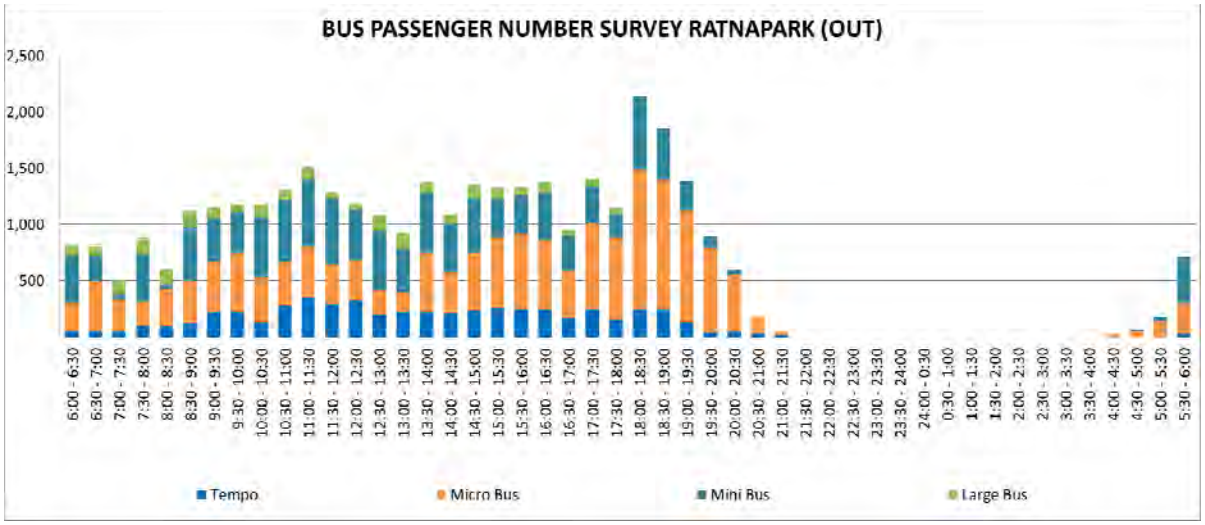
1.6.2 NAC


BUS PASSENGER NUMBER SURVEY NAC (IN)


BUS PASSENGER COUNT SURVEY NAC (OUT)
Tempo
Micro Bus
Mini Bus
Large Bus

1.6.3 Ratnapark





1.7 Stated Preference Survey

Stated Preference Survey was conducted to obtain the factors for preference of traffic mode selection to enhance use of public transport. The target of interview survey was car users, bus users and bus users. Survey Location was car parking, motorcycle parking and three bus parks where bus passenger interview was conducted.

Total Number of Interviewee was shown in Table 1.7.1.

Table 1.7.1 Total Number of Interviewee

	Interviewee
Car user	503
Bus user	504
Motorcycle user	505
Total	1512

Result of interview is shown in the tables below.

1.7.1 Possibility to Modal Shift to New Public Transport System

(i) Car Users

Do you use NPT in following condition?

Travel Time	-30minutes	-20minutes	-10minutes	same	+10minutes
Travel Cost	-40NPR	-40NPR	-40NPR	-40NPR	-40NPR
All Purpose					
Yes	453	371	125	91	70
Percentage	90.1	73.8	24.9	18.1	13.9
No	50	132	378	412	433
Percentage	9.9	26.2	75.1	81.9	86.1
1. To Work					
Yes	30	15	5	9	6
Percentage	90.9	45.5	15.2	27.3	18.2
No	3	18	28	24	27
Percentage	9.1	54.5	84.8	72.7	81.8
3. To Home					
Yes	35	25	13	9	8
Percentage	87.5	62.5	32.5	22.5	20.0
No	5	15	27	31	32
Percentage	12.5	37.5	67.5	77.5	80.0
4. Business					
Yes	119	100	22	15	15
Percentage	93.7	78.7	17.3	11.8	11.8
No	8	27	105	112	112
Percentage	6.3	21.3	82.7	88.2	88.2
5. Others					
Yes	269	231	85	58	41
Percentage	88.8	76.2	28.1	19.1	13.5
No	34	72	218	245	262
Percentage	11.2	23.8	71.9	80.9	86.5

(ii) Bus Users

Do you use NPT in following condition?

Travel Time	-30 minutes	-20 minutes	-20 minutes	-10 minutes	-10 minutes
Travel Cost	+ 20 NPR	+ 20 NPR	+ 10 NPR	+ 20 NPR	+ 10 NPR
All Purpose					
Yes	171	85	317	96	236
Percentage	33.9	16.9	62.9	19.0	46.8
No	333	419	187	408	268
Percentage	66.1	83.1	37.1	81.0	53.2
1. To Work					
Yes	35	14	53	8	30
Percentage	55.6	22.2	84.1	12.7	47.6
No	28	49	10	55	33
Percentage	44.4	77.8	15.9	87.3	52.4
2. To School					
Yes	11	6	14	7	18
Percentage	39.3	21.4	50.0	25.0	64.3
No	17	22	14	21	10
Percentage	60.7	78.6	50.0	75.0	35.7
3. To Home					
Yes	69	40	152	56	132

Percentage	25.1	14.5	55.3	20.4	48.0
No	206	235	123	219	143
Percentage	74.9	85.5	44.7	79.6	52.0
4. Business					
Yes	19	4	20	9	12
Percentage	63.3	13.3	66.7	30.0	40.0
No	11	26	10	21	18
Percentage	36.7	86.7	33.3	70.0	60.0
5. Others					
Yes	37	21	76	16	41
Percentage	35.2	20.0	72.4	15.2	39.0
No	68	84	29	89	64
Percentage	64.8	80.0	27.6	84.8	61.0

(iii) Motorcycle Users

Do you use NPT in following condition?

Travel Time	-30minutes	-20minutes	-10minutes	same	+10minutes
Travel Cost	-20NPR	-20NPR	-10NPR	-20NPR	-20NPR
All Purpose					
Yes	354	329	169	167	36
Percentage	70.1	65.1	33.5	33.1	7.1
No	151	176	336	338	469
Percentage	29.9	34.9	66.5	66.9	92.9
1. To Work					
Yes	38	35	15	14	5
Percentage	64.4	59.3	25.4	23.7	8.5
No	21	24	44	45	54
Percentage	35.6	40.7	74.6	76.3	91.5
2. To School					
Yes	4	4	2	1	0
Percentage	66.7	66.7	33.3	16.7	0.0
No	2	2	4	5	6
Percentage	33.3	33.3	66.7	83.3	100.0
3. To Home					
Yes	64	47	28	39	6
Percentage	70.3	51.6	30.8	42.9	6.6
No	27	44	63	52	85
Percentage	29.7	48.4	69.2	57.1	93.4
4. Business					
Yes	101	117	50	34	9
Percentage	67.8	78.5	33.6	22.8	6.0
No	48	32	99	115	140
Percentage	32.2	21.5	66.4	77.2	94.0
5. Others					
Yes	147	126	74	79	16
Percentage	73.5	63.0	37.0	39.5	8.0
No	53	74	126	121	184
Percentage	26.5	37.0	63.0	60.5	92.0

1.7.2 Favorable Access Time to New Public Transport System

(i) Car Users

Access time to the nearest station of NPT on foot

Access time	30minutes	15minutes	10minutes	5minutes
All Purpose				
Yes	1	31	333	377
Percentage	0.4	10.9	95.1	88.1
No	281	253	17	51
Percentage	99.6	89.1	4.9	11.9
1. To Work				
Yes	0	0	19	21
Percentage	0.0	0.0	86.4	84.0
No	14	14	3	4
Percentage	100.0	100.0	13.6	16.0
3. To Home				
Yes	0	1	24	24
Percentage	0.0	6.3	96.0	80.0
No	16	15	1	6
Percentage	100.0	93.8	4.0	20.0
4. Business				
Yes	1	16	93	95
Percentage	1.2	19.0	93.0	87.2
No	82	68	7	14
Percentage	98.8	81.0	7.0	12.8
5. Others				
Yes	0	14	197	237
Percentage	0.0	8.2	97.0	89.8
No	169	156	6	27
Percentage	100.0	91.8	3.0	10.2

(ii) Bus Users

Access time to the nearest station of NPT on foot

Travel Time	30minutes	15minutes	10minutes	5minutes
All Purpose				
Yes	23	108	262	288
Percentage	4.6	21.4	52.0	57.1
No	481	396	242	216
Percentage	95.4	78.6	48.0	42.9
1. To Work				
Yes	5	20	46	34
Percentage	7.9	31.7	73.0	54.0
No	58	43	17	29
Percentage	92.1	68.3	27.0	46.0
2. To School				
Yes	0	0	10	17
Percentage	0.0	0.0	35.7	60.7
No	28	28	18	11
Percentage	100.0	100.0	64.3	39.3
3. To Home				
Yes	10	51	122	171
Percentage	3.6	18.5	44.4	62.2
No	265	224	153	104
Percentage	96.4	81.5	55.6	37.8

4. Business				
Yes	3	8	22	11
Percentage	10.0	26.7	73.3	36.7
No	27	22	8	19
Percentage	90.0	73.3	26.7	63.3
5. Others				
Yes	5	29	62	52
Percentage	4.8	27.6	59.0	49.5
No	100	76	43	53
Percentage	95.2	72.4	41.0	50.5

(iii) Motorcycle Users

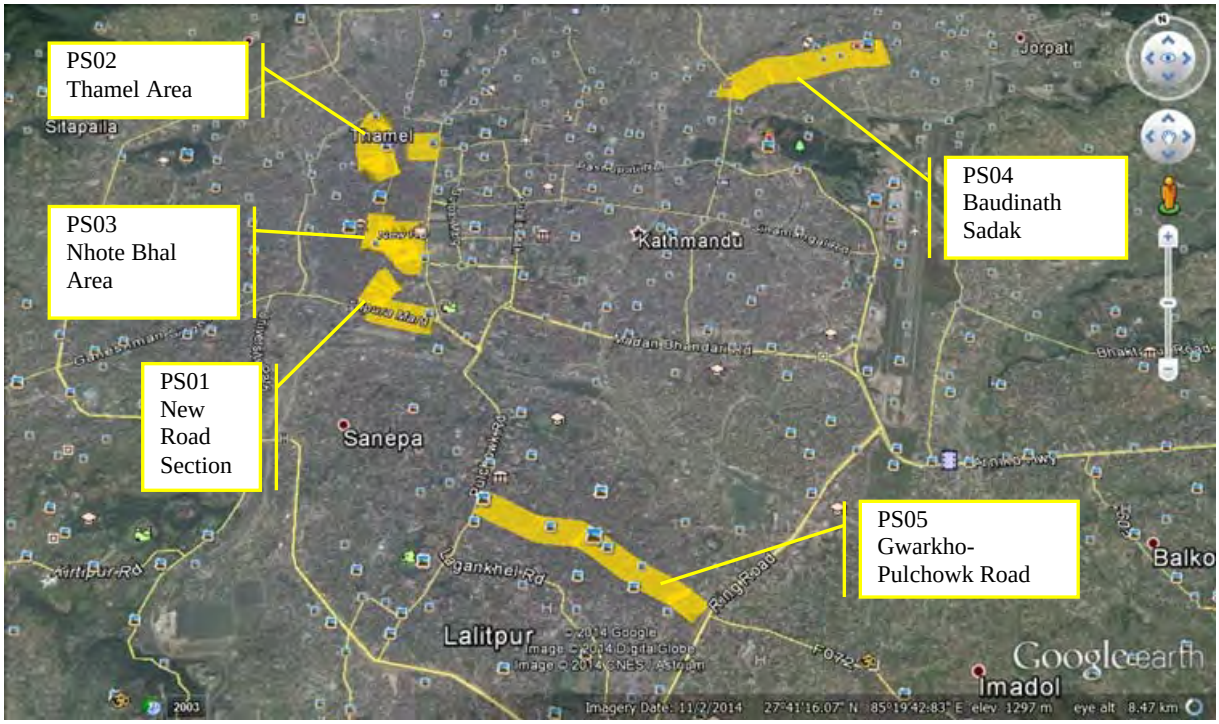
Access time to the nearest station of NPT on foot

Travel Time	30minutes	15minutes	10minutes	5minutes
All Purpose				
Yes	13	101	368	186
Percentage	2.6	20.0	72.9	36.8
No	492	404	137	319
Percentage	97.4	80.0	27.1	63.2
1. To Work				
Yes	1	15	37	19
Percentage	1.7	25.4	62.7	32.2
No	58	44	22	40
Percentage	98.3	74.6	37.3	67.8
2. To School				
Yes	0	0	3	4
Percentage	0.0	0.0	50.0	66.7
No	6	6	3	2
Percentage	100.0	100.0	50.0	33.3
3. To Home				
Yes	2	21	66	26
Percentage	2.2	23.1	72.5	28.6
No	89	70	25	65
Percentage	97.8	76.9	27.5	71.4
4. Business				
Yes	0	28	117	59
Percentage	0.0	18.8	78.5	39.6
No	149	121	32	90
Percentage	100.0	81.2	21.5	60.4
5. Others				
Yes	10	37	145	78
Percentage	5.0	18.5	72.5	39.0
No	190	163	55	122
Percentage	95.0	81.5	27.5	61.0

1.8 Parking Survey

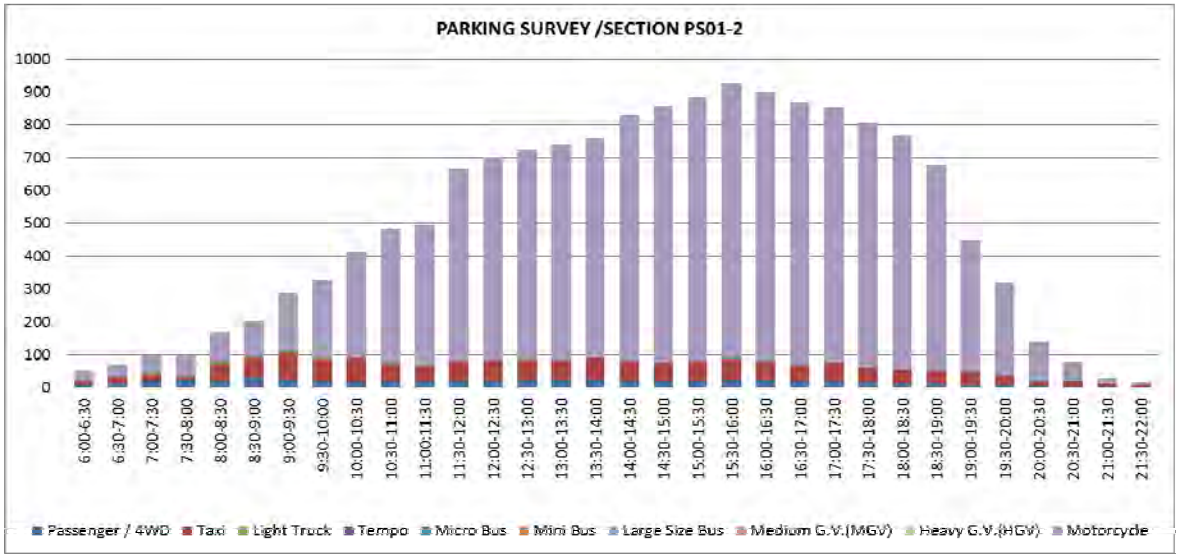
The Parking Survey was conducted at location and duration mentioned below.

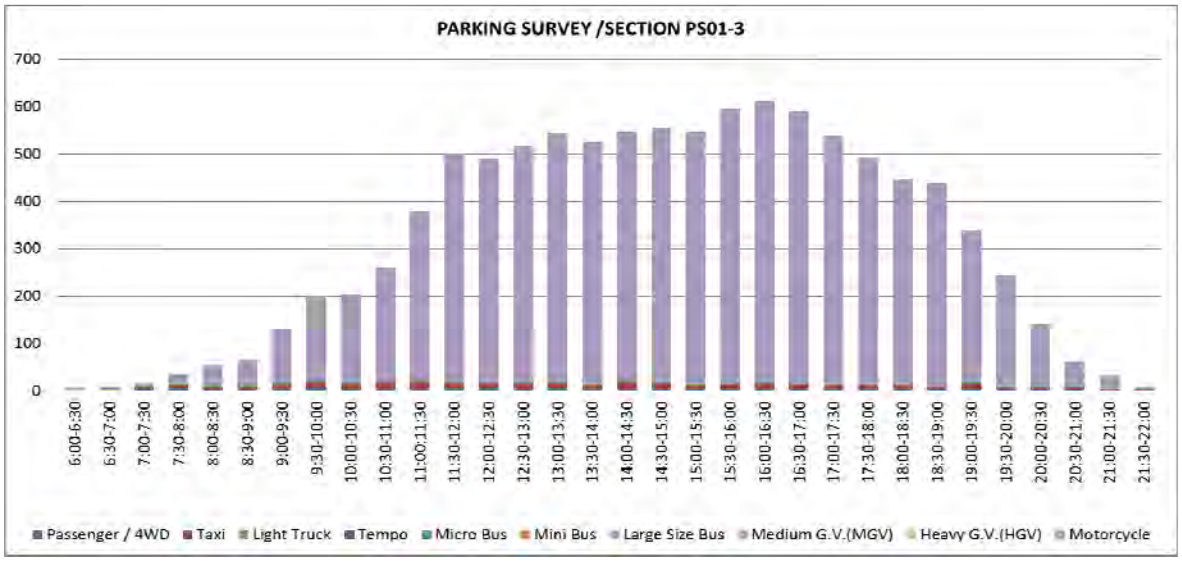
S/N	Location	Date	Hours	Remarks
1	New Road Section	28-Sep,2014	16	PS01
2	Thamel Area	28-Sep,2014	16	PS02
3	Bhote Bhal Area	28-Sep,2014	16	PS03
4	Baudinath Sadak	29-Sep,2014	16	PS04
5	Gowarkho-Pulchowk Road	29-Sep,2014	16	PS05

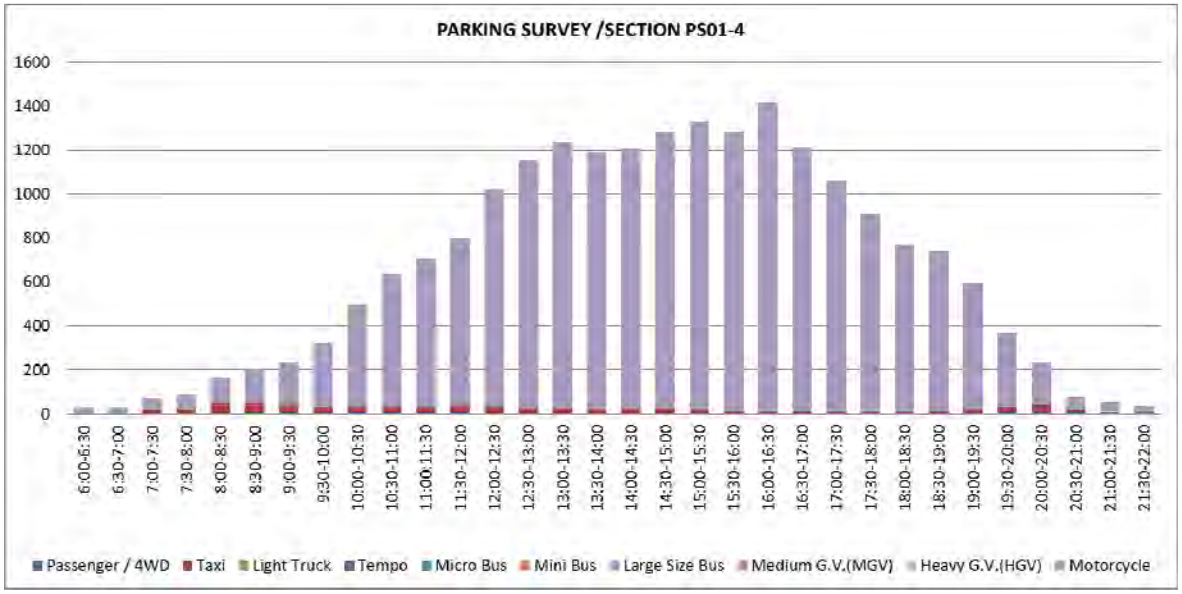


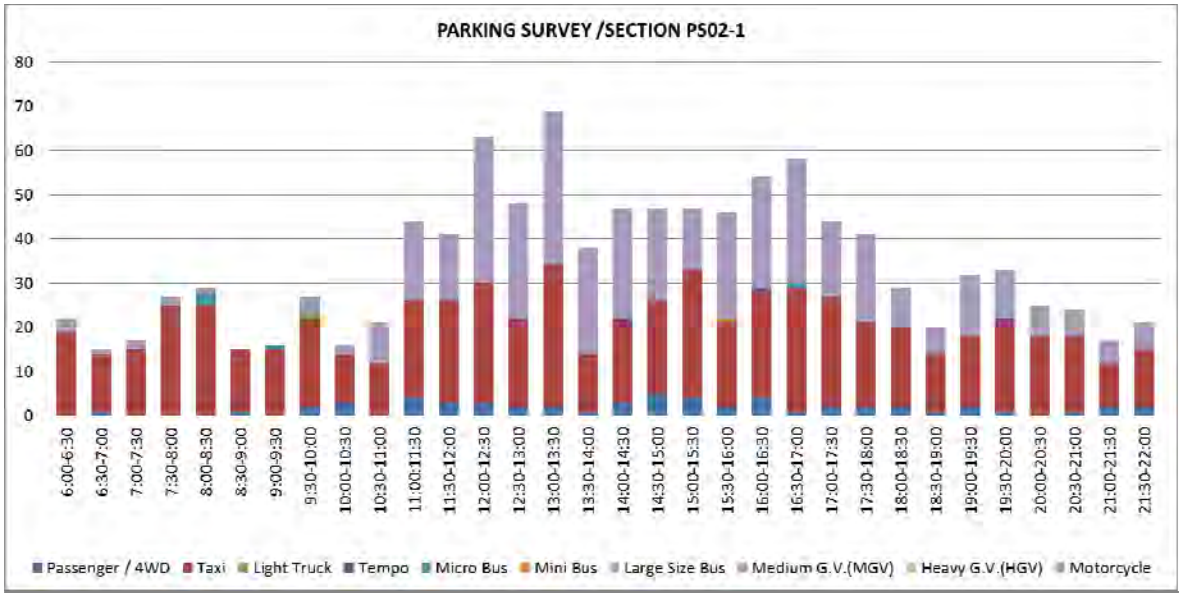
(Photo) Parking at New Road Section (PS01)

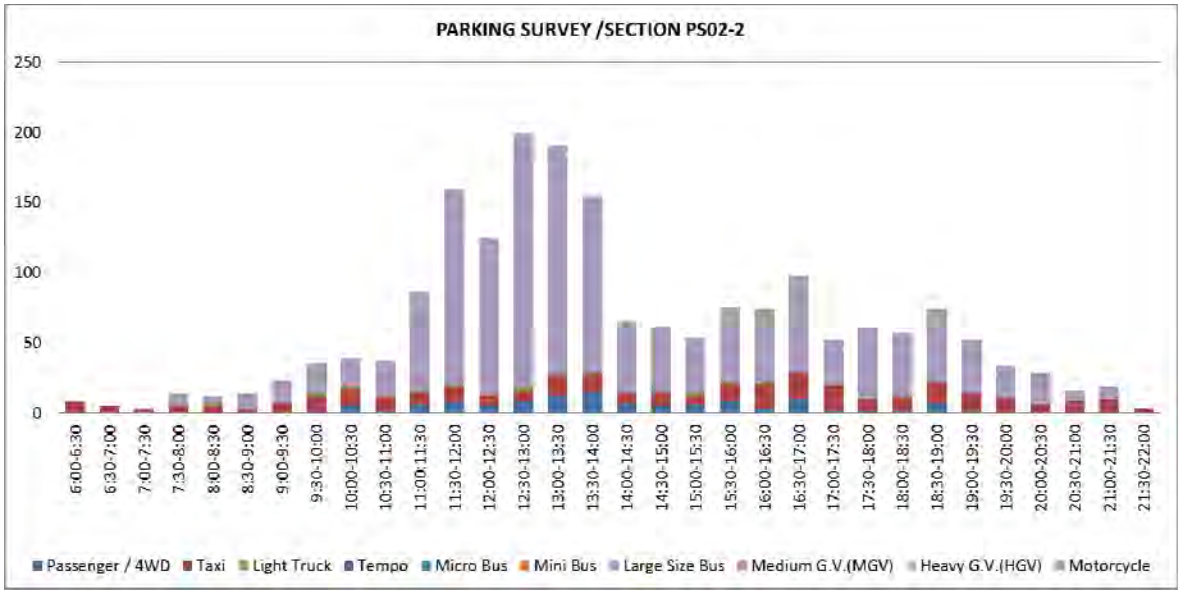
The results of the survey are shown in the following figures.








PARKING SURVEY /SECTION PS02-1
80
70
60
50
40
30
20
10
0
6:00-6:30
6:30-7:00
7:00-7:30
7:30-8:00
8:00-8:30
8:30-9:00
9:00-9:30
9:30-10:00
10:00-10:30
10:30-11:00
11:00-11:30
11:30-12:00
12:00-12:30
12:30-13:00
13:00-13:30
13:30-14:00
14:00-14:30
14:30-15:00
15:00-15:30
15:30-16:00
16:00-16:30
16:30-17:00
17:00-17:30
17:30-18:00
18:00-18:30
18:30-19:00
19:00-19:30
19:30-20:00
20:00-20:30
20:30-21:00
21:00-21:30
21:30-22:00
Passenger / 4WD
Taxi
Light Truck
Tempo
Micro Bus
Mini Bus
Large Size Bus
Medium G.V.(MGV)
Heavy G.V.(HGV)
Motorcycle


PARKING SURVEY /SECTION PS02-2
250
200
150
100
50
0
6:00-6:30
6:30-7:00
7:00-7:30
7:30-8:00
8:00-8:30
8:30-9:00
9:00-9:30
9:30-10:00
10:00-10:30
10:30-11:00
11:00-11:30
11:30-12:00
12:00-12:30
12:30-13:00
13:00-13:30
13:30-14:00
14:00-14:30
14:30-15:00
15:00-15:30
15:30-16:00
16:00-16:30
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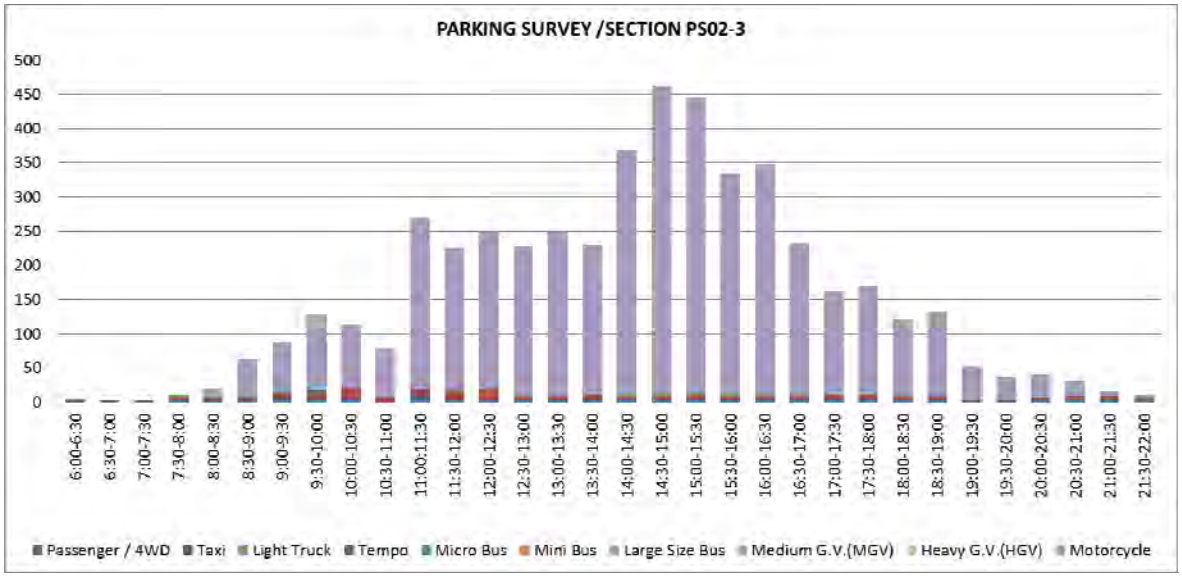
17:00-17:30
17:30-18:00
18:00-18:30
18:30-19:00
19:00-19:30
19:30-20:00
20:00-20:30
20:30-21:00
21:00-21:30
21:30-22:00
Passenger / 4WD
Taxi
Light Truck
Tempo
Micro Bus
Mini Bus
Large Size Bus
Medium G.V.(MGV)
Heavy G.V.(HGV)
Motorcycle


PARKING SURVEY /SECTION PS02-3
500
450
400
350
300
250
200
150
100
50
0
6:00-6:30
6:30-7:00
7:00-7:30
7:30-8:00
8:00-8:30
8:30-9:00
9:00-9:30
9:30-10:00
10:00-10:30
10:30-11:00
11:00-11:30
11:30-12:00
12:00-12:30
12:30-13:00
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14:00-14:30
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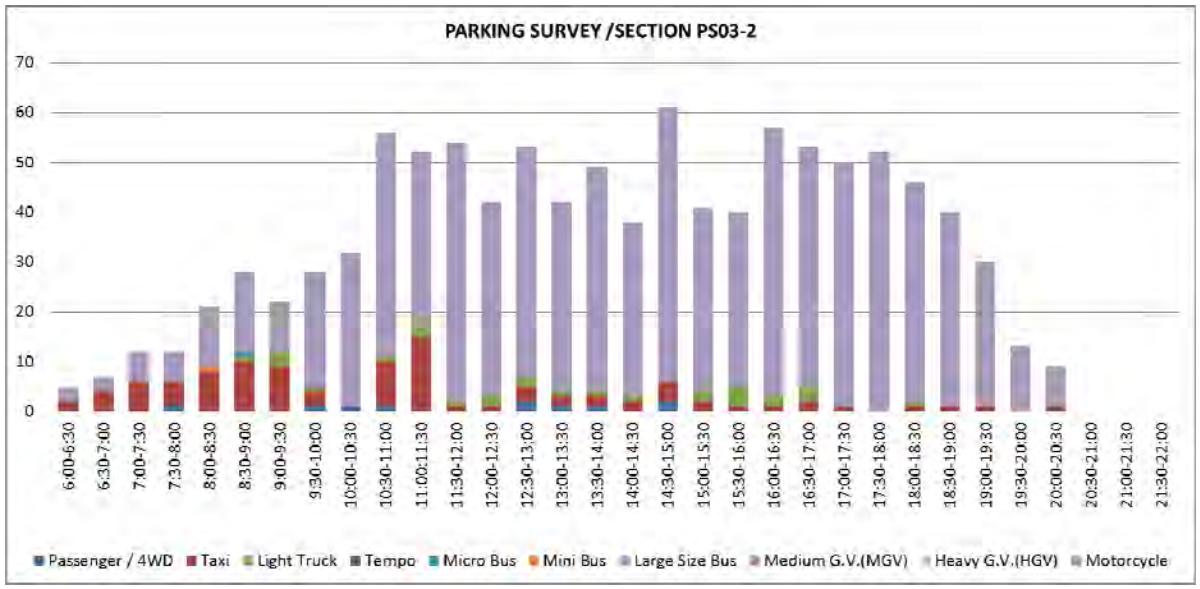
18:30-19:00
19:00-19:30
19:30-20:00
20:00-20:30
20:30-21:00
21:00-21:30
21:30-22:00
Passenger / 4WD
Taxi
Light Truck
Tempo
Micro Bus
Mini Bus
Large Size Bus
Medium G.V.(MGV)
Heavy G.V.(HGV)
Motorcycle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60
50
40
30
20
10
0
6:00-6:30
6:30-7:00
7:00-7:30
7:30-8:00
8:00-8:30
8:30-9:00
9:00-9:30
9:30-10:00
10:00-10:30
10:30-11:00
11:00:11:30
11:30-12:00
12:00-12:30
12:30-13:00
13:00-13:30
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14:00-14:30
14:30-15:00
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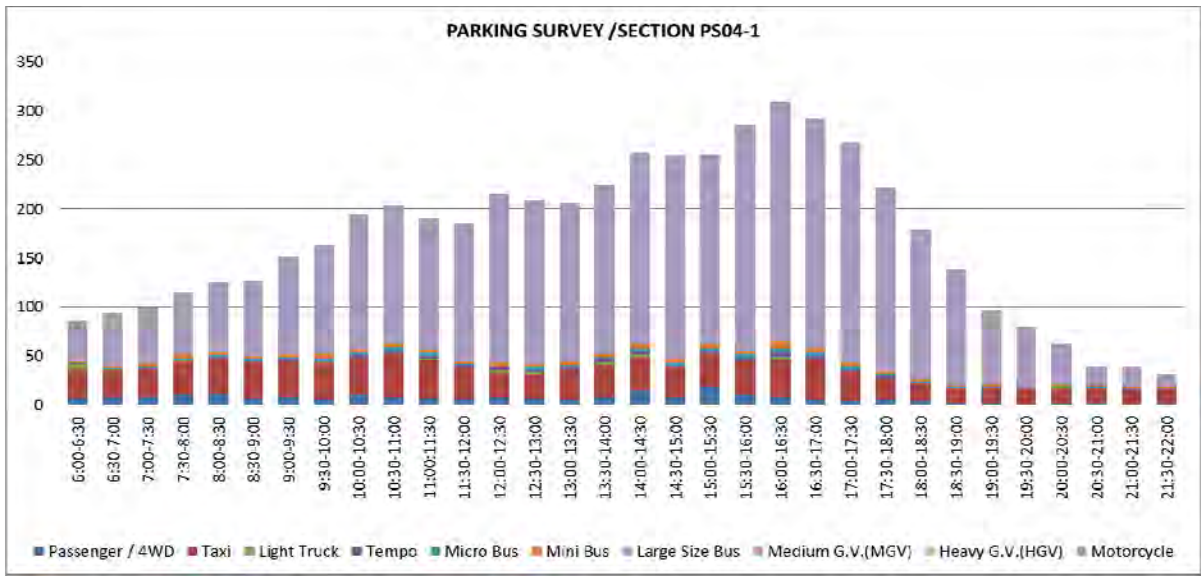
18:30-19:00
19:00-19:30
19:30-20:00
20:00-20:30
20:30-21:00
21:00-21:30
21:30-22:00
Passenger / 4WD
Taxi
Light Truck
Tempo
Micro Bus
Mini Bus
Large Size Bus
Medium G.V.(MGV)
Heavy G.V.(HGV)
Motorcycle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300
250
200
150
100
50
0
6:00-6:30
6:30 7:00
7:00-7:30
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8:30 9:00
9:00-9:30
9:30-10:00
10:00-10:30
10:30-11:00
11:00:11:30
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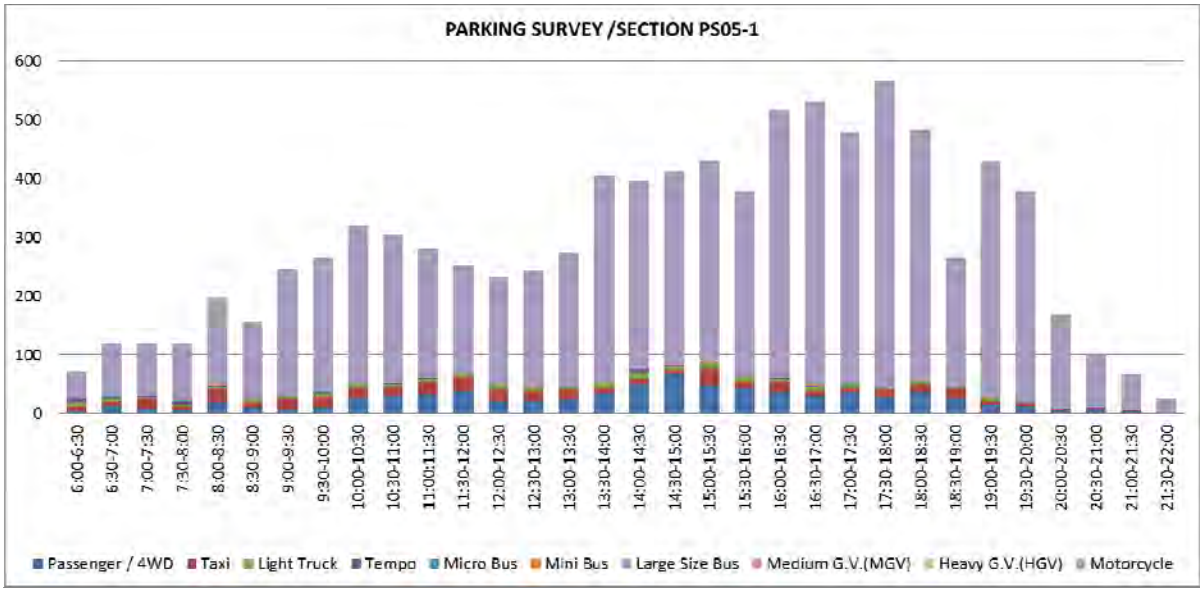
19:30 20:00
20:00-20:30
20:30-21:00
21:00-21:30
21:30-22:00
Passenger / 4WD
Taxi
Light Truck
Tempo
Micro Bus
Mini Bus
Large Size Bus
Medium G.V.(MGV)
Heavy G.V.(HGV)
Motorcycle



1.9 Accident Blackspot Survey

Accident Black Spots given from the Traffic Police are shown in the next table.

Table 1.9.1 Location of Accident Blackspot in Kathmandu Valley

2010-11		2011-12		2012-13		2013-14	
Place	Number	Place	Number	Place	Number	Place	Number
Durbarmarg	416	Koteshwor	527	Koteshwor	564	Koteshwor	597
Koteshwor	359	Gaushala	381	Satdobato	322	Singhdurbar	336
Jawalakhel	321	Satdobato	285	Bhaktapur	289	Satdobato	319
Singhdurbar	317	New Bus Park	264	Singhdurbar	281	New Bus Park	284
Gaushala	275	Bhaktapur	250	Gaushala	253	Bhaktapur	280
Sallaghari	272	Jawalakhel	212	New bus park	249	Swyambhu	210
Satdobato	269	Kalimati	205	Baudha	244	Maharajgunj	207
Thapathali	229	Kalanki	184	Jawalakhel	236	Jawalakhel	203
Baudha	224	Durbarmarg	181	Kalimati	221	Sukedhara	195
Kalanki	211	Baudha	176	Swyambhu	192	Kalanki	194
Kamalpokhari	177	Singhdurbar	160	Kalanki	148	Baudha	162
Kalimati	170	Sukedhara	152	Maharajgunj	130	Gaushala	162
Maharajgunj	140	Maharajgunj	149	Kamalpokhari	127	Gatthaghar	156
Airport	138	Airport	132	Sukedhara	127	Airport	145
New Bus Park	124	Swyambhu	127	Gatthaghar	122	Sanepa	138
Sundhara	119	Putalisadak	123	Airport	107	Nagdhunga	130
Thankot	114	Gatthaghar	109	Division	109	Kalimati	125
Sukedhara	113	Thankot	107	Durbarmarg	105	Kamalpokhari	122
Maitighar	105	Kamalpokhari	106	Thankot	101	Jansewa	118
Swyambhu	100	Kalimati	105	Sanepa	96	Thankot	108
New Baneshwor	98	Tripureshwor	99	Sorhakhutte	90	Kirtipur	73
Gatthaghar	93	Sanepa	98	Maitighar	75	Durbarmarg	67
Putalisadak	85	Sorhakhutte	96	Nagdhunga	55	Kamalbinayak	50
Balaju	77	Padmoday	83	Thapathali	52	Sorhakhutte	49
Kirtipur	70	Bhadrakali	82	Padmoday	50	Kapan	53
Assembly Hall	68	Thapathali	76	Kirtipur	49	Pharping	37
Sanepa	67	Maitighar	75	Bhaisepati	44	Budhanilkantha	35
Nagdhunga	52	Kirtipur	75	Jansewa	44	Thapathali	31
Sorhakhutte	49	Jansewa	71	Kapan	43	Chapagaun	30
Budhanilkantha	26	Budhanilkantha	59	Budhanilkantha	41	Bhaisepati	25
Pharping	22	Sundhara	54	Babarmahal	38	Thamel	13
Chapagaun	14	Nagdhunga	44	Pharping	35	Mahankal	10

Source: Traffic Police

The following table also gives the accident blackspots under interview to traffic police. Understandably some of the locations duplicate with one indicated in the above table.

Table 1.9.2 Location and number of accidents under interview to the Traffic Police

S.No.	Name of Black Spot	Vehicle Description at Black spot Accident				Vehicle categories at Accident					Cause of Accident	Effort to minimize the accident	Measures to Prevent Accident
		Total Accident	Fatality	Serious Accident	Normal Accident	Bus	Truck	Car, Jeep, Van	Motorcycle, Scooter	Other			
13	Shamakhushi, In front of Karyadal	96	2	0	31	9	16	56	61	2	- High speed - Overtake		
12	Kamalbinayak, Kharipati	75	2	3	74	9	16	11	57	0	- Driving after alcohol use - Careless driving, without getting driving license	- Stringent the traffic rule, - Conducted awareness program	- Strict Law - Strict Punishment
5	Syambhu, Bafal	55	2	9	50	15	18	10	12	0	- Open wide road, Uncomfortable to cross the road for Pedestrian		
9	Jorpati Inclination to Narayantar	55	2	0	40	18	4	20	40	0	- Decline way - High Speed - Wrong Overtake - Negligence of Driver		
17	Thapathali, Rotary Club & near to Telecom	52	1	7	0	0	0	0	0	0	- Narrow road and closer to bus park	- Bus Park closer to rotary club should be shift to Nepal food Corporation	- Manage to park the buses at specified place
11	Nag Dhunga, Banbhanjyang, Piplamod	45	2	8	31	16	26	21	12	0	- Uphill, downhill , winding Road Overtake, Negligence of Driver	- Mobilize traffic police at black spots - Marking sign of Uphill, Downhill, Winding road	Should be maintain both side of Tree, Shrubs & road on time
6	Syambhu, Sano Bharyang	38	2	6	35	10	7	8	10		- Slope & Winding Road	- Kept angle bar to divide road at the middle & stopping the undirected overtake - Aside parking at left side and	- Accident can be minimized by placing angle bar like in front of Singhdarbar - Widening the bus park &
4	Sukedhara, Prakash Marg Road	37	1	2	7	11	7	14	8	0	- High Speed, Careless of driver, decline & Curve Way, Alcohol Use etc.	- Setting up more Check point and punished the careless driver at black spot Kept boards to indicate Black spot	- Increase the Traffic check at Black Spots - Keep lane divider & Light during night time
7	S. S. Chowk, Thimi	34	2	3	47	12	3	13	29		- Negligence of driver - High Speed - Unsafe lane change - Wrong overtake	- Permanent duty at potential place, Circular Patrolling - Mobile operation - Miking to Pedestrian by mobile	- Intensity awareness program - Strictly punishment - Find the accidental area, schooling to Pedestrian
18	Dhapakhel Mod & Dholahiti Inclination	30	6	7	28	20	12	18	16	1	- Narrow road - Dirt Road	- Traffic knowledge to driver	- should increase public awareness - Should keep hording board
3	Basundhara Chowk -Tilingetar Chowk	27	3	3	10	6	16	11	17	0	- High speed, Lack of Awareness, Bad condition of Road, Unsafe Lane change, Careless use of Vehicle, Bad condition of Vehicle	- Setting up more Check points and punish the careless driver at black spot, Issued letter to Division office to put Board of Black Spot.	- Regular Italic check, Stringent the distribution of driving license, Convey awareness regarding traffic rule to Pedestrians
2	Kalimati, Soaltee Mod	25	1	7	13	8	4	12	14	3	- Decline & Curve Road - Zebra Crossing near to Y Junction	- Initiative underway to keep continuous divider from Kalimati to Soaltee Mod	- Compulsory presence of traffic Police
8	Salla Ghari, Srijana nagar	22	2	2	27	9	3	5	17				
14	Balaju	21	3	3	27	13	7	7	9	5	- Negligence of Driver - High speed - Alcohol use - Overtake	- Traffic checking from place to place - Comprehension Program	- Should be arrangement of Traffic sign Board - Regular maintenance of Road - Should be displaced the old and
20	Babarmahal	21	1	7	14	11	2	25	15	7	- High speed, - Negligence of Driver	- Schooling regarding minimization of accident to the drivers - Operate traffic sign Board & effective the duty of traffic police	- On the basis of black spot point, Check the vehicle at morning time(Low traffic) and other time also
1	Kalimati, Ravi Bhawan	15	1	5	7	6	3	9	12	4	- Negligence of Driver - Not use of Zebra cross - Decline & Curve Road	- Initiative underway to increase the number of Traffic Police	- Loosed animals should be managed with the coordination of Municipality
10	Bauddha, Shankhu Nanglebhar to Lassi Fedi	15	4	0	52	13	2	2	4	0	- No any indication board regarding traffic rule & bad condition of Road	- Make arrangement of traffic police at Shankhu	
16	Gatthaghar, Chardobato Chowk	15	3	1	10	12	1	12	15	0	- High speed - Absence of Pedestrian Bridge	- Punish the high speed drivers by QRT(Quick Response team) operation	- should initiate to keep pedestrian Bridge - Should keep speed limit board place to place
19	Jansewa, Nagsthan	15	1	0	10	4	0	8	4	4	- Because of Intersection	Kept Board of "Stop, Look, Go" at Nagsthan - Assigned traffic duty	
15	Bhaisepati Aawas	9	2	0	4	0	0	12	3	0	- Uphill, downhill Road - Undergoing road maintenance - No Traffic Sign - High Speed	- Assign duty on peak hour - Informed the driver to decrease the speed	- Initiate to put Traffic Sign - Should make speed breaker

Source: Traffic Police

The locations of the black spots indicated in the above table are shown in the figure bellow.

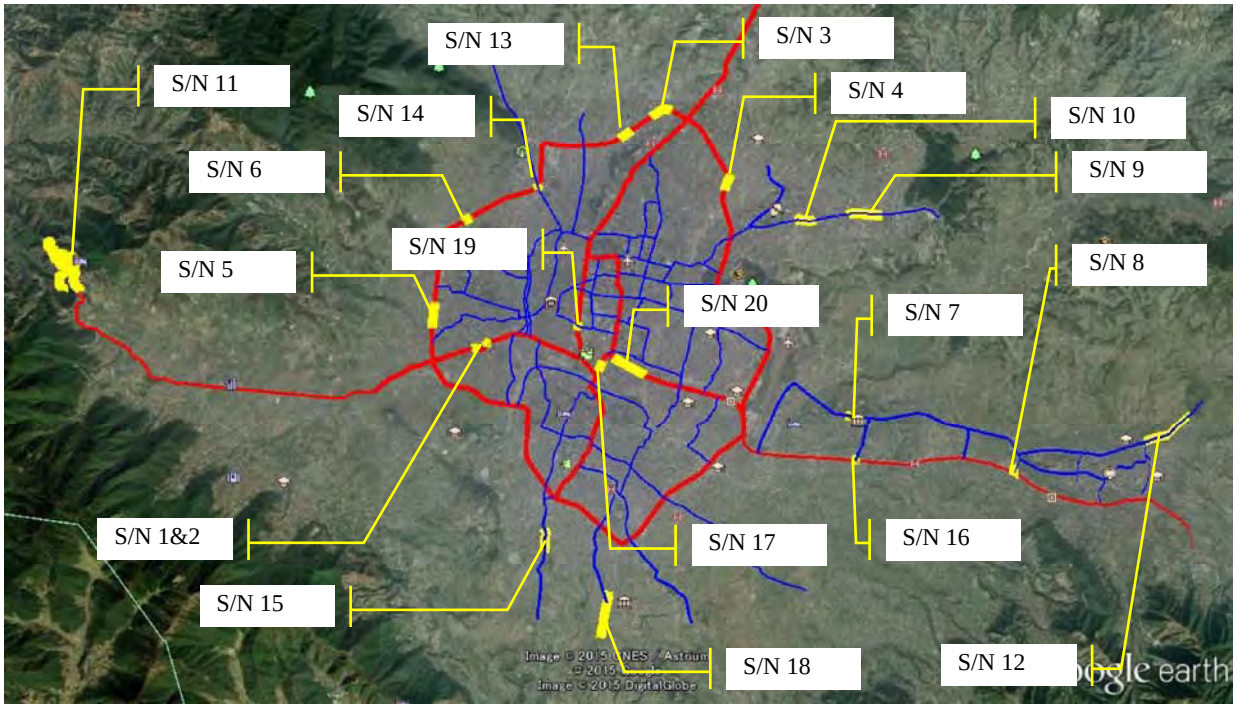


Figure 1.9.1 Location of Black Spots

1.10 Carrier Interview Survey

Carrier interview survey was conducted to the companies affiliated to the Truck Transport Entrepreneurs Association Nepal (ETTAN). Total number of companies interviewed was 51.

1.10.1 Company Profile

Table 1.10.1 The Number of Companies by Employee Size

No. of employees	No. of companies
2	21
3-5	13
6-10	12
11-20	2
21-30	1
31-40	1
41-50	1
Total	51

Table 1.10.2 The Number of Companies by Capital Size

Amount of capital (NRP)	No. of companies
1,000,000-2,000,000	20
2,000,000-5,000,000	16
5,000,000-10,000,000	8
10,000,000-	5
N.A.	2
Total	51

1.10.2 Assets

Table 1.10.3 The Number of Trucks Owned by Companies by Type

Type of truck	Number
Light truck	0
Medium goods vehicle	2
heavy goods vehicle	154
Total	156
Average	3.1

Table 1.10.4 The Number of Companies by Number of Trucks Owned

	Number of trucks owned by the company												
No. of trucks	1	2	3	4	5	6	7	8	9	10	11-15	16-20	Total
No. of company	21	13	4	4	4	0	1	1	1	0	1	1	51

1.10.3 Parking Place of Trucks

Table 1.10.5 Location of Parking Place of Trucks

Location	No. of Companies
Kalanki	16
Balkhu	9
Kuleshower	3
Mahadev Besi	3
Dhungeada	2
Kritipur	2
Naubesi	2
Satungal	2
Thankot	2
Baisepati	1
Balaju	1
Chaimale	1
Lalitpur	1
Naikap	1
Pulchowk	1
Sanepa	1
Sano Bharyang	1
Sorkhute	1
Tripureshower	1
Total	51

1.10.4 Type of Goods

Table 1.10.6 The Number of Companies by Type of Major Carrying Goods

Type of goods	Company
All type of goods	20
Construction material	9
Cement	19
Milk &Construction Material	1
Colth, Cement, Agricultural	1
Sand and Stone	1
Total	51

1.10.5 Freight Volume

Table 1.10.7 Total Freight Volume Carried by Carriers

Total number of trucks	Total freight volume (t/year)	Avarage freight volume by a truck (t/year, vehicle)	Avarage freight volume by a truck by a workday (t/year, vehicle, day)
156	218,970	1,404	4.48

Note: Workday is counted as 313 days.

1.11 Roadside Freight OD Survey

Roadside freight OD Survey was conducted at the survey points from TC01 to TC17 shown in Figure APP 1.3.1.

Total number of vehicles interviewed is shown in Table APP. 1.11.1.

Table 1.11.1 The Number of Vehicles Interviewed for Freight OD

Survey point	Direction 1: from center 2: to center	All the traffic volume				Roadside freight OD interviewed			
		Light Truck	MGV	HGV	Total	Light Truck	MGV	HGV	Total
TC01	1	223	59	65	347	7	19	28	54
TC01	2	558	138	75	771	37	18	25	80
TC02	1	235	338	60	633	10	152	17	179
TC02	2	362	461	96	919	20	153	10	183
TC03	1	1,543	678	553	2,774	49	78	138	265
TC03	2	1,339	723	443	2,505	35	58	75	168
TC04	1	269	210	61	540	8	24	29	61
TC04	2	406	167	73	646	10	28	39	77
TC05	1	500	321	105	926	5	36	19	60
TC05	2	715	269	88	1,072	18	64	29	111
TC06	1	160	188	105	453	27	64	36	127
TC06	2	354	177	105	636	32	24	31	87
TC07	1	484	285	65	834	2	74	10	86
TC07	2	232	222	33	487	43	42	27	112
TC08	1	890	353	836	2,079	34	111	238	383
YC08	2	381	400	988	1,769	33	63	164	260
TC09	1	116	46	6	168	47	11	6	64
TC09	2	155	52	11	218	49	16	4	69
TC10-1	1	89	148	56	293	3	82	56	141
TC10-1	2	88	117	41	246	30	51	41	122
TC10-2	1	129	117	114	360	19	55	40	114

TC10-2	2	131	132	76	339	13	28	15	56
TC11	1	780	671	922	2,373	17	90	142	249
TC11	2	701	727	739	2,167	29	76	81	186
TC12	1	185	116	33	334	3	16	10	29
TC12	2	160	185	36	381	9	22	11	42
TC13	1	131	144	42	317	19	37	9	65
TC13	2	151	141	26	318	42	12	12	66
TC14	1	502	651	1,102	2,255	4	105	246	355
TC14	2	454	511	867	1,832	28	135	73	236
TC15	1	91	180	973	1,244	31	180	346	557
TC15	2	121	86	1,017	1,224	2	43	497	542
TC16	1	224	229	172	625	27	77	24	128
TC16	2	234	163	112	509	30	59	39	128
TC17	1	593	653	373	1,619	2	134	99	235
TC17	2	550	811	412	1,773	41	149	45	235
Total		14,236	10,869	10,881	35,986	815	2,386	2,711	5,912

Table 1.11.2 The Number of Trucks Interviewed by Survey Point per Direction

Unit: Vehicles

Zone No.	Light Truck			Medium Goods Vehicle			Heavy Goods Vehicl			Total		
	Arrive	Send	Total	Arrive	Send	Total	Arrive	Send	Total	Arrive	Send	Total
101	51	13	64	23	34	57	2	22	24	76	69	145
102	44	51	95	1	10	11	5	3	8	50	64	114
103	120	16	136	35	16	51	25	22	47	180	54	234
104	0	1	1	0	5	5	0	2	2	0	8	8
105	452	230	682	283	185	468	150	97	247	885	512	1,397
106	61	75	136	376	87	463	90	86	176	527	248	775
107	246	24	270	119	62	181	62	34	96	427	120	547
108	1	32	33	2	2	4	8	12	20	11	46	57
109	4	127	131	91	129	220	43	42	85	138	298	436
110	1,450	878	2,328	623	519	1,142	479	424	903	2,552	1,821	4,373
111	9	55	64	60	22	82	31	63	94	100	140	240
112	261	400	661	316	390	706	224	266	490	801	1,056	1,857
113	2	0	2	12	2	14	13	0	13	27	2	29
114	12	16	28	35	17	52	33	7	40	80	40	120
115	0	0	0	0	0	0	0	0	0	0	0	0
116	48	88	136	84	36	120	48	41	89	180	165	345
117	24	1	25	2	2	4	4	2	6	30	5	35
118	9	1	10	19	112	131	7	3	10	35	116	151
119	1,401	331	1,732	414	253	667	303	236	539	2,118	820	2,938
201	2	56	58	21	52	73	1	3	4	24	111	135
202	202	396	598	123	252	375	34	37	71	359	685	1,044
301	50	56	106	86	49	135	45	33	78	181	138	319
301	189	84	273	52	19	71	25	9	34	266	112	378
303	303	527	830	336	373	709	209	228	437	848	1,128	1,976
304	419	242	661	454	232	686	117	114	231	990	588	1,578
305	432	144	576	89	26	115	42	13	55	563	183	746
401	127	196	323	38	111	149	23	15	38	188	322	510
402	339	270	609	99	197	296	43	32	75	481	499	980
403	123	44	167	87	76	163	59	41	100	269	161	430
404	29	154	183	4	110	114	1	4	5	34	268	302
501	213	278	491	123	138	261	104	65	169	440	481	921
502	147	2	149	15	1	16	21	4	25	183	7	190
601	1	29	30	37	36	73	1	1	2	39	66	105
602	57	387	444	282	306	588	23	20	43	362	713	1,075

603	104	255	359	72	145	217	5	12	17	181	412	593
604	424	634	1,058	220	283	503	134	110	244	778	1,027	1,805
605	479	405	884	112	170	282	114	112	226	705	687	1,392
606	149	149	298	89	50	139	55	27	82	293	226	519
607	39	8	47	62	30	92	57	22	79	158	60	218
608	1,655	112	1,767	521	162	683	24	31	55	2,200	305	2,505
609	78	99	177	32	78	110	114	132	246	224	309	533
609	348	67	415	27	58	85	28	12	40	403	137	540
701	5	6	11	15	8	23	11	6	17	31	20	51
702	532	178	710	246	162	408	105	75	180	883	415	1,298
703	719	573	1,292	239	383	622	82	115	197	1,040	1,071	2,111
704	988	527	1,515	282	320	602	122	81	203	1,392	928	2,320
801	181	261	442	59	48	107	65	32	97	305	341	646
802	67	138	205	32	147	179	3	12	15	102	297	399
803	82	132	214	34	95	129	24	13	37	140	240	380
901	72	34	106	53	43	96	26	44	70	151	121	272
911	296	824	1,120	422	374	796	643	507	1,150	1,361	1,705	3,066
912	132	1,130	1,262	227	284	511	282	666	948	641	2,080	2,721
913	54	314	368	147	229	376	152	126	278	353	669	1,022
914	70	1,360	1,430	245	192	437	1,174	1,312	2,486	1,489	2,864	4,353
920	331	314	645	11	366	377	57	124	181	399	804	1,203
Total	13,633	13,633	27,266	7,488	7,488	14,976	5,552	5,552	11,104	26,673	26,673	53,346

Table 1.11.3 Freight Volume by Survey Point per Direction

Unit: t

Zone No.	Light Truck			Medium Goods Vehicle			Heavy Goods Vehicl			Total		
	Arrive	Send	Total	Arrive	Send	Total	Arrive	Send	Total	Arrive	Send	Total
101	58	2	60	143	59	202	19	130	149	220	191	411
102	0	76	76	2	10	12	31	51	82	33	137	170
103	364	6	370	145	29	174	340	149	489	849	184	1,032
104	0	0	0	0	42	42	0	20	20	0	62	62
105	696	334	1,030	1,017	423	1,440	1,669	700	2,369	3,381	1,457	4,838
106	107	42	149	3,367	474	3,841	1,036	361	1,396	4,509	876	5,386
107	106	220	326	504	214	718	599	389	988	1,210	823	2,033
108	6	21	27	12	27	39	101	168	269	119	216	335
109	10	1	11	167	462	629	306	421	727	483	884	1,366
110	2,888	18,290	21,179	4,159	4,843	9,002	4,763	2,170	6,933	11,810	25,303	37,113
111	14	137	151	238	62	300	386	387	773	637	586	1,223
112	430	815	1,244	1,733	751	2,484	2,659	1,332	3,991	4,821	2,898	7,719
113	7	0	7	48	0	48	30	0	30	85	0	85
114	35	0	35	204	54	258	294	39	333	533	93	626
115	0	0	0	0	0	0	0	0	0	0	0	0
116	64	524	588	311	272	583	575	31	606	950	827	1,777
117	46	304	349	25	32	57	88	12	100	159	348	506
118	0	0	0	113	16	129	32	0	32	145	16	161
119	1,715	648	2,363	1,927	1,536	3,464	3,012	954	3,966	6,654	3,138	9,792
201	0	12	12	154	156	310	8	32	40	162	200	362
202	0	466	466	3,090	1,559	4,649	444	410	854	3,534	2,435	5,969
301	110	174	284	398	184	582	439	237	676	947	595	1,542
301	278	136	414	206	42	248	318	10	328	802	188	990
303	765	1,587	2,352	1,080	1,255	2,334	1,732	1,439	3,171	3,577	4,280	7,856
304	214	55	269	3,453	492	3,945	1,143	494	1,637	4,810	1,040	5,850
305	278	419	697	237	102	339	412	127	539	927	648	1,575
401	359	2,017	2,376	190	164	354	94	55	149	642	2,236	2,878

402	489	142	631	233	431	664	338	97	435	1,060	670	1,729
403	144	5	148	195	143	338	591	56	646	929	203	1,132
404	0	112	112	8	266	274	5	22	27	13	399	412
501	265	129	394	389	377	766	980	106	1,086	1,634	611	2,245
502	1	0	1	1	2	3	62	15	77	64	17	81
601	1	12	13	145	111	256	18	8	26	164	131	295
602	1,925	101	2,026	1,804	1,339	3,143	99	211	310	3,828	1,651	5,479
603	2	120	122	572	504	1,076	72	115	187	646	739	1,385
604	718	809	1,527	573	1,144	1,717	1,360	708	2,068	2,651	2,661	5,313
605	952	1,452	2,404	502	616	1,117	1,367	475	1,842	2,820	2,543	5,363
606	684	520	1,204	347	151	498	609	255	864	1,640	926	2,566
607	11	0	11	244	84	328	665	42	707	919	126	1,045
608	629	0	629	678	946	1,624	3,177	122	3,299	4,484	1,068	5,552
609	148	57	205	128	510	638	1,460	871	2,331	1,736	1,438	3,174
609	2,570	55	2,625	89	313	402	271	114	385	2,930	482	3,412
701	25	130	155	87	25	112	124	16	140	236	171	407
702	1,171	448	1,619	1,575	570	2,145	1,247	695	1,942	3,993	1,713	5,706
703	1,013	762	1,775	850	1,291	2,142	694	937	1,631	2,558	2,990	5,548
704	349	405	754	523	505	1,028	899	140	1,039	1,771	1,050	2,821
801	84	1,230	1,313	375	118	493	535	47	582	994	1,395	2,388
802	6	27	33	59	302	361	30	30	60	95	359	454
803	139	113	253	86	177	263	151	11	162	376	301	677
901	63	194	257	182	107	289	137	246	383	382	547	929
911	15,537	1,569	17,106	1,518	2,694	4,211	5,973	4,729	10,702	23,028	8,991	32,019
912	214	732	946	1,577	2,195	3,771	790	9,187	9,977	2,581	12,113	14,695
913	0	162	162	551	1,464	2,015	1,248	819	2,067	1,799	2,445	4,243
914	153	271	425	683	1,736	2,419	5,843	17,647	23,490	6,679	19,654	26,333
920	0	0	0	22	5,538	5,560	504	1,943	2,447	526	7,481	8,007
Total	35,841	35,841	71,681	36,915	36,915	73,830	49,778	49,778	99,556	122,534	122,533	245,067

APPENDIX 2 TRAFFIC DEMAND FORECAST

2.1 Trip Generation and Attraction

Table 2.1.1 Trip Generation by Zone in 2020

Person trips per day

Small Zone		Trip Generation					
		To Work	To School	Business	Others	To Home	Total
1	101	3,041	2,982	1,566	2,648	27,947	38,183
2	102	5,330	4,405	1,586	2,128	18,996	32,445
3	103	39,372	26,233	6,636	16,502	93,268	182,012
4	104	5,994	5,693	452	3,784	6,011	21,934
5	105	34,109	40,058	17,045	24,623	90,757	206,591
6	106	19,241	18,801	6,787	13,839	40,407	99,076
7	107	31,048	34,152	8,558	17,478	96,123	187,359
8	108	7,067	5,662	3,724	3,485	45,053	64,990
9	109	8,297	7,686	1,524	2,680	4,521	24,708
10	110	28,939	39,550	13,530	14,582	117,628	214,228
11	111	20,143	18,483	4,547	6,967	39,679	89,819
12	112	24,716	30,060	6,751	13,945	72,054	147,526
13	113	14,611	10,751	1,701	6,016	16,956	50,036
14	114	11,470	8,397	6,243	7,632	59,419	93,161
15	115	3,081	3,352	2,574	2,487	21,580	33,074
16	116	13,899	13,836	3,881	7,440	65,058	104,115
17	117	3,892	5,849	6,430	2,482	51,028	69,680
18	118	31,565	14,092	5,804	9,207	67,578	128,246
19	119	30,915	38,894	15,840	24,613	83,385	193,646
20	201	21,686	12,140	3,476	14,542	25,431	77,275
21	202	10,479	5,205	1,997	10,957	61,189	89,827
22	301	20,996	13,515	4,037	8,756	56,803	104,107
23	302	10,568	11,019	2,585	6,480	31,000	61,653
24	303	13,635	13,826	5,358	12,144	82,904	127,867
25	304	22,432	18,433	3,872	10,311	30,410	85,458
26	305	8,127	5,526	1,765	4,069	31,209	50,696
27	306	5,160	2,873	699	2,323	705	11,760
28	401	6,057	7,231	1,995	4,942	54,609	74,834
29	402	4,423	4,763	702	1,340	13,064	24,293
30	403	7,434	3,076	1,589	4,399	24,292	40,790
31	404	6,747	3,371	1,043	2,830	69,423	83,413
32	501	22,528	16,665	4,344	10,136	80,030	133,703
33	502	19,354	14,439	2,411	8,361	70,909	115,473
34	601	7,126	13,312	2,642	1,580	10,022	34,682
35	602	11,012	10,661	1,931	2,078	10,150	35,833
36	603	4,067	7,879	1,410	3,710	5,879	22,945
37	604	56,437	70,391	5,158	25,982	64,977	222,945

38	605	60,329	70,158	12,907	25,470	47,014	215,879
39	606	26,047	39,993	5,451	15,767	20,643	107,902
40	607	21,201	29,625	6,022	16,031	26,504	99,384
41	608	8,755	9,015	1,066	6,627	9,083	34,546
42	609	19,769	18,881	4,628	8,332	52,437	104,047
43	610	927	1,707	109	260	1,225	4,228
44	701	13,303	8,530	1,213	6,161	12,329	41,536
45	702	17,855	15,762	2,305	10,208	18,234	64,365
46	703	8,996	8,807	1,631	5,533	11,044	36,011
47	704	24,237	20,326	5,241	12,092	9,685	71,581
48	801	22,408	17,919	1,777	10,611	125,112	177,827
49	802	3,686	4,224	659	4,799	6,080	19,449
50	803	8,174	14,798	1,956	2,941	35,201	63,069
Total		830,686	823,003	207,163	442,311	2,115,043	4,418,206

Source: JST

Table 2.1.2 Trip Attraction by Zone in 2020

Person trips per day

Small Zone		Trip Attraction					
		To Work	To School	Business	Others	To Home	Total
1	101	15,841	8,140	2,857	4,865	8,182	39,884
2	102	10,041	6,771	2,582	3,147	11,089	33,629
3	103	40,399	38,364	8,915	21,466	76,064	185,208
4	104	2,285	3,179	421	1,511	14,087	21,483
5	105	33,914	45,534	11,646	22,990	86,807	200,890
6	106	18,968	16,248	6,105	13,894	43,188	98,404
7	107	32,270	53,834	9,823	14,338	77,778	188,044
8	108	26,931	12,833	4,717	6,452	15,598	66,531
9	109	2,508	1,854	566	541	17,887	23,355
10	110	42,514	50,975	18,839	35,588	75,500	223,416
11	111	14,885	18,543	3,663	8,154	43,908	89,154
12	112	27,278	37,437	9,189	14,409	61,736	150,049
13	113	6,171	9,282	1,317	3,335	29,051	49,156
14	114	32,135	6,805	12,198	26,905	24,632	102,675
15	115	8,531	3,830	5,048	10,392	9,206	37,008
16	116	31,879	22,889	8,848	10,686	35,379	109,680
17	117	26,049	16,397	7,203	8,283	13,592	71,524
18	118	31,162	29,339	8,223	9,165	52,769	130,658
19	119	29,813	38,721	12,222	23,290	85,738	189,783
20	201	10,473	13,203	1,740	7,553	41,280	74,249
21	202	16,606	8,837	2,111	20,833	43,377	91,764
22	301	27,730	23,366	6,021	7,609	41,153	105,879
23	302	12,490	14,362	2,732	6,050	26,086	61,720
24	303	25,673	36,203	8,549	21,977	40,472	132,874
25	304	12,536	13,113	2,739	6,809	48,482	83,679

26	305	13,275	11,781	3,608	8,249	16,398	53,311
27	306	386	231	152	255	9,807	10,831
28	401	20,207	9,218	2,337	11,769	32,906	76,437
29	402	5,552	4,479	989	4,310	9,798	25,128
30	403	10,512	10,333	1,969	4,782	13,644	41,240
31	404	22,509	1,139	1,222	6,738	52,706	84,314
32	501	32,797	26,224	5,055	11,323	59,235	134,633
33	502	20,626	4,462	2,054	7,721	80,134	114,998
34	601	3,506	6,041	821	416	21,862	32,646
35	602	4,749	7,450	545	1,103	20,419	34,267
36	603	2,516	4,698	698	1,990	12,013	21,915
37	604	25,898	47,701	4,077	11,582	129,948	219,205
38	605	27,888	45,018	6,220	11,398	116,068	206,592
39	606	7,567	22,056	1,914	5,341	65,562	102,439
40	607	8,795	14,473	4,215	6,008	62,234	95,725
41	608	3,323	6,043	902	2,448	20,894	33,610
42	609	21,069	16,412	3,944	7,695	54,125	103,245
43	610	402	1,125	0	188	2,390	4,105
44	701	5,988	6,709	553	1,869	24,965	40,084
45	702	6,570	10,870	1,152	4,358	39,181	62,131
46	703	4,693	6,134	1,025	2,813	20,237	34,903
47	704	8,725	12,559	1,873	5,445	38,384	66,986
48	801	23,881	7,476	1,514	9,799	134,743	177,414
49	802	1,458	2,310	384	1,752	12,707	18,611
50	803	8,712	8,001	1,666	2,716	41,643	62,738
Total		830,686	823,003	207,163	442,311	2,115,043	4,418,206

Source: JST

Table 2.1.3 Trip Generation by Zone in 2025

Person trips per day

Small Zone		Trip Attraction					
		To Work	To School	Business	Others	To Home	Total
1	101	3,228	3,056	1,704	2,765	29,714	40,467
2	102	5,401	4,309	1,648	2,121	19,165	32,644
3	103	41,452	26,658	7,163	17,086	97,018	189,376
4	104	5,937	5,443	459	3,686	5,931	21,456
5	105	35,605	39,920	18,185	25,518	91,756	210,983
6	106	21,336	19,904	7,692	15,236	43,780	107,947
7	107	30,483	32,365	8,615	16,876	93,177	181,515
8	108	7,469	5,775	4,035	3,621	47,720	68,620
9	109	7,782	6,957	1,465	2,472	4,135	22,811
10	110	29,518	38,940	14,150	14,627	119,327	216,562
11	111	20,812	18,432	4,817	7,079	40,347	91,487
12	112	24,541	28,809	6,873	13,617	70,644	144,484
13	113	13,289	9,438	1,586	5,381	15,219	44,914

14	114	10,325	7,296	5,762	6,756	54,107	84,247
15	115	2,804	2,945	2,402	2,226	19,830	30,207
16	116	13,814	13,273	3,955	7,272	64,210	102,525
17	117	3,927	5,697	6,653	2,463	51,558	70,297
18	118	30,464	13,127	5,743	8,738	64,412	122,484
19	119	33,247	39,933	17,411	26,280	86,411	203,283
20	201	21,270	11,368	3,484	14,160	23,704	73,987
21	202	10,855	5,147	2,115	11,268	60,789	90,175
22	301	22,956	14,263	4,526	9,415	61,507	112,666
23	302	11,803	11,880	2,961	7,118	34,345	68,107
24	303	15,453	15,125	6,226	13,536	93,224	143,565
25	304	23,550	18,679	4,168	10,645	31,331	88,374
26	305	7,939	5,211	1,768	3,909	30,534	49,361
27	306	4,939	2,655	686	2,187	668	11,135
28	401	9,802	11,172	3,299	7,941	84,674	116,887
29	402	4,214	4,332	683	1,268	12,115	22,612
30	403	7,533	2,975	1,646	4,425	23,845	40,424
31	404	6,510	3,105	1,028	2,711	62,188	75,541
32	501	23,337	16,481	4,599	10,424	78,860	133,701
33	502	22,825	16,257	2,906	9,789	77,589	129,367
34	601	7,111	12,683	2,695	1,565	9,778	33,831
35	602	11,186	10,338	2,005	2,096	9,863	35,487
36	603	3,920	7,251	1,390	3,551	5,732	21,845
37	604	56,879	67,726	5,313	25,997	63,358	219,273
38	605	60,393	67,050	13,206	25,314	46,782	212,744
39	606	26,620	39,020	5,693	15,998	26,262	113,593
40	607	21,020	28,042	6,102	15,780	25,279	96,223
41	608	8,496	8,353	1,058	6,385	8,460	32,752
42	609	35,699	32,549	8,542	14,937	89,168	180,895
43	610	841	1,477	101	234	987	3,640
44	701	16,243	9,943	1,513	7,469	14,406	49,575
45	702	24,349	20,520	3,213	13,820	23,614	85,517
46	703	14,429	13,485	2,674	8,810	16,960	56,359
47	704	29,994	24,014	6,629	14,856	13,430	88,923
48	801	23,212	17,721	1,881	10,912	119,145	172,872
49	802	12,713	13,909	2,324	16,432	19,818	65,196
50	803	37,016	63,973	9,051	13,222	148,919	272,181
Total		924,545	898,979	233,802	489,997	2,335,793	4,883,116

Source: JST

Table 2.1.4 Trip Attraction by Zone in 2025

Person trips per day

Small Zone		Trip Attraction					
		To Work	To School	Business	Others	To Home	Total
1	101	17,004	8,637	3,186	5,271	8,280	42,377
2	102	10,287	6,858	2,748	3,254	10,791	33,937
3	103	43,004	40,367	9,858	23,063	76,803	193,094
4	104	2,288	3,147	438	1,527	13,665	21,066
5	105	35,246	46,777	12,572	24,115	86,420	205,130
6	106	20,941	17,731	7,002	15,483	46,142	107,299
7	107	32,034	52,824	10,130	14,366	73,246	182,600
8	108	28,776	13,554	5,235	6,958	15,868	70,392
9	109	2,378	1,738	558	517	16,379	21,569
10	110	43,846	51,967	20,182	37,046	73,390	226,430
11	111	15,550	19,148	3,975	8,598	43,635	90,905
12	112	27,385	37,151	9,582	14,600	58,643	147,361
13	113	5,675	8,437	1,258	3,095	25,729	44,195
14	114	29,248	6,122	11,532	24,716	21,471	93,090
15	115	7,851	3,484	4,826	9,653	8,088	33,901
16	116	32,036	22,737	9,236	10,839	33,569	108,416
17	117	26,578	16,537	7,634	8,530	13,037	72,317
18	118	30,408	28,299	8,336	9,027	49,057	125,126
19	119	31,922	40,982	13,593	25,170	87,608	199,275
20	201	10,227	12,744	1,765	7,444	38,938	71,119
21	202	17,127	9,009	2,262	21,686	42,021	92,104
22	301	30,654	25,532	6,915	8,490	43,307	114,897
23	302	14,106	16,032	3,205	6,896	28,074	68,313
24	303	29,420	41,007	10,176	25,419	43,526	149,548
25	304	13,306	13,759	3,020	7,295	49,272	86,653
26	305	13,113	11,502	3,702	8,224	15,493	52,034
27	306	374	221	153	249	9,273	10,270
28	401	32,557	14,681	3,912	19,139	49,128	119,416
29	402	5,266	4,200	974	4,126	8,826	23,392
30	403	10,605	10,305	2,063	4,869	13,075	40,917
31	404	21,623	1,081	1,219	6,533	45,930	76,386
32	501	33,824	26,734	5,415	11,786	56,990	134,750
33	502	24,219	5,179	2,506	9,151	87,803	128,857
34	601	3,483	5,933	847	417	21,107	31,788
35	602	4,802	7,448	573	1,126	19,940	33,889
36	603	2,415	4,458	696	1,928	11,377	20,873
37	604	25,985	47,311	4,249	11,729	126,492	215,768
38	605	27,795	44,351	6,439	11,466	113,556	203,608
39	606	7,699	22,184	2,023	5,485	70,734	108,124
40	607	8,682	14,122	4,322	5,986	59,655	92,766
41	608	3,211	5,771	905	2,387	19,641	31,915

42	609	37,879	29,167	7,365	13,963	91,178	179,552
43	610	363	1,004	0	171	1,990	3,528
44	701	7,279	8,062	699	2,293	29,542	47,875
45	702	8,920	14,589	1,625	5,972	51,480	82,586
46	703	7,494	9,683	1,701	4,534	31,242	54,653
47	704	10,749	15,295	2,397	6,771	48,095	83,308
48	801	24,630	7,621	1,622	10,200	128,418	172,491
49	802	5,006	7,841	1,369	6,073	42,180	62,468
50	803	39,277	35,656	7,804	12,359	175,690	270,787
Total		924,545	898,979	233,802	489,997	2,335,793	4,883,116

Source: JST

Table 2.1.5 Trip Generation by Zone in 2030

Person trips per day

Small Zone		Trip Attraction					
		To Work	To School	Business	Others	To Home	Total
1	101	3,527	3,208	1,921	2,975	32,277	43,908
2	102	5,668	4,345	1,784	2,192	19,973	33,961
3	103	45,447	28,088	8,100	18,450	105,275	205,361
4	104	6,101	5,374	487	3,730	6,041	21,733
5	105	38,513	42,277	20,481	26,850	97,029	225,151
6	106	24,313	22,205	9,127	16,888	48,985	121,518
7	107	31,295	31,932	9,123	17,065	94,628	184,044
8	108	8,234	6,119	4,588	3,932	52,366	75,239
9	109	7,544	6,482	1,465	2,360	3,974	21,826
10	110	31,452	39,874	15,551	15,351	126,045	228,272
11	111	22,424	19,086	5,353	7,513	43,054	97,429
12	112	25,472	28,736	7,358	13,920	72,667	148,154
13	113	12,452	8,499	1,533	4,966	14,113	41,564
14	114	9,609	6,525	5,531	6,193	50,137	77,994
15	115	2,645	2,669	2,337	2,068	18,569	28,287
16	116	14,336	13,238	4,234	7,434	66,134	105,375
17	117	4,146	5,779	7,243	2,561	54,069	73,798
18	118	30,691	12,710	5,968	8,671	64,191	122,231
19	119	36,882	43,371	20,111	28,359	93,637	222,359
20	201	21,592	11,298	3,683	13,983	23,425	73,982
21	202	11,160	5,181	2,264	11,269	61,162	91,036
22	301	26,071	15,567	5,301	10,532	69,235	126,705
23	302	13,639	13,192	3,529	8,101	39,253	77,714
24	303	18,071	16,998	7,510	15,590	107,705	165,875
25	304	25,773	19,645	4,705	11,475	33,889	95,486
26	305	8,088	5,101	1,858	3,922	30,816	49,784
27	306	4,967	2,566	712	2,166	668	11,079

28	401	14,092	15,726	4,939	11,106	119,322	165,185
29	402	4,126	4,153	697	1,208	11,610	21,794
30	403	7,889	3,050	1,795	4,508	24,474	41,716
31	404	6,446	3,010	1,060	2,611	60,181	73,309
32	501	23,992	16,589	4,923	10,425	79,106	135,035
33	502	27,349	19,071	3,626	11,410	90,701	152,157
34	601	7,331	12,801	2,892	1,570	9,674	34,267
35	602	11,757	10,638	2,194	2,143	9,948	36,679
36	603	3,872	7,013	1,429	3,412	5,475	21,202
37	604	59,422	69,274	5,779	26,420	63,819	224,714
38	605	62,658	68,108	14,266	25,548	46,568	217,148
39	606	28,159	40,412	6,271	16,462	26,394	117,697
40	607	21,538	28,131	6,511	15,729	25,040	96,949
41	608	8,518	8,199	1,104	6,227	8,226	32,274
42	609	45,237	40,383	11,271	18,413	109,980	225,283
43	610	761	1,309	95	206	854	3,227
44	701	19,932	11,946	1,934	8,915	17,088	59,814
45	702	32,121	26,503	4,413	17,735	30,011	110,782
46	703	20,682	18,925	3,992	12,285	23,497	79,381
47	704	30,837	24,172	7,097	14,858	13,363	90,326
48	801	31,448	23,506	2,654	14,382	156,686	228,677
49	802	22,748	24,366	4,329	28,601	33,286	113,331
50	803	38,077	64,428	9,694	13,230	148,232	273,660
Total		1,019,102	961,781	264,820	535,918	2,542,850	5,324,471

Source: JST

Table 2.1.6 Trip Attraction by Zone in 2030

Person trips per day

Small Zone		Trip Attraction					
		To Work	To School	Business	Others	To Home	Total
1	101	18,655	9,261	3,649	5,729	8,822	46,117
2	102	10,840	7,062	3,023	3,397	11,088	35,410
3	103	47,344	43,437	11,331	25,157	82,492	209,761
4	104	2,361	3,174	472	1,561	13,772	21,340
5	105	38,071	49,385	14,178	25,810	91,222	218,666
6	106	23,829	19,721	8,318	17,456	51,484	120,808
7	107	33,024	53,226	10,902	14,674	73,580	185,406
8	108	31,855	14,665	6,051	7,632	17,143	77,346
9	109	2,315	1,653	567	499	15,569	20,603
10	110	46,911	54,344	22,544	39,272	76,364	239,435
11	111	16,823	20,248	4,489	9,217	46,085	96,863
12	112	28,541	37,845	10,427	15,077	59,534	151,424
13	113	5,340	7,759	1,236	2,886	23,684	40,904

14	114	27,332	5,592	11,251	22,885	19,565	86,625
15	115	7,435	3,225	4,771	9,057	7,451	31,940
16	116	33,384	23,158	10,048	11,191	34,064	111,845
17	117	28,171	17,133	8,448	8,959	13,407	76,118
18	118	30,762	27,981	8,804	9,048	48,539	125,133
19	119	35,361	44,372	15,721	27,627	94,760	217,842
20	201	10,367	12,627	1,868	7,477	38,693	71,033
21	202	17,583	9,040	2,424	22,060	41,971	93,078
22	301	34,957	28,458	8,232	9,593	48,231	129,472
23	302	16,366	18,181	3,882	7,928	31,679	78,037
24	303	34,546	47,064	12,475	29,574	49,619	173,277
25	304	14,622	14,778	3,465	7,943	52,823	93,631
26	305	13,413	11,499	3,954	8,335	15,449	52,650
27	306	377	218	161	250	9,188	10,194
28	401	46,743	20,601	5,863	27,227	68,486	168,919
29	402	5,149	4,013	994	3,998	8,423	22,578
30	403	11,090	10,532	2,252	5,045	13,347	42,267
31	404	21,382	1,045	1,259	6,401	44,081	74,168
32	501	34,726	26,827	5,804	11,990	56,843	136,189
33	502	28,978	6,057	3,130	10,848	102,550	151,563
34	601	3,586	5,969	911	425	21,195	32,086
35	602	5,040	7,640	628	1,171	20,465	34,944
36	603	2,382	4,298	716	1,884	10,942	20,222
37	604	27,109	48,242	4,628	12,124	128,967	221,071
38	605	28,797	44,912	6,965	11,770	115,001	207,445
39	606	8,133	22,904	2,231	5,740	72,781	111,788
40	607	8,883	14,123	4,617	6,068	59,679	93,371
41	608	3,214	5,648	946	2,368	19,267	31,443
42	609	47,932	36,074	9,731	17,506	112,342	223,585
43	610	328	887	0	154	1,753	3,122
44	701	8,919	9,655	894	2,784	35,453	57,706
45	702	11,750	18,784	2,234	7,795	66,308	106,871
46	703	10,727	13,547	2,542	6,430	43,665	76,910
47	704	11,036	15,348	2,569	6,888	48,568	84,409
48	801	33,322	10,078	2,291	13,674	168,825	228,190
49	802	8,945	13,693	2,553	10,752	72,500	108,443
50	803	40,345	35,799	8,369	12,579	175,130	272,222
Total		1,019,102	961,781	264,820	535,918	2,542,850	5,324,471

Source: JST

2.2 Trip Distribution by Purpose

Table 2.2.1 Trip Distribution by Purpose by Large Zone in 2020

Person trips per day

Purpose	Large Zone	100	200	300	400	500	600	700	800	Total
To Work	100	246,581	10,516	21,100	14,379	17,042	15,580	1,765	9,765	336,729
	200	15,653	9,319	4,399	667	522	1,092	163	349	32,165
	300	26,689	2,718	34,691	4,446	4,989	3,517	905	2,963	80,917
	400	2,565	37	652	18,751	1,143	211	16	1,286	24,661
	500	12,310	75	2,915	5,072	17,841	762	111	2,795	41,882
	600	97,015	3,602	16,841	5,721	5,690	81,906	711	4,185	215,671
	700	22,882	740	9,009	2,199	2,510	1,832	22,186	3,034	64,392
	800	9,880	72	2,484	7,546	3,685	811	118	9,674	34,269
	Total	433,575	27,079	92,090	58,780	53,423	105,712	25,975	34,051	830,686
To School	100	270,232	8,006	19,839	4,093	7,389	15,604	2,896	875	328,934
	200	6,250	7,725	2,495	99	119	518	120	18	17,345
	300	15,104	2,159	40,066	1,196	1,927	3,039	1,485	216	65,192
	400	3,369	94	1,196	12,505	742	298	70	167	18,441
	500	10,826	171	3,391	1,463	14,045	736	275	197	31,104
	600	90,823	3,183	21,065	2,444	3,743	148,368	1,518	476	271,622
	700	13,097	488	7,395	577	950	1,236	29,545	136	53,424
	800	11,273	214	3,607	2,793	1,772	1,219	363	15,701	36,941
	Total	420,975	22,040	99,054	25,169	30,686	171,018	36,272	17,787	823,003
Business	100	91,090	1,913	9,650	2,288	3,513	4,765	528	1,432	115,180
	200	3,334	804	779	91	99	286	35	46	5,473
	300	8,478	395	6,937	480	687	896	165	280	18,317
	400	2,058	32	466	2,076	325	169	15	188	5,329
	500	3,929	42	841	435	989	271	32	217	6,755
	600	18,988	542	3,395	620	878	16,394	158	351	41,326
	700	4,294	97	1,261	192	333	380	3,651	182	10,391
	800	2,211	26	473	334	286	173	20	868	4,392
	Total	134,382	3,851	23,802	6,516	7,109	23,335	4,604	3,564	207,163
Others	100	132,523	10,875	11,917	6,561	6,490	8,347	1,406	4,419	182,538
	200	11,264	9,889	2,876	336	190	631	153	160	25,498
	300	15,037	3,155	18,069	2,064	1,795	1,826	761	1,376	44,084
	400	2,168	38	558	9,152	582	155	26	833	13,511
	500	7,157	43	1,725	2,127	5,691	395	108	1,250	18,496
	600	51,655	3,527	8,786	2,476	1,871	35,338	595	1,591	105,839
	700	12,686	809	5,224	895	870	923	11,303	1,285	33,994
	800	6,922	51	1,795	3,988	1,554	553	134	3,353	18,351
	Total	239,412	28,386	50,949	27,599	19,044	48,168	14,485	14,268	442,311
To Home	100	592,559	31,087	54,054	7,702	28,972	229,955	46,321	26,797	1,017,447
	200	27,389	39,463	7,450	161	281	9,660	1,887	328	86,620
	300	50,655	9,239	89,835	2,303	7,712	45,070	20,662	7,554	233,030
	400	23,822	1,040	7,325	93,653	8,269	10,183	3,506	13,590	161,389
	500	29,722	796	8,379	2,359	87,828	10,959	4,169	6,724	150,939
	600	37,990	2,125	8,045	636	1,820	191,017	3,821	2,480	247,934
	700	5,807	408	3,010	108	474	2,714	38,182	589	51,292
	800	14,243	498	4,301	2,131	4,012	5,959	4,218	131,031	166,393

	Total	782,188	84,656	182,398	109,054	139,369	505,517	122,768	189,094	2,115,043
All Purpose	100	1,332,986	62,397	116,560	35,024	63,405	274,251	52,916	43,288	1,980,828
	200	63,890	67,200	17,998	1,355	1,212	12,188	2,358	901	167,102
	300	115,964	17,666	189,597	10,489	17,110	54,348	23,978	12,388	441,541
	400	33,982	1,241	10,197	136,136	11,061	11,017	3,633	16,063	223,330
	500	63,945	1,128	17,251	11,456	126,394	13,123	4,695	11,184	249,176
	600	296,471	12,978	58,133	11,896	14,003	473,023	6,802	9,084	882,390
	700	58,765	2,542	25,898	3,971	5,137	7,086	104,868	5,227	213,493
	800	44,530	861	12,659	16,792	11,309	8,715	4,853	160,627	260,345
	Total	2,010,532	166,013	448,293	227,119	249,632	853,750	204,103	258,764	4,418,206

Source: JST

Table 2.2.2 Trip Distribution by Purpose by Large Zone in 2025

Person trips per day

Purpose	Large Zone	100	200	300	400	500	600	700	800	Total
To Work	100	239,917	10,148	21,263	15,381	16,953	18,501	2,145	17,128	341,436
	200	14,975	9,229	4,463	671	515	1,498	204	570	32,125
	300	26,532	2,812	36,747	4,904	5,128	4,708	1,152	4,658	86,642
	400	2,845	35	752	20,753	1,298	299	25	2,052	28,058
	500	12,879	76	3,189	5,690	19,095	1,014	156	4,063	46,162
	600	97,470	3,951	18,220	6,343	5,908	91,041	987	8,245	232,165
	700	28,508	971	11,789	2,778	3,232	3,120	29,557	5,062	85,016
	800	19,331	133	4,549	13,532	5,915	2,134	216	27,133	72,942
	Total	442,457	27,353	100,971	70,051	58,043	122,315	34,442	68,913	924,545
To School	100	259,300	7,545	19,591	4,053	6,711	18,126	3,934	3,017	322,276
	200	5,701	7,345	2,407	92	104	644	163	58	16,515
	300	14,770	2,150	41,263	1,213	1,788	3,841	2,092	696	67,812
	400	3,905	99	1,428	14,169	814	417	125	627	21,584
	500	11,008	171	3,610	1,550	14,462	917	419	599	32,738
	600	87,512	3,310	21,822	2,418	3,475	151,937	2,227	1,788	274,489
	700	15,975	619	9,484	675	1,109	2,008	37,600	494	67,962
	800	28,326	514	8,448	6,097	3,452	3,858	1,069	43,839	95,603
	Total	426,498	21,754	108,053	30,266	31,913	181,748	47,628	51,119	898,979
Business	100	91,787	1,922	10,357	2,652	3,593	5,633	691	3,681	120,317
	200	3,271	816	802	98	97	359	45	111	5,599
	300	8,901	400	7,814	548	692	1,102	215	663	20,335
	400	2,447	35	573	2,427	392	244	24	516	6,657
	500	4,071	42	906	514	1,078	347	46	502	7,505
	600	20,154	621	3,846	753	959	18,547	236	989	46,104
	700	5,394	126	1,650	247	425	606	5,109	472	14,030
	800	5,856	65	1,223	929	685	581	55	3,861	13,256
	Total	141,881	4,027	27,171	8,168	7,921	27,419	6,421	10,795	233,802
Others	100	128,887	10,768	12,131	7,151	6,428	9,203	1,891	7,361	183,819
	200	10,845	9,837	2,966	333	185	803	211	248	25,429
	300	14,931	3,335	19,114	2,279	1,815	2,237	1,061	2,038	46,810
	400	2,609	37	704	10,643	710	218	48	1,375	16,344
	500	7,361	45	1,864	2,402	6,182	477	166	1,717	20,213
	600	51,250	3,890	9,402	2,687	1,899	38,893	880	2,958	111,859

	700	15,952	1,114	6,971	1,190	1,123	1,460	15,029	2,117	44,956
	800	13,994	103	3,421	7,983	2,595	1,367	283	10,820	40,567
	Total	245,829	29,130	56,573	34,668	20,937	54,658	19,570	28,633	489,997
To Home	100	551,792	29,665	53,678	8,913	29,989	227,461	57,704	59,257	1,018,460
	200	26,618	35,969	7,727	164	284	10,485	2,513	733	84,493
	300	50,909	9,329	89,545	2,763	8,344	47,835	27,051	15,833	251,609
	400	25,361	1,039	8,007	97,513	9,230	10,987	4,438	26,246	182,821
	500	28,992	772	8,420	2,700	87,820	10,957	5,272	11,517	156,449
	600	44,255	2,807	10,403	896	2,327	211,515	6,338	7,125	285,667
	700	7,646	543	4,123	190	713	3,944	49,733	1,519	68,410
	800	26,246	834	7,044	3,820	6,086	12,485	7,310	224,059	287,882
	Total	761,819	80,959	188,946	116,959	144,793	535,670	160,359	346,287	2,335,793
All Purpose	100	1,271,684	60,048	117,020	38,150	63,673	278,925	66,365	90,443	1,986,308
	200	61,410	63,197	18,365	1,358	1,185	13,789	3,137	1,720	164,162
	300	116,043	18,027	194,482	11,708	17,767	59,723	31,570	23,888	473,208
	400	37,167	1,245	11,463	145,504	12,444	12,165	4,660	30,816	255,465
	500	64,311	1,106	17,989	12,855	128,637	13,712	6,059	18,399	263,067
	600	300,641	14,579	63,693	13,097	14,567	511,933	10,668	21,105	950,283
	700	73,475	3,372	34,017	5,079	6,601	11,138	137,028	9,663	280,374
	800	93,753	1,650	24,685	32,360	18,732	20,425	8,933	309,712	510,249
	Total	2,018,483	163,223	481,714	260,112	263,607	921,810	268,421	505,746	4,883,116

Source: JST

Table 2.2.3 Trip Distribution by Purpose by Large Zone in 2030

Person trips per day

Purpose	Large Zone	100	200	300	400	500	600	700	800	Total
To Work	100	249,433	10,044	23,276	17,868	17,956	20,549	2,659	18,965	360,749
	200	14,862	9,356	4,702	730	531	1,699	249	624	32,752
	300	28,517	2,966	41,085	5,866	5,579	5,582	1,482	5,532	96,608
	400	3,371	35	930	23,495	1,563	392	39	2,730	32,553
	500	13,925	79	3,610	6,733	20,482	1,200	211	5,099	51,341
	600	101,521	4,130	20,196	7,520	6,274	98,992	1,298	9,323	249,254
	700	33,737	1,186	14,712	3,425	3,681	4,183	36,188	6,461	103,572
	800	22,989	155	5,771	18,727	7,638	2,810	306	33,878	92,273
	Total	468,354	27,950	114,281	84,364	63,704	135,406	42,432	82,612	1,019,102
To School	100	264,667	7,251	21,149	4,529	6,427	18,550	4,716	3,230	330,519
	200	5,566	7,313	2,488	97	95	666	191	63	16,479
	300	15,537	2,169	44,757	1,378	1,729	4,146	2,573	780	73,069
	400	4,812	109	1,828	16,661	929	525	190	886	25,940
	500	11,928	177	4,111	1,830	15,342	1,016	535	722	35,661
	600	89,640	3,343	23,749	2,673	3,337	158,768	2,806	1,952	286,268
	700	18,889	734	11,847	819	1,186	2,513	44,982	575	81,545
	800	32,202	572	10,269	8,205	3,839	4,512	1,340	51,362	112,300
	Total	443,240	21,668	120,199	36,192	32,883	190,696	57,333	59,570	961,781
Business	100	99,457	1,993	12,108	3,315	3,935	6,388	875	4,223	132,293
	200	3,392	863	872	116	104	416	57	126	5,947
	300	10,158	416	9,362	668	733	1,255	268	754	23,615
	400	3,111	42	753	2,968	510	338	37	732	8,491

	500	4,497	45	1,036	658	1,212	419	63	619	8,549
	600	22,123	698	4,445	971	1,069	20,963	323	1,222	51,813
	700	6,453	158	2,057	322	500	810	6,542	593	17,435
	800	7,041	78	1,536	1,350	872	782	75	4,945	16,677
	Total	156,230	4,292	32,170	10,369	8,935	31,372	8,239	13,213	264,820
Others	100	132,336	10,697	13,128	8,312	6,664	10,030	2,478	7,833	191,477
	200	10,511	9,732	3,068	350	185	884	268	256	25,253
	300	15,949	3,531	21,286	2,719	1,930	2,600	1,442	2,329	51,785
	400	3,206	38	907	12,203	877	289	83	1,829	19,432
	500	7,617	46	2,020	2,768	6,622	530	227	2,004	21,835
	600	51,631	3,988	10,091	3,052	1,929	41,129	1,185	3,126	116,130
	700	18,647	1,375	8,630	1,534	1,263	1,911	17,799	2,633	53,792
	800	17,239	131	4,492	11,732	3,369	1,839	415	16,996	56,213
	Total	257,136	29,537	63,622	42,671	22,838	59,212	23,897	37,005	535,918
To Home	100	562,626	29,106	57,222	10,830	32,143	233,790	68,022	69,424	1,063,164
	200	26,127	35,285	8,050	175	294	10,765	3,055	835	84,587
	300	55,264	9,723	97,973	3,506	9,390	52,277	33,685	19,749	281,566
	400	29,261	1,116	9,489	110,031	10,849	12,713	5,510	36,618	215,587
	500	29,885	779	8,901	3,215	95,655	11,203	5,909	14,259	169,807
	600	47,380	3,095	11,874	1,155	2,653	222,705	8,274	8,840	305,977
	700	9,421	661	5,246	298	934	5,083	60,329	1,988	83,959
	800	28,662	898	8,235	5,126	7,476	13,855	9,210	264,742	338,204
	Total	788,626	80,663	206,989	134,337	159,393	562,392	193,994	416,455	2,542,850
All Purpose	100	1,308,518	59,091	126,882	44,855	67,124	289,308	78,750	103,674	2,078,203
	200	60,457	62,548	19,180	1,468	1,210	14,430	3,820	1,903	165,018
	300	125,424	18,804	214,464	14,138	19,359	65,859	39,450	29,144	526,643
	400	43,761	1,340	13,907	165,358	14,727	14,258	5,859	42,795	302,003
	500	67,852	1,127	19,679	15,205	139,314	14,368	6,945	22,702	287,192
	600	312,294	15,253	70,355	15,372	15,261	542,557	13,886	24,462	1,009,441
	700	87,147	4,114	42,493	6,397	7,563	14,500	165,840	12,250	340,303
	800	108,132	1,834	30,302	45,139	23,193	23,798	11,346	371,923	615,668
	Total	2,113,586	164,111	537,261	307,932	287,752	979,077	325,896	608,855	5,324,471

Source: JST

2.3 Trip Distribution by Mode

Table 2.3.1 Trip Distribution by Mode by Large Zone in 2020

Person trips per day

Mode	Large Zone	100	200	300	400	500	600	700	800	Total
Walk	100	553,436	7,098	13,925	2,472	6,890	30,131	2,680	2,553	619,185
	200	7,258	50,668	2,105	69	68	1,027	150	44	61,389
	300	14,035	2,097	109,839	699	1,571	3,492	2,242	819	134,793
	400	2,389	65	682	94,827	1,594	557	277	3,937	104,329
	500	6,868	65	1,557	1,655	80,427	891	429	2,224	94,116
	600	31,640	1,069	3,644	584	932	331,159	291	523	369,843
	700	2,910	160	2,356	292	452	297	77,014	402	83,883
	800	2,599	43	820	4,107	2,258	507	346	127,157	137,836
	Total	621,136	61,266	134,927	104,704	94,191	368,061	83,430	137,661	1,605,376
Bicycle	100	40,221	4,386	8,126	2,391	4,988	9,105	2,635	2,273	74,125
	200	4,349	293	1,521	69	68	538	136	44	7,017
	300	8,216	1,524	3,589	665	1,582	2,858	1,031	781	20,248
	400	2,310	65	646	5,601	1,552	531	260	1,449	12,414
	500	4,969	65	1,568	1,599	1,740	877	368	635	11,821
	600	9,846	568	3,002	558	919	4,786	267	509	20,455
	700	2,838	144	1,122	274	383	274	1,342	334	6,710
	800	2,308	43	782	1,478	612	492	319	177	6,211
	Total	75,057	7,088	20,356	12,637	11,843	19,462	6,357	6,203	159,003
Motorcycle	100	355,447	19,559	43,043	10,762	24,567	144,804	30,183	21,646	650,012
	200	21,747	9,310	6,402	383	618	4,376	700	196	43,732
	300	42,513	5,845	36,095	3,421	6,059	27,481	12,676	4,266	138,358
	400	10,856	303	3,371	13,653	3,849	4,433	1,578	4,608	42,650
	500	26,455	550	6,289	3,905	20,669	5,098	1,678	4,406	69,049
	600	162,103	4,810	30,570	5,087	5,688	71,530	3,015	2,663	285,465
	700	34,996	794	14,116	1,811	1,907	3,256	13,789	2,528	73,197
	800	23,260	171	4,626	4,882	4,555	2,465	2,302	6,486	48,746
	Total	677,377	41,343	144,512	43,904	67,910	263,442	65,920	46,800	1,351,209
Car	100	145,739	8,223	17,026	4,214	7,581	21,758	4,506	3,565	212,612
	200	8,250	1,179	1,825	195	108	1,693	449	115	13,815
	300	16,397	1,776	12,297	1,011	1,772	3,529	2,361	1,395	40,538
	400	3,763	173	938	6,681	1,508	1,039	392	2,242	16,738
	500	6,959	100	1,849	1,638	4,258	1,284	731	1,478	18,297
	600	24,061	1,919	3,879	1,177	1,433	7,406	399	1,404	41,678
	700	5,025	504	2,596	444	852	417	713	523	11,073
	800	3,476	106	1,414	2,393	1,469	1,301	468	390	11,018
	Total	213,670	13,981	41,825	17,753	18,982	38,427	10,018	11,113	365,770
Bus	100	238,143	23,131	34,440	15,185	19,380	68,454	12,912	13,250	424,894
	200	22,285	5,750	6,144	640	351	4,553	924	501	41,148
	300	34,803	6,424	27,777	4,692	6,125	16,988	5,667	5,127	107,603
	400	14,663	634	4,560	15,374	2,558	4,457	1,127	3,826	47,198
	500	18,693	348	5,988	2,659	19,300	4,974	1,490	2,442	55,894
	600	68,822	4,611	17,038	4,490	5,031	58,141	2,830	3,984	164,948
	700	12,997	941	5,709	1,150	1,544	2,841	12,010	1,440	38,630

	800	12,887	498	5,017	3,932	2,416	3,949	1,418	26,416	56,533
	Total	423,292	42,336	106,672	48,122	56,704	164,357	38,377	56,987	936,848
All Modes	100	1,332,986	62,397	116,560	35,024	63,405	274,251	52,916	43,288	1,980,828
	200	63,890	67,200	17,998	1,355	1,212	12,188	2,358	901	167,102
	300	115,964	17,666	189,598	10,489	17,110	54,348	23,978	12,388	441,541
	400	33,982	1,241	10,197	136,136	11,060	11,017	3,633	16,063	223,330
	500	63,945	1,128	17,251	11,456	126,394	13,123	4,695	11,184	249,176
	600	296,471	12,978	58,133	11,896	14,003	473,023	6,802	9,084	882,390
	700	58,765	2,542	25,898	3,971	5,137	7,086	104,868	5,227	213,493
	800	44,530	861	12,659	16,792	11,309	8,715	4,852	160,627	260,345
	Total	2,010,532	166,013	448,293	227,119	249,632	853,750	204,103	258,764	4,418,206

Source: JST

Table 2.3.2 Trip Distribution by Mode by Large Zone in 2025

Person trips per day

Mode	Large Zone	100	200	300	400	500	600	700	800	Total
Walk	100	526,939	6,763	13,788	2,654	6,903	29,744	3,371	4,997	595,159
	200	6,904	47,582	2,135	69	66	1,146	198	73	58,173
	300	13,867	2,128	112,183	779	1,618	3,776	2,934	1,346	138,632
	400	2,568	65	764	101,043	1,719	622	317	6,013	113,111
	500	6,887	64	1,608	1,785	81,627	888	543	2,726	96,128
	600	31,157	1,185	3,928	651	928	348,691	457	1,192	388,187
	700	3,647	210	3,079	334	571	468	100,365	645	109,318
	800	5,103	71	1,360	6,282	2,768	1,160	579	239,634	256,956
	Total	597,072	58,068	138,845	113,595	96,200	386,493	108,764	256,627	1,755,664
Bicycle	100	38,119	4,254	8,060	2,549	5,038	9,247	3,274	4,597	75,137
	200	4,224	293	1,571	69	66	608	175	73	7,079
	300	8,141	1,575	3,686	721	1,636	3,073	1,331	1,177	21,341
	400	2,464	65	703	5,868	1,662	594	295	2,390	14,041
	500	5,018	64	1,626	1,715	1,807	875	471	1,058	12,634
	600	9,974	639	3,217	623	915	6,006	400	1,115	22,889
	700	3,515	185	1,443	311	491	411	1,770	554	8,679
	800	4,691	71	1,191	2,449	1,048	1,082	528	701	11,760
	Total	76,146	7,146	21,496	14,306	12,662	21,895	8,244	11,665	173,561
Motorcycle	100	321,073	18,493	41,095	12,073	24,328	145,770	36,654	44,329	643,815
	200	20,544	9,333	6,381	382	594	4,916	914	403	43,466
	300	40,416	5,823	36,565	3,755	5,924	30,162	16,155	9,883	148,683
	400	12,315	302	3,736	15,009	4,803	4,487	2,088	10,220	52,959
	500	26,354	532	6,185	4,849	21,528	5,457	2,115	7,828	74,847
	600	162,655	5,339	33,465	5,169	6,031	81,090	4,939	6,855	305,542
	700	42,405	1,035	17,957	2,388	2,388	5,339	18,443	3,744	93,698
	800	48,120	350	10,730	10,874	8,180	6,459	3,283	23,791	111,787
	Total	673,881	41,205	156,115	54,498	73,775	283,680	84,592	107,052	1,474,798
Car	100	175,810	8,318	20,989	4,655	8,420	24,792	6,711	7,329	257,024
	200	8,318	1,488	1,910	194	110	1,957	633	170	14,781
	300	20,201	1,860	15,508	1,163	2,247	4,234	3,704	2,447	51,365
	400	4,176	174	1,100	8,817	1,593	1,209	487	3,977	21,533
	500	7,753	102	2,362	1,731	5,447	1,404	1,018	2,597	22,414

	600	27,178	2,187	4,589	1,356	1,552	10,340	613	2,749	50,564
	700	7,437	705	4,041	547	1,177	644	1,280	1,057	16,887
	800	7,279	160	2,487	4,321	2,612	2,582	943	1,186	21,571
	Total	258,151	14,994	52,986	22,784	23,158	47,162	15,390	21,513	456,138
Bus	100	209,743	22,221	33,089	16,219	18,984	69,372	16,355	29,190	415,173
	200	21,419	4,500	6,367	645	349	5,163	1,217	1,002	40,662
	300	33,418	6,641	26,540	5,289	6,342	18,478	7,446	9,034	113,187
	400	15,645	638	5,160	14,768	2,668	5,253	1,474	8,216	53,822
	500	18,300	345	6,208	2,776	18,228	5,087	1,911	4,189	57,045
	600	69,677	5,229	18,494	5,298	5,142	65,807	4,260	9,195	183,101
	700	16,471	1,238	7,498	1,499	1,975	4,277	15,170	3,663	51,791
	800	28,559	998	8,917	8,434	4,125	9,143	3,599	44,400	108,175
	Total	413,232	41,810	112,272	54,928	57,812	182,580	51,431	108,889	1,022,955
All Modes	100	1,271,683	60,048	117,020	38,150	63,673	278,925	66,365	90,443	1,986,308
	200	61,410	63,197	18,365	1,358	1,185	13,789	3,137	1,720	164,162
	300	116,043	18,027	194,482	11,708	17,767	59,723	31,570	23,888	473,208
	400	37,167	1,245	11,463	145,504	12,444	12,165	4,660	30,816	255,465
	500	64,311	1,106	17,989	12,855	128,637	13,712	6,059	18,399	263,067
	600	300,641	14,579	63,693	13,097	14,567	511,933	10,668	21,105	950,283
	700	73,475	3,372	34,017	5,079	6,601	11,138	137,028	9,663	280,373
	800	93,753	1,650	24,685	32,360	18,732	20,425	8,933	309,712	510,249
	Total	2,018,483	163,223	481,714	260,112	263,607	921,810	268,421	505,746	4,883,116

Source: JST

Table 2.3.3 Trip Distribution by Mode by Large Zone in 2030

Person trips per day

Mode	Large Zone	100	200	300	400	500	600	700	800	Total
Walk	100	535,755	6,580	14,571	3,095	7,165	29,651	3,949	5,645	606,410
	200	6,717	47,151	2,232	74	68	1,180	241	82	57,745
	300	14,639	2,223	122,252	944	1,757	4,133	3,574	1,671	151,193
	400	2,990	71	928	115,026	1,955	735	348	8,192	130,245
	500	7,154	65	1,748	2,032	88,418	910	582	3,505	104,413
	600	31,069	1,220	4,302	769	950	365,270	589	1,318	405,487
	700	4,273	256	3,758	367	612	603	120,782	797	131,448
	800	5,788	81	1,693	8,605	3,565	1,286	714	283,388	305,118
	Total	608,384	57,645	151,483	130,912	104,491	403,768	130,778	304,598	1,892,060
Bicycle	100	38,233	4,201	8,580	2,954	5,346	9,452	3,813	5,142	77,722
	200	4,174	282	1,656	74	68	634	209	82	7,180
	300	8,646	1,659	4,029	852	1,782	3,343	1,609	1,489	23,410
	400	2,851	71	831	6,597	1,885	705	318	3,353	16,610
	500	5,316	65	1,772	1,951	1,961	897	507	1,353	13,823
	600	10,227	667	3,502	739	938	6,754	504	1,238	24,569
	700	4,094	221	1,741	337	530	517	2,086	694	10,220
	800	5,267	81	1,511	3,447	1,344	1,205	662	1,064	14,579
	Total	78,808	7,247	23,622	16,950	13,853	23,508	9,706	14,417	188,112
Motorcycle	100	279,365	17,086	38,814	11,953	22,735	141,740	39,991	49,736	601,420
	200	19,369	9,390	6,434	370	554	5,027	1,048	404	42,596
	300	37,828	5,696	36,382	4,208	5,582	32,197	18,431	11,082	151,408

	400	11,707	291	4,062	16,353	5,723	4,638	2,486	14,844	60,104
	500	24,822	501	5,870	5,988	22,064	5,692	2,255	8,914	76,106
	600	160,294	5,445	35,965	5,055	6,174	85,600	6,117	7,739	312,388
	700	46,977	1,191	20,782	2,865	2,518	6,601	22,567	4,193	107,693
	800	50,664	354	12,127	16,006	9,480	7,356	3,717	33,191	132,897
	Total	631,024	39,955	160,436	62,799	74,831	288,851	96,613	130,104	1,484,612
Car	100	224,933	7,138	24,028	3,283	7,382	29,312	9,822	6,819	312,716
	200	7,669	1,652	1,825	157	67	1,956	791	156	14,273
	300	25,211	1,802	22,030	941	2,590	4,426	5,755	2,496	65,250
	400	3,770	183	1,107	11,733	1,465	1,460	742	5,161	25,621
	500	6,472	93	1,757	1,461	7,306	1,375	1,381	3,163	23,008
	600	26,915	1,949	3,554	1,147	1,151	14,278	971	2,219	52,185
	700	6,834	803	4,841	819	1,596	984	2,440	1,680	19,996
	800	6,581	182	2,719	5,675	2,844	2,761	1,604	2,035	24,400
	Total	308,384	13,803	61,860	25,215	24,402	56,551	23,506	23,727	537,450
Bus	100	129,748	9,706	16,812	1,413	5,341	38,267	10,950	11,157	223,395
	200	11,244	4,073	2,626	79	55	2,007	658	491	21,233
	300	18,060	2,755	23,142	1,170	3,170	9,242	5,559	5,999	69,096
	400	4,612	236	2,216	14,861	1,244	3,512	1,489	9,141	37,311
	500	6,579	116	3,187	1,027	19,564	3,222	1,913	3,639	39,247
	600	38,545	1,755	8,091	2,750	3,557	63,582	3,739	8,279	130,299
	700	10,661	630	6,016	1,667	2,028	3,842	17,965	4,278	47,088
	800	10,222	460	5,154	9,776	3,555	8,439	4,016	51,383	93,005
	Total	229,671	19,731	67,244	32,743	38,515	132,112	46,290	94,367	660,674
New Transport System		100,485	14,380	24,076	22,158	19,155	40,885	10,226	25,175	256,540
		11,285	0	4,407	714	399	3,626	873	687	21,991
		21,040	4,670	6,628	6,023	4,478	12,518	4,522	6,406	66,285
		17,832	488	4,762	788	2,454	3,208	477	2,104	32,112
		17,510	286	5,346	2,746	0	2,272	307	2,129	30,596
		45,244	4,216	14,942	4,912	2,491	7,073	1,966	3,669	84,513
		14,308	1,013	5,355	343	279	1,953	0	607	23,858
		29,610	677	7,099	1,631	2,405	2,752	633	863	45,669
		257,314	25,731	72,615	39,313	31,661	74,287	19,003	41,642	561,564
All Modes	100	1,308,518	59,091	126,882	44,855	67,124	289,308	78,750	103,674	2,078,203
	200	60,457	62,548	19,180	1,468	1,210	14,430	3,820	1,903	165,018
	300	125,424	18,804	214,464	14,138	19,359	65,859	39,450	29,144	526,643
	400	43,761	1,340	13,907	165,358	14,727	14,258	5,859	42,795	302,003
	500	67,852	1,127	19,679	15,205	139,314	14,368	6,945	22,702	287,192
	600	312,294	15,253	70,355	15,372	15,262	542,557	13,886	24,463	1,009,441
	700	87,147	4,114	42,493	6,397	7,563	14,500	165,840	12,250	340,303
	800	108,132	1,834	30,302	45,139	23,193	23,798	11,346	371,924	615,668
	Total	2,113,586	164,111	537,261	307,932	287,752	979,077	325,896	608,855	5,324,471

Source: JST

APPENDIX 3 TECHNICAL TRANSFER

3.1 JICA Strada

3.1.1 Outline of Technical Transfer

3.1.1.1 Background

This project, by the form of technical cooperation for development planning, is expected to transfer the technology for planning method as well as planning procedure. This appendix describes the technical transfer of JICA Strada (Strada: System for Traffic Demand Analysis) which is one of the components of technical transfer.

JICA Strada is the package software for traffic demand forecast operating on the Windows System and was developed as the tool for transport planning in developing countries.

3.1.1.2 Objective

Technical transfer of JICA Strada was conducted to transfer the usage of JICA Strada in order to analyze the existing traffic condition and to evaluate the effect of transport plan by the traffic engineers of Nepal unaided.

3.1.1.3 Goal

The technical transfer was aimed to achieve the following goals:

a. The trainees can analyze the traffic condition and issues in Kathmandu Valley by utilizing JICA Strada and data formulated by the MP study.

b. The trainees attain the knowledge and technique to formulate the data for the urban transport development in new urban area.

3.1.2 Preparation for Training

3.1.2.1 Conditions for Training

(1) Venue

Training room in DOR had been supposed to be the training venue. However due to the earthquake occurrence on 25 April, the training room was damaged and out of use.

Therefore the venue for training was decided to the meeting room of the Study Team.

(2) Computers for Training

Likewise, computers in the DOR training room could not be applied for training. Trainees were requested to bring their laptop computers.

(3) Training Hour

Regular work hour of the government is from 10:00 to 16:00. The load shedding (planned power outage) caused by oil shortage was executed for long hours, therefore outage hours should have been taken into account for deciding the training schedule. Also operation of public transport was largely decreased and trainee had difficulty in transport.

3.1.2.2 Selection of Trainees

(1) Nomination of Trainees

In response to the request letter from JICA Study Team, DOR nominated eight trainees.

Trainees were engaged in their own business and could not concentrate to the training exclusively. The working condition of trainees should have been considered.

(2) Capacity of Trainees

Working section in DOR, position and career of the trainees are shown in Table 3.1.1. Table 3.1.1Trainees from various sections and various careers were attending the training.

Table 3.1.1 Affiliated Department and Career of Trainee

No	Sex	Age	Position	Career	Section
1	M	53	SDE	25	Laboratory Section
2	M	50	SDE	25	Road section Skills Development
3	M	40	SDE	17	RSTU Section
4	M	41	Er	10	Traffic Section
5	M	34	Er	5	PMEW Section
6	M	-	Er	3	RSDP Section
7	F	23	Er	1	PH Project Section
8	M	28	Er	2	Traffic Safety Section
9	F	29	Er	5	Road Section

Note: SDE: Senior Divisional Engineer, Er: Engineer

Preliminary questionnaire regarding skill on computer, knowledge on the software and knowledge on traffic demand was delivered to trainee and was collected. Most of the trainees were aware of Microsoft Word and Excel, but did not have the knowledge of other software. As for the traffic demand forecast, general concept was well known among the trainees but detailed method was not understood.

Table 3.1.2 Skill for Computer and Knowledge of Demand Forecast of Trainee

No	Skill for Computer					Knowledge on Demand Forecast				
	WORD	EXCEL	GIS	HDM-4	TRANSCAD	Four step methods	Trip generation /attraction	Trip distribution	Modal split	Traffic assignment
1	Ok	Ok	No	Very Little	No	Basic	Basic	None	None	None
2	Ok	Ok	No	Basic	No	Basic	Basic	None	None	None
3	Ok	Ok	No	No	No	None	None	None	None	None
4	Ok	Ok	No	No	No	None	None	None	None	None
5	Ok	Ok	No	No	No	None	Basic	None	Basic	None
6	Ok	Ok	No	No	No	None	None	None	None	None
7	Ok	Ok	No	No	No	None	None	None	None	None
8	Ok	Ok	No	No	No	Basic	Basic	Basic	None	None
9	Ok	Ok	No	No	No	Basic	Basic	Basic	Basic	Basic

QUESTIONNAIRE BEFORE STRADA TRAINING

JICA Study Team

1. Basic Information
   Name:
   Sex: ☐ Male ☐ Female
   Age:
   Member of Department of , Section
   Position
   Occupation: ☐ Engineer ☐ Clerical staff
   Career: years

2. Skill for Computer
   Check the name of software you usually use
   ☐ Microsoft WORD
   ☐ Microsoft EXCEL
   ☐ GIS Software (e.g. Arc GIS, Quantum GIS, etc.)
   ☐ HDM-4
   ☐ TRANSCAD

3. Knowledge on Demand Forecast
   1) Do you know the four step method of traffic demand forecast?
   ☐ None
   ☐ I know basic concept of four step method.
   ☐ I know exact procedure of four step method
   2) Understanding on each step
   i) Trip generation and attraction model
   ☐ None
   ☐ I know basic concept of trip generation and attraction model.
   ☐ I have experience in model building for trip generation and attraction.
   ii) Trip distribution model
   ☐ None
   ☐ I know basic concept of trip distribution model.
   ☐ I have experience in model building for trip distribution model.
   iii) Modal sprit model
   ☐ None
   ☐ I know basic concept of modal sprit model.
   ☐ I have experience in model building for modal sprit model.
   iv) Traffic assignment model
   ☐ None
   ☐ I know basic concept of traffic assignment model.
   ☐ I have experience in model building for traffic assignment.

4. In which procedure are you interested most? (Multiple answers allowed)
   ☐ Trip generation and attraction model
   ☐ Trip distribution model
   ☐ Modal sprit model
   ☐ Traffic assignment model

5. Request to the lesson, if any.
   ———

Thank you for your cooperation!

Figure 3.1.1 Questionnaire before Training

3.1.2.3 Training Plan

(1) Training Schedule

Duration of training was decides from 24 November to 10 December. Training day was scheduled to be every other day and training hour to be from 2:00 pm to 5:00 pm.

(2) Contents of Training

Package of JICA Strada is shown in Table 3.1.3. Among the packages, training was focused to the programs for compilation of traffic data, display of traffic assignment result and analysis of traffic movement. In order to formulate the network data in the target area, Google My Map, map drawing software, and QGIS, free GIS software, were added to the training components.

Table 3.1.3 Program Module of JICA Strada and Method of Training

Seq	Program Module	Method of training	Remark
1	Disaggregate Model	Explanation	Program for Disaggregate Model. Disaggregate Model is comprehensible only after mastering of basic demand forecast. Therefore the training is limited to the introduction of the model.
2	OD Calibrator	Explanation	Software for calibration of OD table to improve the accuracy of data. Training is limited to the introduction of software.
3	Matrix Manipulator	Practice	Software for creation of OD table from the data obtained by traffic survey. Since this procedure is basic component of demand forecast, practical training is conducted utilizing data obtained by the traffic survey.
4	GIS Converter	Explanation	Software for conversion of GIS data to transport network data. Due to the short training period, practice is not conducted although this procedure is basic component of demand forecast.
5	Network Editor	Practice	Software for editing the network data. Considering new network development project in the Valley, practical training is conducted by utilizing network data developed in the project.
6	Incremental Assignment	Explanation	Software for traffic assignment by Incremental Assignment method. Since the Incremental Assignment method is not applied in the MP, the training is limited to the introduction of the model.
7	User Equilibrium Assignment	Practice	User equilibrium assignment is applied in the project. In order to utilize and reproduce the traffic in modified network, this software is essential. Practical training is conducted.
8	Stochastic User Equilibrium Assignment	Explanation	Software for traffic assignment by Stochastic User Equilibrium Assignment method. Since the Stochastic User Equilibrium Assignment method is not applied in the MP, the training is limited to the introduction of the model.

9	Transit Assignment	Explanation	Software for traffic assignment by Transit Assignment method. Since the Transit Assignment method is not applied in the MP, the training is limited to the introduction of the model.
10	Highway Reporter	Practice	Software for display of the result of traffic assignment. Practical training is conducted for appropriate display of assignment result and proper understanding of traffic assignment result.
11	Intersection Analyzer	Explanation	Software for calculation of optimal split time and saturation degree of signal intersection. In general, introduction of signal intersection has many obstacles in Nepal.
12	Evaluator	Explanation	Software for evaluation of the project by calculating travel costs and time cost. The training was focused to the traffic demand forecast, the training is limited to the introduction of the model.

In addition to the training on JICA Strada, the following two subjects were included in the training:

1) Four-step traffic demand forecast method

Trainees were not familiar with the general concept of demand forecast.

2) Method for data conversion from traffic survey to demand forecast

Trainees requested to obtain knowledge for the data creation for demand forecast.

Based on the above consideration, training curriculum was decided as shown in Table 3.1.4.

Table 3.1.4 Training Curriculum

Step	Contents
1st	1st Session - Guidance of this training - Installation and Summary of "STRADA" - Lecture on basic concept of traffic forecast - Practice on calculation and analysis
2nd	
3rd	2nd Session - Practice on editing of network data - Practice on editing of OD matrix
4th	
5th	
6th	3rd Session - Practice on creation of the STRADA data from traffic survey
7th	

3.1.2.4 Training Material

The following six materials were prepared for the training.

1) Training guidance
2) Outline of JICA Strada and installation method
3) Introduction of Four-step traffic demand forecast method
4) Method of traffic assignment and display of assignment result
5) Method for edit of network data
6) Method for compilation of OD table from traffic survey data

3.1.2.5 Input Data

The following data created in the project were applied as the input data for the training:

1) VT OD table in pcu
2) Road network data
3) Parameters for traffic assignment

3.1.3 Implementation of Training

3.1.3.1 Training Duration

In order to make time for self-study, eight trainees were divided into two groups and each trainee attended the training once in two days. However due to the load shedding, training hour was limited and joint training was conducted. As the total, eight training sessions were conducted from 24 Nov. to 10 Dec.

Table 3.1.5 Date of Conducted Training

	Group	Session 1	Session 2	Session 3	Session 4	Session 5	Session 6	Session 7	Session 8
Date	A	11/24	11/26	11/30	12/1	12/3	12/6	12/8	12/10
	B		11/27						

3.1.3.2 Contents of Training

(1) Session 1

1) Date: 24 Nov. 2015
2) Objective:

To understand the contents of training course

To acquire general concept of traffic demand forecast

3) Contents of Training

Table 3.1.6 Contents of Training Session 1

Subject	Method	Contents of training	Software & Input data
a) Guidance for training course	Explanation	・ Overall contents of training course were explained.	
b) Installation of JICA Strada	Practice	・ Each trainee installed the JICA Strada software under the guidance by CD ROM.	
c) Outline of JICA Strada	Explanation	・ Composition of JICA Strada and outline of each component of 12 components were explained.	
d) Outline of four-step traffic demand forecast method	Explanation	・ Outline of four-step traffic demand forecast method was explained.	
e) Traffic Assignment	Practice	・ Necessary input data for traffic assignment, i.e. OD table, network data and parameters for assignment model, was explained. ・ Practical training was carried out utilizing the input data prepared by the project.	Software User Equilibrium Assignment Highway Reporter Input Data VTOD table in pcu. Road network data Parameters
f) Making display of traffic assignment result	Practice	・ Assignment result was visualized by software “Highway Reporter” and each trainee confirmed the result of traffic assignment.	

(2) Session 2

1) Date: 26 Nov. (Group A), 27 Nov. (Group B)

2) Objective:

To acquire knowledge for analysis of the traffic assignment result

3) Contents of Training

Table 3.1.7 Contents of Training Session 2

Subject	Method	Contents of training	Software & Input data
a) Setting for display of traffic assignment results	Explanation	・ Since a certain data is abandoned after the completion of traffic assignment, additional setting is necessary for extracting the abandoned data. Setting for display of the data was explained.	
b) Extraction of trip OD on a certain link	Explanation	・ Method of extraction of trip OD on a certain link was explained.	
c) Extraction of information of travel route	Explanation	・ Method to display the travel route by the software “Highway Reporter” was explained.	
d) Traffic volume by direction	Explanation	・ Traffic movement regarding intersection was explained. ・ Traffic movement at an intersection can be displayed by OD matrix. ・ To analyze the saturation of intersection, analysis by traffic volume by direction is necessary.	
e) Conversion to MS Excel	Explanation	・ Conversion method of traffic assignment result from JICA Strada to MS Excel was explained. ・ Using MS Excel, tabulation of assignment result is possible.	

f) Evaluation of network	Explanation	・ Method of network evaluation by total distance travelled and total travel time was explained.	
g) Analysis of traffic assignment result	Practice	・ Practical training of extraction of trip OD and travel route by JICA Strada was conducted. ・ In the outskirt area, trip toward specific area is majority, thus many OD trip becomes zero. ・ In the central area, many OD trip appears, thus mapping becomes difficult.	Software User equilibrium assignment Highway reporter Network editor Input Data VTOD table in pcu. Road network data Parameters

(3) Session 3

1) Date: 30 Nov.

2) Objective:

To acquire knowledge for editing road network data

3) Contents of Training

Table 3.1.8 Contents of Training Session 3

Subject	Method	Contents of training	Software & Input data
a) Edit of road network data	Explanation	・ Method of edit of road network data, i.e. modification of link value, deletion of link, division of link and addition of link, was explained.	
b) Edit of road network data	Practice	・ Each trainee edited road network by adding new link to the existing network. ・ Traffic assignment was conducted to the edited road network. ・ In the central area where many substitute routes exist, diversion of traffic rarely occurs. ・ Provision of arterial road cause large diversion.	Software User equilibrium assignment Highway reporter Network editor Input Data VTOD table in pcu. Road network data Parameters

(4) Session 4

1) Date: 1 Dec.

2) Objective:

To review the knowledge of network editing

To draw report using the result of calculation by JICA Strada

3) Contents of Training

Table 3.1.9 Contents of Training Session 4

Subject	Method	Contents of training	Software & Input data
a) Review of edit of road network data	Explanation	・ Method of edit of road network data, i.e. modification of link value, deletion of link, division of link and addition of link, was explained.	

b) Edit of road network data	Practice	・ Each trainee edited road network by adding new link to the existing network. ・ Making a report on traffic assignment, assignment result mapping, travel route mapping, traffic volume by direction and variation of traffic volume inside Ring Road was requested.	Software User equilibrium assignment Highway reporter Network editor Input Data VTOD table in pcu. Road network data Parameters

(5) Session 5

1) Date: 3 Dec.

2) Objective:

To review the knowledge of network editing

To draw report using the result of calculation by JICA Strada

3) Contents of Training

Table 3.1.10 Contents of Training Session 5

Subject	Method	Contents of training	Software & Input data
a) Review of edit of road network data	Explanation	・ Method of edit of road network data, i.e. modification of link value, deletion of link, division of link and addition of link, was explained.	
b) Edit of road network data	Practice	・ Each trainee edited road network by adding new link to the existing network. ・ Making a report on traffic assignment, assignment result mapping, travel route mapping, traffic volume by direction and variation of traffic volume inside Ring Road was requested.	Software User equilibrium assignment Highway reporter Network editor Input Data VTOD table in pcu. Road network data Parameters

(6) Session 6

1) Date: 6 Dec.

2) Objective:

To acquire knowledge on editing OD table

3) Contents of Training

Table 3.1.11 Contents of Training Session 6

Subject	Method	Contents of training	Software & Input data
a) Edit of OD table	Explanation	・ Method of edit of OD table, i.e. deletion of mode, addition of new mode, division of zoning, was explained. ・ Centroid of network represents the point of trip generation and attraction in a zone.	
b) Edit of OD Table	Practice	・ Each trainee edited OD table by dividing the existing zone.	Software User equilibrium

		・ Creating new centroid for the divided zone, traffic assignment was conducted by new zoning.	assignment Highway reporter Network editor Matrix manipulator Input Data VTOD table in pcu. Road network data Parameters

(7) Session 7

1) Date: 8 Dec.

2) Objective:

To acquire knowledge on method of traffic assignment from traffic survey data

3) Contents of Training

Table 3.1.12 Contents of Training Session 7

Subject	Method	Contents of training	Software & Input data
a) Formulation of road network data	Explanation	・ In training session 7 and 8, Pokhara was applied as the target field. ・ Two methods exist for formulation of road network vector data. One is to use Network Editor and the other is to convert from GIS data. ・ To create GIS data in kml. file, Google My Map is user-friendly free software. ・ QGIS, free GIS software, is also introduced for network formulation software.	Software Google My Map QGIS Network editor GIS converter Input Data Road network data Parameters
b) Conversion of GIS data to JICA Strada data	Explanation	・ Method of conversion of GIS data to JICA Strada data was explained.	
c) Application of link value	Explanation	・ Method to apply link value to network data was explained. ・ Capacity of road in the network was explained based on the project report.	

(8) Session 8

1) Date: 10 Dec.

2) Objective:

To acquire knowledge on method for creation of OD table

3) Contents of Training

Table 3.1.13 Contents of Training Session 8

Subject	Method	Contents of training	Software & Input data
a) Zoning	Explanation	・ In training session 7 and 8, Pokhara was applied as the target field. ・ Essential point in zoning was explained. ・ Living sphere, activity of citizen and zoning in statistics should be taken into consideration.	

b) Implementation of traffic survey	Explanation	· Necessary traffic survey for the creation of OD table was explained. · Roadside traffic count is necessary to obtain the accuracy of OD survey. · Cooperation by traffic police and public announcement is required for the success of the traffic survey.	
c) Formulation of OD table	Explanation	· Expansion of traffic survey data by population was explained. · Formulation of OD table from individual trip data was explained.	
d) Traffic assignment	Explanation	· Traffic assignment of OD table formulated in this session to network data formulated previous session was conducted. · As the result, it was confirmed that the assigned traffic volume corresponded to the observed traffic volume.	

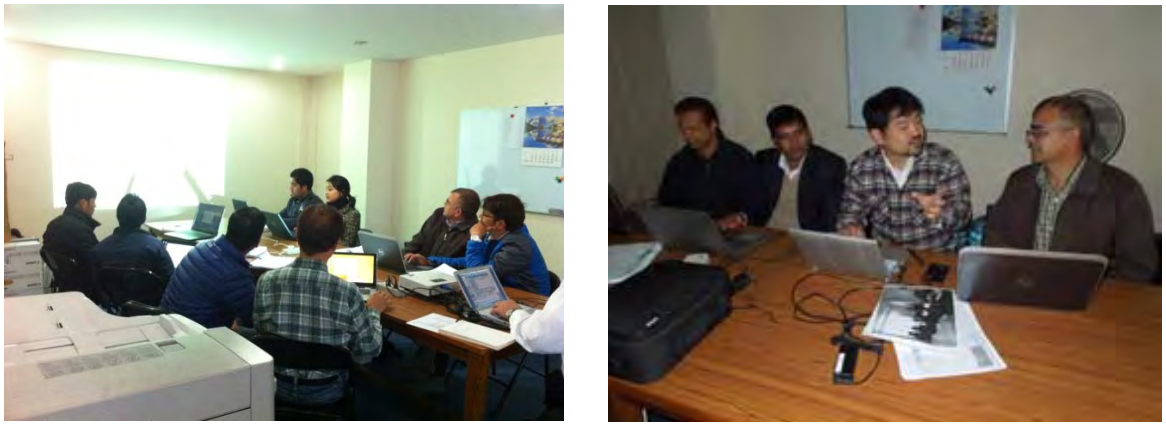


Figure 3.1.2 Training Scene

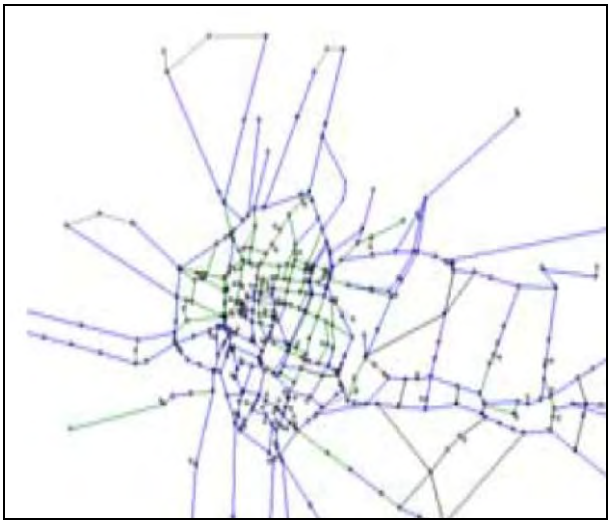
3.1.4 Achievement

3.1.4.1 Mid-term Report

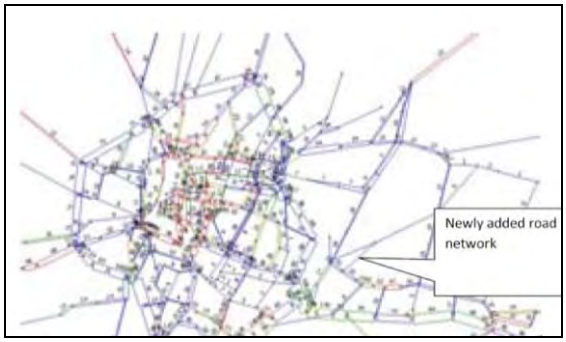
In order to grasp the learning level, mid-term report was set to trainees at the session 3. The subject was to calculate and illustrate the following results of demand forecast to the network edited by trainee.

1) Traffic volume on the network link
2) Travel route
3) Traffic volume by direction
4) Variation of traffic volume inside Ring Road between original network and edited network.

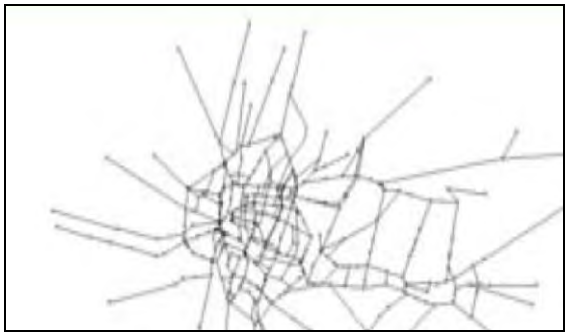
Mid-term report was submitted from two trainees. Due to the power shortage, time for making report was not sufficient and only illustration of demand forecast was submitted as shown in Figure 3.1.3. and Figure 3.1.4. The reports show that two trainees are well accustomed to JICA Strada and achieved to the requested level.



Original Route Map



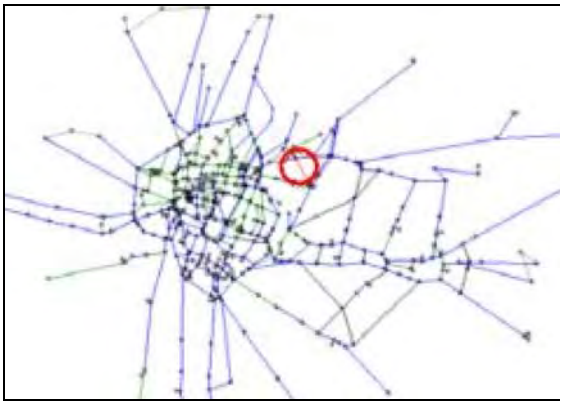
Additional Route



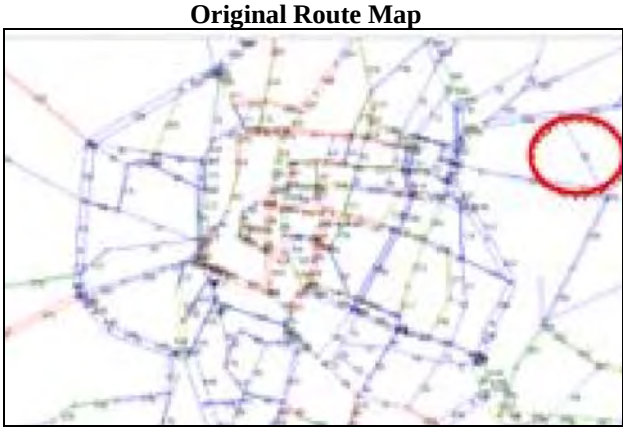
Route Information Map

Figure 3.1.3 Mid-term Report by Trainee (1)

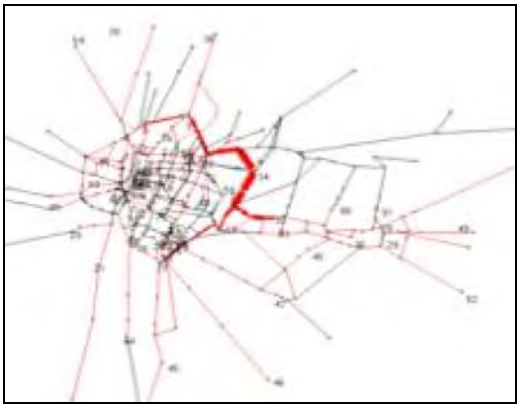
Original Route Map



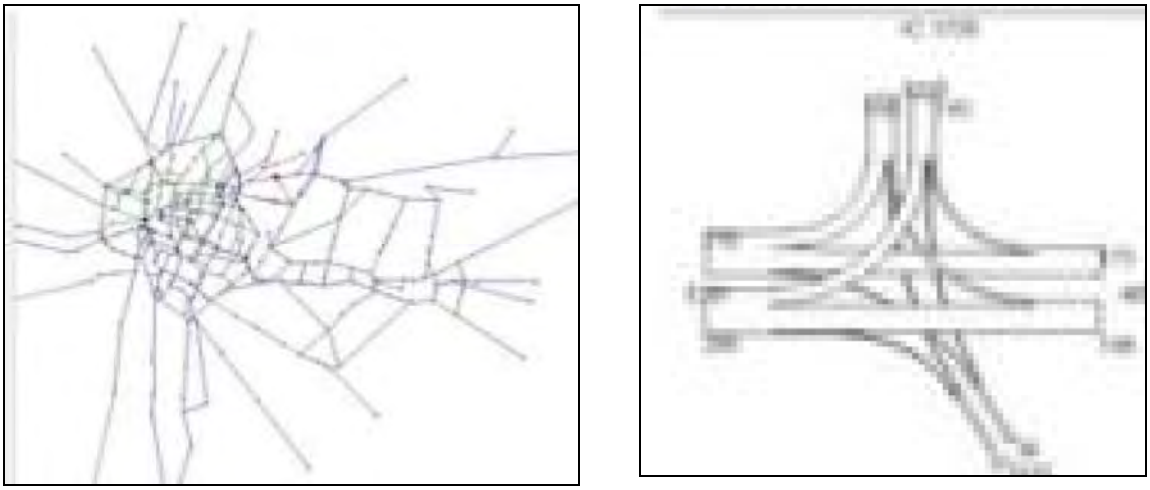
Additional Route



Demand Forecast Result



Route Information Map



Intersection Diagram

Figure 3.1.4 Mid-term Report by Trainee (2)

3.1.4.2 Proficiency level by Training

Proficiency level observed in the training is summarized as follows:

1) Four step traffic demand forecast method

The preliminary questionnaire showed that several trainees did not have the knowledge of four step traffic demand forecast method. Therefore lesson for the for step demand forecast was given at the first session. Basic concept of four step method was understood by the trainees.

2) Each step of four step demand forecast

Along with the four step demand forecast method, method for each step of demand forecast was explained. However, because large scale person trip survey will not be conducted in Nepal, most of training was focused to vehicle based movement and practical training for person based movement was not conducted. Structure of demand forecast method was well understood.

3) Traffic assignment

Training was focused to the traffic assignment based on the vehicle trip and most of time was devoted to this training. As the result, trainees were capable of application of appropriate data and implementation of traffic assignment. Moreover, method for acquisition of necessary data, such as OD table and network data was understood by the trainees. As a whole, proficiency in JICA Strada for traffic assignment was attained by trainees.

3.1.5 Conclusion and Recommendation

By the implementation of training session, basic knowledge for operation of JICA Strada was transferred and trainees are observed to be capable of operation of JICA Strada. The followings are proposed in order to utilize JICA Strada more and more.

1) Securement of training condition

Since the trainees were attending the training while engaged in their own job. When some trainees were occupied by the job, they were forced to cease the training. Training condition in which trainee can concentrate the training exclusively during the training period is required.

2) Expansion of training outcome

Based on the outcome of the training, expansion of knowledge on JICA Strada is expected. For instance, training by the trainees for DOR engineers is expected measure for the expansion.

3) Training for urban transport

Throughout the establishment of Master Plan, technical transfer was conducted. However the major field of technical transfer was policy decision for urban transport. Hence, opportunity for technical transfer on detailed technology of traffic survey, road network plan and public transport plan is expected.

3.2 Training in Japan

3.2.1 Background

Data Collection Survey on Traffic Improvement in Kathmandu Valley was conducted in 2012 including training in Japan for eight participants. During the training following subjects were introduced: policies and institutions on road development and transport planning in Japan; cases in local governments; cases of public transport in different modes. The training was aimed to raise effectiveness of cooperative work for the Basic Information Collection and Confirmation Survey; and the Master Plan Study. This time, the participants will learn policy measures recommended in the Master Plan in the context of the Kathmandu Valley Urban Transport Improvement Project--the Master Plan Study. At the same time, the training aims to raise capacity of government officials so that the Master Plan will be maintained and updated. In the training in Japan, the participants will learn cases of local governments that have been conducting advanced measures on land use planning, sustainable transport system development, harmonization of historical resources and urban development.

3.2.2 Outline of the Training

The training "Urban Traffic Improvement Technologies for the Federal Democratic Republic of Nepal" was conducted in Japan from January 28 to February 5, 2015. Three from DOR, one from MOUD, two from KVDA, one from KMC, and one from Bhaktapur Municipality participated in the training.

(1) Goals

- The participants initially learn: 1) legal and institutional framework on road development and transport planning that are aimed to solve urban transport problems; 2) Cases of urban area formulation in local governments, road development, and urban transport network development.
- With the initial understanding, implementation methods and effects of policy measures recommended in KUTMP.
- By exchanging opinions on the Master Plan, effectiveness of cooperate activities in formulating the Master Plan will be raised.

(2) Expected Results

- The participants will learn necessity and effectiveness of urban planning measures such as guiding land uses, and coordination among government agencies.
- Significance of planned road network will be understood and road development projects will be implemented as planned in a development program.
- The participants will understand more on public transport development that are cost effective and that reflect conditions of the Kathmandu Valley.
- The participants will become more conscious on requirements for Kathmandu Metropolitan City as a city of heritage and culture.

(3) Expected Level of Achievement

- The participants will learn the public administration system on urban planning in Japan.
- Issues on urban transport plans in local authorities with specific urban environment or historical characters will be understood with possible solutions embedded in the methods and thinking of the Master Plan.
- The participants will learn linkages between urban planning and transport policy measures.

- As the participants learn characteristics of public transport systems, background of implementation and effectiveness of introduction shall be evaluated.

(4) Training Curriculum

Table 3.2.1 below shows the training curriculum.

Table 3.2.1 Training Curriculum in Japan.

Expected Achievement	Course
The participants will learn the public administration system on urban planning in Japan.	➢ Urban traffic policy in Tokyo Metropolitan and Japan
Issues on urban transport plans in local authorities with specific urban environment or historical characters will be understood with possible solutions embedded in the methods and thinking of the Master Plan.	➢ Traffic policy in the suburbs of Kanazawa city ➢ Urban traffic management measures of Kanazawa city: Urban planning in a historical city
The participants will learn linkages between urban planning and transport policy measures.	➢ Urban traffic management measures of Kanazawa city ➢ Urban traffic management measures of Nagoya city
As the participants learn characteristics of public transport systems, background of implementation and effectiveness of introduction shall be evaluated.	➢ Lecture for Introduction of AGT in Japan ➢ Experience of new public transport system (Yurikamome) ➢ Experience of route bus and community bus in Kanazawa city ➢ Lecture and experience of Key route bus and guideway bus

(5) Participants and Schedule

Table 3.2.2 and Table 3.2.3 present the participants and schedule of the training respectively.

Table 3.2.2 Participants of the Training in Japan

	Name	Position	Age
1	Mr. Binod Kumar Mauwar	Senior Divisional Engineer, Department of Roads (DOR), Ministry of Physical Infrastructure and Transport	44
2	Ms. Shova Giree	Engineer, Department of Roads (DOR), Ministry of Physical Infrastructure and Transport	43
3	Mr. Pradeep Kumar Shrestha	Engineer, Department of Roads (DOR) Ministry of Physical Infrastructure and Transport	52
4	Mr. Navin Kumar Devkota	Senior Divisional Architect Physical Planning and Urban Development Division, Ministry of Urban Development	53
5	Dr. Bhai Kaji Tiwari	Deputy Development Commissioner Kathmandu Valley Development Authority (KVDA)	56

6	Mr. Narayan Prasad Bhandari	Lalitpur District Commissioner, Kathmandu Valley Development Authority (KVDA)	44
7	Mr. Suraj Shakya	Senior Architect, Project Implementation Unit Kathmandu Metropolitan City	48
8	Mr. Dil Bhakta Jayana	Senior Architect, Land Pooling Project, Bhaktapur Municipality	37

Table 3.2.3 Schedule of the Training in Japan

Date	Time	Type	Contents	Lecturer/Guide	
				Name	Position
1/27(T)	13:20 ～ 20:20	MH171	KTM → KL		
	23:35 ～	MH088	KL → NRT		
1/28(W)	～ 07:15		Arrival at Narita Airport		
1/29(Th)	10:00 ～ 12:30		Briefing		JICA Tokyo
	12:30 ～ 13:30		Lunch		
	13:30 ～ 14:30		Orientation of the program	Mr. Motoki OGAWA	EJEC
	14:30 ～ 16:00		Preparation for presentation on 30th January	Mr. Motoki OGAWA	EJEC
1/30(F)	9:30 ～ 11:00	Lecture	Urban Transportation policy in Japan and Tokyo Metropolitan Area	Dr. Katsutoshi OHTA	Professor Emeritus of Tokyo University
	11:00 ～ 12:30	Presentation	Issues on Urban Transportation in Kathmandu Valley	Dr. Katsutoshi OHTA / Mr. Motoki Ogawa	Professor Emeritus of Tokyo University / EJEC
	12:30 ～ 13:30		Lunch		
	13:30 ～ 14:30		Move to Hongo-Sanchome Sta.	Mr. Motoki OGAWA	EJEC
	14:30 ～ 16:00	Lecture	Introduction of Automated Guideway Transit in Tokyo	Mr. Takeshi YAMAZAKI	Japan Transportation Planning Association (JTPA)
	16:00 ～ 17:00		Move to Shiodome, urban Re-developed Area	Mr. Motoki OGAWA	EJEC
	17:00 ～ 18:14	Observation	Take Automated Guideway Transit, Yurikamome	Mr. Motoki OGAWA	EJEC
	18:21 ～ 18:50		Back to JICA Tokyo	Mr. Motoki OGAWA	EJEC
1/31(Sa)	～		Holiday		
2/1(Su)	8:00 ～ 9:00		Move to Haneda Airport	Ms. Erina KAN	EJEC
	9:45 ～ 10:50	JAL1275	Fly to Komatsu Airport	Mr. Motoki OGAWA	EJEC
	11:00 ～ 12:00		Move to Kanazawa	Mr. Motoki OGAWA	EJEC

Date	Time	Type	Contents	Lecturer/Guide	
				Name	Position
	12:00 ～ 13:00		Lunch		
	13:00 ～ 16:00	Observation	Transport policy in suburb of Kanazawa	Mr. Motoki OGAWA	EJEC
	16:00 ～ 17:00		Move to Hotel	Mr. Motoki OGAWA	EJEC
2/2(M)	8:45 ～ 9:00		Move to Kanazawa City Hall	Mr. Motoki OGAWA	EJEC
	9:00 ～ 10:30	Lecture	Community Development of Kanazawa city	Hiroshi KOTANI	Section head of Urban Planning Division, Kanazawa City
	10:30 ～ 12:30	Observation	Urban Transportation System in Kanazawa City	Mr. Motoki OGAWA	EJEC
	12:30 ～ 13:30		Lunch		
	13:40 14:00		Move to Kanazawa station	Mr. Motoki OGAWA	EJEC
	14:30 18:28		Move to Meitesu Bus Center (Nagoya)	Mr. Motoki OGAWA	EJEC
	18:30 19:00		Move to Hotel	Mr. Motoki OGAWA	EJEC
2/3(Tu)	8:30 ～ 9:00		Move to Nagoya City Hall	Mr. Motoki OGAWA	EJEC
	9:15 ～ 10:00	Lecture	Urban Transportation Policy in Nagoya	Mr. Sadahiko KUWAZOE	Nagoya Ctiy
	10:00 ～ 11:00	Lecture	Introduction of Key Route Bus Lane System	Mr. Yu YOSHIMURA	Nagoya Ctiy
	11:00 ～ 12:00	Lecture	Introduction of Guideway Bus	Mr. Yusuke MIYATA	Nagoya Ctiy
	12:00 ～ 13:00		Lunch		
	13:00 ～ 15:00	Observation	Take Key Route bus to Chayagasaka Sta. Take subway to Ozone Sta. Take Guideway Bus to Ryusenjiguchi Sta.	Mr. Motoki OGAWA	EJEC
	15:00 ～ 16:00		Move to Nagoya Station	Mr. Motoki OGAWA	EJEC
	16:42 ～ 18:23		Move to Tokyo Station	Mr. Motoki OGAWA	EJEC
	18:30 ～ 19:00		Move to JICA Tokyo	Ms. Erina KAN	EJEC
2/4(W)	9:00 ～ 12:30		Preparation of report	Ms. Erina KAN	EJEC
	12:30 13:30		Lunch		
	13:30 ～ 15:00	Presentation	Presentation of Action Plan	Mr. Katsutoshi OHTA	Professor Emeritus of Tokyo University
	15:00 ～ 16:00	Presentation	Review of the presentation	Mr. Katsutoshi OHTA	Professor Emeritus of Tokyo University
	16:00 ～ 16:30		Closing ceremony	Ms. Tomoko FUJIKAWA	JICA
2/5(Th)	10:30 ～ 17:05	MH089	NRT → KL		
	20:15 22:50	MH114	KL → KTM		

3.2.3 Summary of Training

The comments on the training from the participants, which are collected through questionnaire, revealed that the training was generally useful and appropriate according to the needs of them. All of the participants rated the training as 4 or 5 out of 5 (most appropriate). According to the participants, the subjects that should be added to the training includes "improvement of built-up area", "comparative study/analysis of similar modes of transportation", "How the different transport system is organized by private sector", "theoretical study on transport and land use", and "BRT and metro system".

(1) Lecture

All the lectures were conducted as scheduled. The participants evaluated the lectures were informative and appropriate so that they learned different traffic management measures in different cities as well as new transport system in such a short period. Most of the participants rated the lectures as 4 or 5 (highest). There are, however, some comments to improve the training that includes "the lecture needed more time to explain the background and context of Japan with more case studies" and the "lectures on PPP should be added and overall training program should be longer."

Figure 3.2.1 Lecture in Japan Transportation Planning Association

Figure 3.2.2 Lecture in Nagoya City Hall

(2) Discussion/ Presentation

On the first day of the training, the participants made a presentation on the issues of urban traffic management in Kathmandu Valley followed by discussion with Prof. Ohta from Tokyo University. The participants were divided into two groups and requested to present issues on "land use and urban development" and "transportation" based on the discussion made in the working groups of the Project. This aimed at clarifying the issues that they faced and the objective of the training for each participant. On the last day of the training, the participants presented how the lectures learnt in the training could be applied to the issues in Kathmandu Valley. By doing so, they are expected to be proactive and take actions in order to improve the current situation in Kathmandu as government/administration officers.

Figure 3.2.3 Lecture and Discussion in Kanazawa City Hall

Figure 3.2.4 Presentation by the Participants

(3) Observation/ Experience

The participants had an opportunity to experience the different modes of transport such as AGT, metro, guideway bus and community bus in the cities with different characteristics and transport policy. This helps them to have a clearer view of how to apply the different type of transport system into Kathmandu Valley. In fact, some participants commented that observation and experience of the different mode of transport was one of the most beneficial subjects in the training.

Figure 3.2.5 On Yurikamome (AGT)

Figure 3.2.6 Key Route Bus in Nagoya City

3.2.4 Achievement

The lectures and ideas obtained in the training were presented by the participants on the last day. Table 3.2.4 and Table 3.2.5 summarize the shared presentation focusing on issues and actions for land use and urban planning, and transportation respectively.

Table 3.2.4 Issues and Actions for Land Use and Urban Planning

Issues	Action/Response
➢ Inadequate land use zoning regulation and weak monitoring of development activities	➢ Need integrated urban structure and land use master plan of Kathmandu Valley ➢ Integration of transportation management plan with structure plan ➢ National land use act (under discussion)
➢ Private land ownership and the issues of compensation or incentives for limited land use as agriculture	➢ Land use regulation / Taxation / Incentives
➢ Lack of coordination between physical planning and infrastructure development	➢ Development prioritization and phasing to suit integrated physical planning

Issues	Action/Response
➢ Lack of coordination and cooperation between different institutions ➢ Overlapping of authorities and responsibilities of city manager organizations	➢ Clarify the jurisdiction and implement in practice
➢ Lack of ownership of plans and policies	➢ Institutionalization of policies ➢ Clarifying roles and responsibilities
➢ Lack of public open spaces and road encroachment	➢ Designate appropriate open space in structure plan ➢ Improve conditions of existing open spaces ➢ Monitoring of development/ construction activities
➢ Inadequate political commitment and management capacities	➢ Need good governance

Table 3.2.5 Issues and Actions for Transportation

Issues	Action/Response
➢ Insufficient road density (6%)	➢ Average in Japan is 10-18%. Need to increase (widening/ elevating, river corridor, new construction and expansion)
➢ Unplanned road network (incremental)	➢ Road networks should be considered as an integral part of urban planning. ➢ Introduction/ adaption of appropriate mode of transport (separation of lane, NMT/MT)
➢ Uncontrolled access to the major roads	➢ Need to provide service track/grade separator ➢ Study of feeder roads for appropriate access to the main arterial network
➢ Mixed traffic system (mode of transport)	➢ Separation and prioritization of lane/traffic ➢ Promotion of bicycle and separation of pedestrian
➢ High rate of accident	➢ Providing and maintaining sufficient traffic sign and signals ➢ Providing traffic information center ➢ Improvement of Junctions/ Intersections ➢ Study and selection of appropriate mode of pedestrian crossing ➢ Enhancement of rules and regulations ➢ Awareness and enforcement of law
➢ High travel time	➢ Study and analysis of routes for hourly volume of traffic defining peak/off-peak ➢ Enhancement of public transport as per demand and secured travel time
➢ Poor parking facility	➢ Promotion of private parking system ➢ Enhancement of pay parking system ➢ Developing and modernize stopping stand

The figures below show the presentation by the participants for land use and urban development, and transportation.

Land Use and Urban Development

Presentation on

PROGRAM OVERVIEW & ACTION PLAN

(In Context of the Project on Urban Traffic Improvement technology for Federal Republic of Nepal: Kathmandu Valley)

Group Members:

Dr. Bhai Kaji Tiwari
Narayan Bhandari
Suraj Shakya
Dil Bhakta Jayana

2015 Feb 04, JICA Tokyo Int'l Centre

Program Overview

Jan 29, 2015:

Orientation of program

Jan 30:

- Lecture by Prof. OHTA: Urban Transportation policy in Japan and Tokyo Metropolitan Area
- Presentation on Issues of Urban transportation in Kathmandu Valley:
  - Urban structure and Land use
  - Transportation
- Lecture by Mr. YAMAZAKI on : Introduction of AGT in Tokyo"
- Observation of Redevelopment Area in Shiodome
- observation & Experience AGT

Program Overview

FEB 1, 2015

- observation : Kanazawa station
  - Kenroku – en park
  - 21st century Museum (Architects)
  - Higasi Chaya District (Old settlement)

Program Overview

FEB 2, 2015

- Lecture by Mr. KOTANI : Community Development of Kanazawa City
- observation:
  - Transit mall Kanazawa Ometo – Sando
  - Ohicho market
  - Experience of community bus

Program Overview

FEB 3, 2015

- Lecture by KUWAZOE on Urban Transportation policy in Nagoya
- Lecture By Mr. YOSHIMURA on Introduction of Key Bus route Lane system
- Lecture by Mr. MIYATA on Introduction of Guideway Bus
- Observation / experience :
  - Key bus route to Chayagasaka station
  - subway to Ozone station
  - Guideway Bus to Obata – Ryokuchi Station

Learning / Insights

- History of Changing Modes of Urban transportation :
  Tram >> Key Bus Route >> Guide way >> AGT >> Subway
  (Post world war development)
- Integrated Infrastructure development
- Conservation approaches in settlement
- transportation management in historic core and Newly developing Area
- development Corridor at Kanazawa
- Inclusive Infrastructure

Limitations

- Limited theoretical insights in Urban Development and Transportation planning Procedures
- Limited lectures on urban and Regional development
- limited deliberations on Integration of Land use plan and Transportation plan

Issues & Problems

	Issues	Action / Response
	Inadequate Land use zoning regulation and weak monitoring of Development Activities	• need Integrated urban structure and Land use Master plan of Kathmandu Valley •integration of Transportation management plan with structure plan •National Land use Act (under discussion)
	Private Land ownership and the issues of compensation or incentives for limited land use as agriculture	Land use Regulation / Taxation/ incentives
	Lack of co ordination between physical planning and Infrastructure Development	development prioritization and phasing to suit Integrated Physical planning.
	•Lack of co ordination and co operation between different Institutions •Overlapping of Authorities and responsibilities of city manager organisations	clearify the jurisdiction and implement in practice

Issues & Problems

	Issues	Action / Response
	Lack of ownership of Plans and Policies	• Institutionalization of Policies • Clearifying roles and responsibilities
	Lack of public open spaces & Road encroachments:	• designate appropriate open spaces in Structure Plan • improve conditions of existing open spaces • Monitoring of Development / construction activities
	Inadequate Political commitment & Management Capabilities	need good governance

Remarks

- the knowledge gained in training will be used while working in own organisation and while working with other organisations
  >> Kathmandu valley Urban transport Management Plan
- Thanks to JICA

Transportation

The Project on Urban Transport Improvement for Kathmandu Valley

Presented by:
Er. Navin Devkota
Er. Binod Kumar Mauwar
Er. Pradeep Kumar Shrestha
Er. Shova Giree

Presented On : 2015.02.04

Major Issues 1

- Insufficient road density (6%)
  - Average in Japan (10-18%)
  - Need to increase (widening/ elevating, river corridor, new construction & expansion of road)
- Unplanned road network (Incremental)
  - Road networks should be considered as an integral part of urban planning
  - Introduction/ adaption of appropriate mode of transportation (Separation of lane, NMT/ MT)
- Uncontrolled access to the major roads
  - Need to provide service track/ grade separator
  - Study of feeder roads for appropriate access to the main arterial network

Major Issues 2

- Mixed traffic system (Mode of Transportation)
  - Separation and prioritization of lane/ traffic
  - Promotion of bicycle and separation of pedestrian (Japanese Urban Transportation Note)
- High rate of accident
  - Providing and maintaining sufficient traffic sign and signals
  - Providing Traffic information center
  - Improvement of Junctions/ Intersections
  - Study and selection of appropriate mode of pedestrian crossing
  - Enhancement of rules and regulations
  - Awareness and enforcement law of road users

Major Issues 2 contd….

- High travel time
  - Study and analysis of routes for hourly volume of traffic defining peak/ off
  - Enhancement of public transportation as per demand and secured the travel time.
- Poor parking facility
  - Promotion of private parking system
  - Enhancement of pay parking system
  - Developing and modernize stopping stand

Field Observation and Feedback

- **Visit of Tokyo**
  Efficient mass transportation system (AGT, Metro, Sub-way transportation)
- **Walking and bicycle are still very important (mixed land uses)**
- **Public transport services are provided with the self financing base**
- **Very efficient financing system for transportation network**
- **Low level of transportation pollution**
- **Efficient safety concern**

Field Observation and Feedback 1

- **Visit of Kanazawa**
  Preservation of historical places/ old heritage, Limit the growth of city, Tourism development based transportation development
- **Classification of transportation zone**
  Downtown/ Commercial/ Residential
- **Business center and community based transportation system**
- **Different mode of transportation (BRT, NMT)**

Field Observation and Feedback 2

- **Visit of Nagoya**
- **Classification of transportation zone**
  Downtown/ Commercial/ Residential
- **Different mode of transportation**
  BRT, Key route bus system, Guideway bus system, metro
- **Pedestrian and bicycle mode of transportations are efficiently managed**

Feedback from field observation and related to Kathmandu Valley Urban Traffic Development

- **Kathmandu Valley is somehow similar to the Kanazawa**
- **Kathmandu also have historical/ old heritage and newly developed business/ administrative center**
- **The key issues of mode of transportation of zoning may describe as**
  - Downtown central old city zone which can be extended up to IRR that could be beneficial by pedestrian/ cyclist facilitation, efficient public transportation through community based arrangement
  - Enhancement of BRT through main arterial
  - Improvement of radial roads
  - Study of appropriate grid network under appropriate distribution of transportation
  - Development of river corridor for additional mode of transportation

Feedback from field observation and related to Kathmandu Valley Urban Traffic Development (KVTD) contd…

- Construction of outer ring road like Kanazawa
- Extension of east-west and north-south transportation network through mass transportation system followed by land use development plan
- Development of efficient transportation system on the country need base to link the sister cities around the valley
- Efficient safety concern of transportation of Japan is useful for KVTD
- Public transport services are provided with the self financing in Japan is very concern to KVTD also
- Mode of transportation adapted for the pollution control is efficient as well KVTD also

THANK YOU

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3.2.5 Conclusion

The participants, as government/ administration officers are expected to take the actions/responses shared in the presentation. Since some of them can be implemented in the short term, the participants expressed to implement them on practice. They are further expected to make contributions to discussion in working groups in order to incorporate the lessons learned into the master plan.

APPENDIX 4 STUDY ON NECESSITY OF PROJECT IMPLEMENTATION OF INNER RING ROAD

4.1 Background

4.1.1 Necessity of Project Implementation

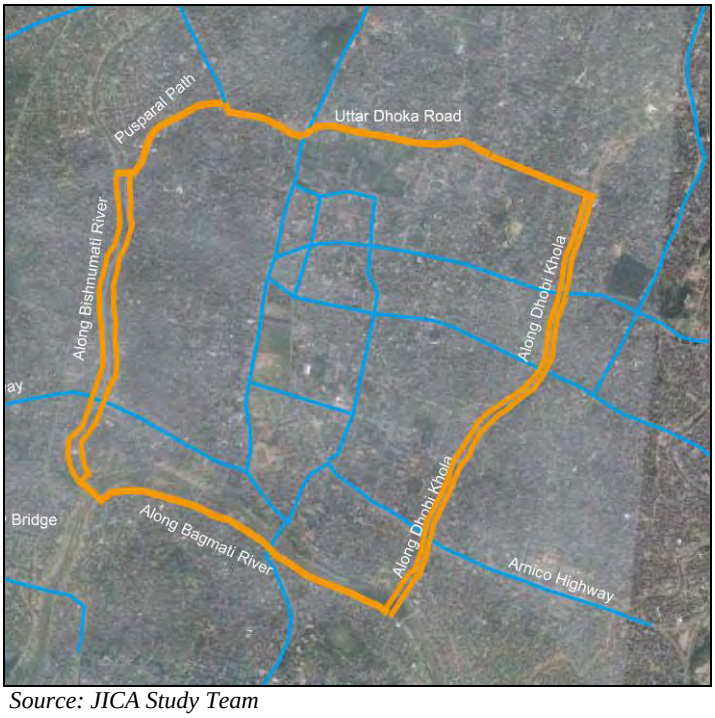
Existing road network in Kathmandu valley is basically radial road network except for Ring Road. Inner Ring Road will have function to divert the network system from radial system to radial-circumferential system. By development of Inner Ring Road (herein after referred to as IRR), traffic congestion in the city center area will be alleviated. Additionally, in the east part of Inner Ring Road, Road network density is very low. Therefor Inner Ring Road will take essential part of the emergency road network.
Considering above condition, this study is the first step for realization of IRR.

4.1.2 Objective of the Report

Albeit necessity for development of Inner Ring Road is very high as mentioned above, many issues should be solved till the implementation of the project because the development project requires widening and new construction of roads in built up area. Considering these condition, this report aims to grasp the fundamental function of IRR, to clarify necessary procedure to be taken for the implementation.

4.1.3 Location of IRR

The location of IRR is shown in Figure 4.1.1.



Source: JICA Study Team

Figure 4.1.1 Location of Inner Ring Road

4.2 Confirmation of Effectiveness of IRR

Inner Ring Road will function as axis for the daily life in peripheral area, trunk route for public transport service and emergency transport road at disaster occurrence as well as artery for the regional transportation.

Consensus building among relevant authority and local resident is essential for the progress of the project. Basic concept of mitigation measure for negative impact and procedure for consensus building will be considered.

IRR is expected to serve functions as follows:

(1) Urban development

- IRR enables dispersion of major urban function which is now concentrating into city center area.
- Area along the road will be converted to more efficient utilization land use.

(2) Traffic function (Vehicle)

- IRR enables traffic to detour and avoid the congested city center area, and consequently alleviates traffic congestion in the city center area.
- IRR covers the area where arterial road density is low, and connects the regional traffic to outside area.

Unit: hundred pcu/day

Source: JICA Study Team

Figure 4.2.1 Traffic Volume on IRR in 2030

(3) Traffic function (public transport)

- IRR forms new primary public transport route in the area where service level of public transport is low.
- By disposing new terminals along IRR, overconcentration of bus terminals in the city center area is defused.
- Connecting major urban functions each other outside the city center area, modal shift from private transport to public transport is achieved.

(4) Disaster management

- IRR composes a part of Emergency Transport Road Network (ETRN), and becomes a route for transportation of relief goods and rescue troops.
- IRR also serves as evacuation route for residents in peripheral area.

(5) Livelihood

- As the axis of livelihood of residents, IRR becomes a passage for everyday life and a space for building intimacy.

4.3 Overall Program for Development of IRR

Program for the development of IRR is divided into four Phases. Overall program is shown in Figure 4.3.1 below.

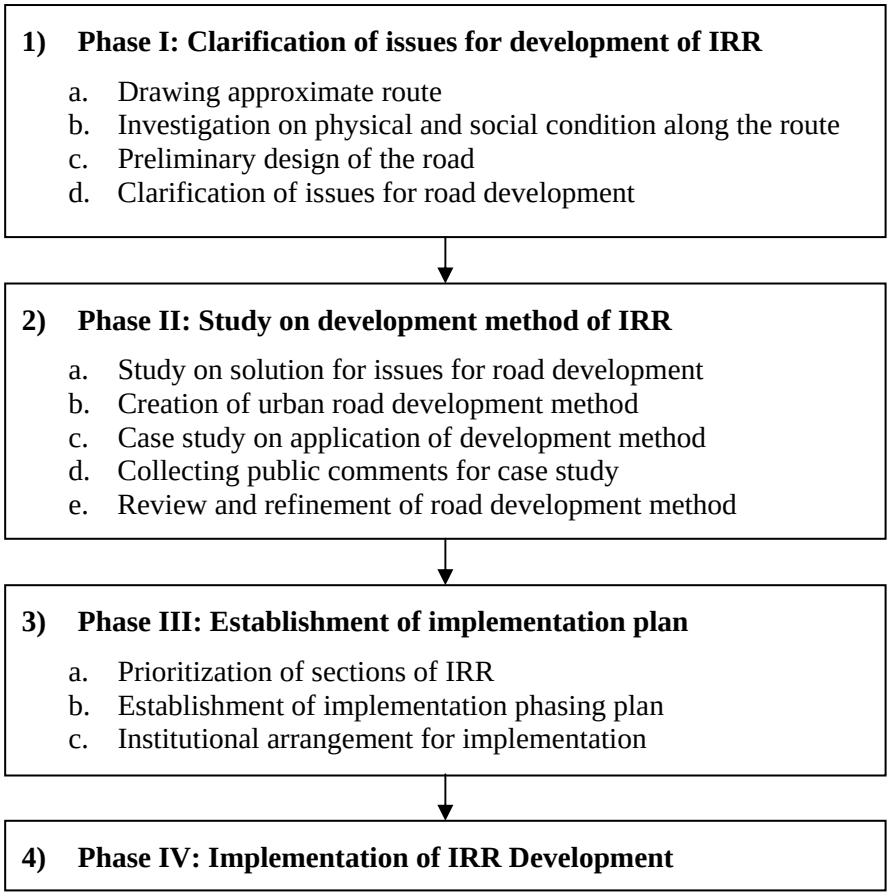


Figure 4.3.1 Development Program of IRR

4.4 Detailed Program for Development of IRR

4.4.1 Phase I: Clarification of issues for development of IRR

For the development of IRR, existing issues are clarified.

(1) Drawing approximate route

Approximate route of envisaged IRR is drawn for the investigation of surrounding conditions.

(2) Investigation on physical and social condition along the route

Physical and social condition of 50m on both sides of IRR is investigated from the following aspects:

1) Physical condition
- **a)** Geography
- **b)** Geology
- **c)** Drainage

2) Social Condition
- **a)** Land use
- **b)** Site scale
- **c)** Building: Structure and story

(3) Preliminary design of the road

Considering the present physical and social condition along IRR, vertical and horizontal alignment of IRR is decided. If necessary, alternative route is examined.

(4) Clarification of issues for IRR development

Based on the preliminary design, issues for the development of IRR are clarified from the following viewpoint:

1) Traffic flow and alignment

By the preliminary design, difficulty in settling the alignment such as irregular intersection alignment, inconsistent level of river crossing and too much steep slope is investigated.

2) Public transport

For the introduction of public transport into IRR, issues in locating bus stop and bus terminal are investigated.

3) Social and environmental condition

Issues in acquisition of land and resettlement will be clarified.

- Area with large land acquisition.
- Area with large resident's resettlement and building compensation.
- Area where IRR divides existing community

4.4.2 Phase II: Study on development method of IRR

(1) Study on solution for issues for road development

The solution method of the extracted issues in phase I is analyzed.

- Alternate road alignment
- Selection and application of appropriate typical cross section
- Feature of issues arisen by the land acquisition and resettlement

(2) Creation of urban road development method

Road development method is analyzed based on the issues of land acquisition and resettlement. Detailed description of urban road development is described in 4.6.

Procedure for realization of IRR will be proposed step by step and roles of relevant authority will be recommended.

(3) Case study on application of development method

A fictional development area of IRR is formulated and case study is conducted applying the urban road development method. The work items are as follows:

a. Land use plan
b. Building/housing plan
c. Infrastructure plan
d. Replotting plan
e. Selection of development method
f. Financial plan
g. Issues of the project

(4) Collecting public comments for case study

By the notification of result of the case study, public comments are collected.

(5) Review and refinement of road development method

According to the collected public comments, the plan in case study and development method are reviewed and refined. Development method is finalized for implementation.

4.4.3 Phase III: Establishment of implementation plan

(1) Prioritization of sections of IRR

IRR is divided into sections and implementation priority is evaluated by the following elements:

a. Urgency of road development
b. Necessity in formation of road network
c. Necessity in formation of public transport network
d. Length of implementation period
e. Number of affected residents

(2) Establishment of implementation phasing plan

Based on the prioritization of implementation, phasing plan of sections of IRR is established. Required public finance for IRR development is also established.

(3) Institutional arrangement for implementation

Arrangement of laws and regulations for the urban development method are arranged. Structure of implementation agency is clarified and reinforcement plan of implementation agency is established.

4.4.4 Phase IV: Implementation of IRR Development

Detailed plan for development of IRR is established, necessary finance for implementation is secured and IRR development project is implemented.

4.5 Implementation Schedule

Implementation schedule for IRR development is shown in Table 4.5.1.

Table 4.5.1 Implementation Schedule for IRR Developmeny

	1st year	2nd year	3rd year	4th year	5th year	After
Phase I: Clarification of issues for development of IRR						
Phase II: Study on development method of IRR						
Phase III: Establishment of implementation plan						
Phase IV: Implementation of IRR Development						

Source: JST

4.6 Urban road development method

LP system in Nepal is advanced development system for residential area. LP system has been applied for the provision of residential area with appropriate infrastructure in farm lands and vacant lands. Conversion of present LP system to the road development tool integrated with improvement of urban built-up area will contribute to create urban area with necessary urban function and infrastructure. In this way, LP system can be applied as the development method of IRR.

4.6.1 Improvement of LP System for Integration with IRR Development

For the application of LP system for road development in built-up area, creation of land for road by reallocating private land to public use becomes a large burden of participants because the margin of land is less. Moreover, if the land lot in LP area is small, it will occur that the housing lot after reallocation becomes too small for the residential function. In order to utilize LP system for integrated development with urban road, the following improvement of LP system is recommended.

(1) Cost sharing for public infrastructure

In case the developed infrastructure benefits users in large area rather than peripheral residents, required investment, land acquisition cost and construction cost, shall be borne by public institution. In LP project including IRR development, the cost allocation by public will reduce the land contribution borne by the participated land owners.

(2) Preceding acquisition of public land

Prior to the implementation of LP project, unused land and low utilized land in the project area are acquired to allot to the public land.

(3) Private Implementer

Currently, only public sector can implement LP projects under the Law and regulation. Incorporation of private sector such as private developer will be recommended to provide opportunity foreign investment and reduce burden of public sectors.

(4) Multilevel replotting

This method is to rebuild the house and to convert the land area to floor space in order to enable to secure necessary living space for original land owners after project implementation. Necessary cost for rebuilding is supplied by sales of reserved floor space excluding converted floor space for original land owners.

(5) Improvement of the financial system for LP

Establishment of urban development fund and taxation as the resource for low interest rate for LP project is recommended for decreasing the interest cost, because generally the implementation period of LP project is long and accumulated interest cost is large. Benefit of public investment of IRR will be return to sustainable urban development through this financial system based on Land-Value-Capture (LVC) concept.

4.6.2 Capacity development

Capacity development along with reinforcement in personnel of relevant organization is required to realize the project. To this end, request for technical cooperation to donors shall be issued.

APPENDIX 5 SEISMIC REINFORCEMENT OF BRIDGES

5.1 Background

On April 25, 2015, Gorkha Earthquake (Mw7.8), one of the worst natural disasters, struck the central and western region of Nepal. During the earthquake, many major roads suffered severe damage including cave-ins, uplifts and slope failures. The road damages caused by the earthquake obstructed access to the areas where the disaster was severe, and brought difficulties to prompt relief activities for the damaged areas and the victims.

The function of Kathmandu Valley as the central base for the relief and recovery of the entire country is essential, and the strengthening of roads against disaster is crucial for both Kathmandu Valley and rural areas. Bridge collapse during a future earthquake in the Valley can present considerable interference to the transportation of relief goods and passage of emergency vehicles. It is therefore critical to take aseismic reinforcement measures systematically for the bridges on the vital transport network in the Kathmandu Valley.

5.2 Objective

The objective of the work is to prioritize the bridges on the transport network in the Kathmandu Valley to take systematic aseismic reinforcement measures by evaluating the necessity of aseismic reinforcement, the importance of the route, and the expected gravity of damage through a field survey of the existing bridges. An outline of aseismic reinforcement methods is then examined for the bridges that are judged necessary, and the approximate construction cost is estimated and included in the cost estimate for the short-term (Year 2020), the middle-term (Year 2025), and the long-term (Year 2030) based on the prioritization.

5.3 Aseismic Reinforcement Method

The outline of aseismic reinforcement method is examined for the bridges that are judged necessary. The basic approach is to widen the seating length as a bridge fall prevention measure. The reasons for the above are:

i) Lack of existing data

Earthquake resistance of a bridge is generally evaluated by modeling existing bridge piers to examine aseismic reinforcement method. To evaluate, soil condition (foundation geometry), geometries/strength condition (reinforcement bars arrangement and concrete strength) and many other conditions need to be considered. However, there are no drawings or design documents for most of the target bridges. Thus detailed survey is required to confirm the conditions.

ii) Geological Structure of the Kathmandu Valley

It is well known that the Kathmandu Valley used to be a lake and is speculated to have been formed 10,000 years ago. Lacustrine deposit and continental sediment that deposited from Pilocene to Pleistocene are thick, and the depth to the basement rock (bedrock) is over 400-500m.

From the foregoing, it is speculated that foundations of most bridges in the Kathmandu Valley do not reach the bearing layer (good quality bearing layer: N value is approximately equal to or larger than 20 for cohesive soil layers and approximately equal to or larger than 30 for sandy soil and gravel layers, Specifications for highway bridges IV) and therefore they are spread foundations or friction piles that bear supporting force with skin friction force. Assuming future uneven settlement, more simple girder bridges have been applied more common than continuous girder bridges. Reinforcement methods which increase the weight such as the concrete jacketing method may therefore cause subsidence.

iii) Advantage of widening of the seating length

One of the aseismic reinforcement methods of bridges is a countermeasure for bridge collaspe. These include 1) widening of the seating length, and 2) installation of unseating prevention structures (e.g. connecting superstructure and substructure with PC cable or chain). “Resistance against bridge fall”, the minimum aseismic performance, shall be secured by keeping sufficient seating length and preventing deviation of superstructure from substructure.

5.4 Field Survey of Existing Bridges to Judge the Necessity of Aseismic Reinforcement

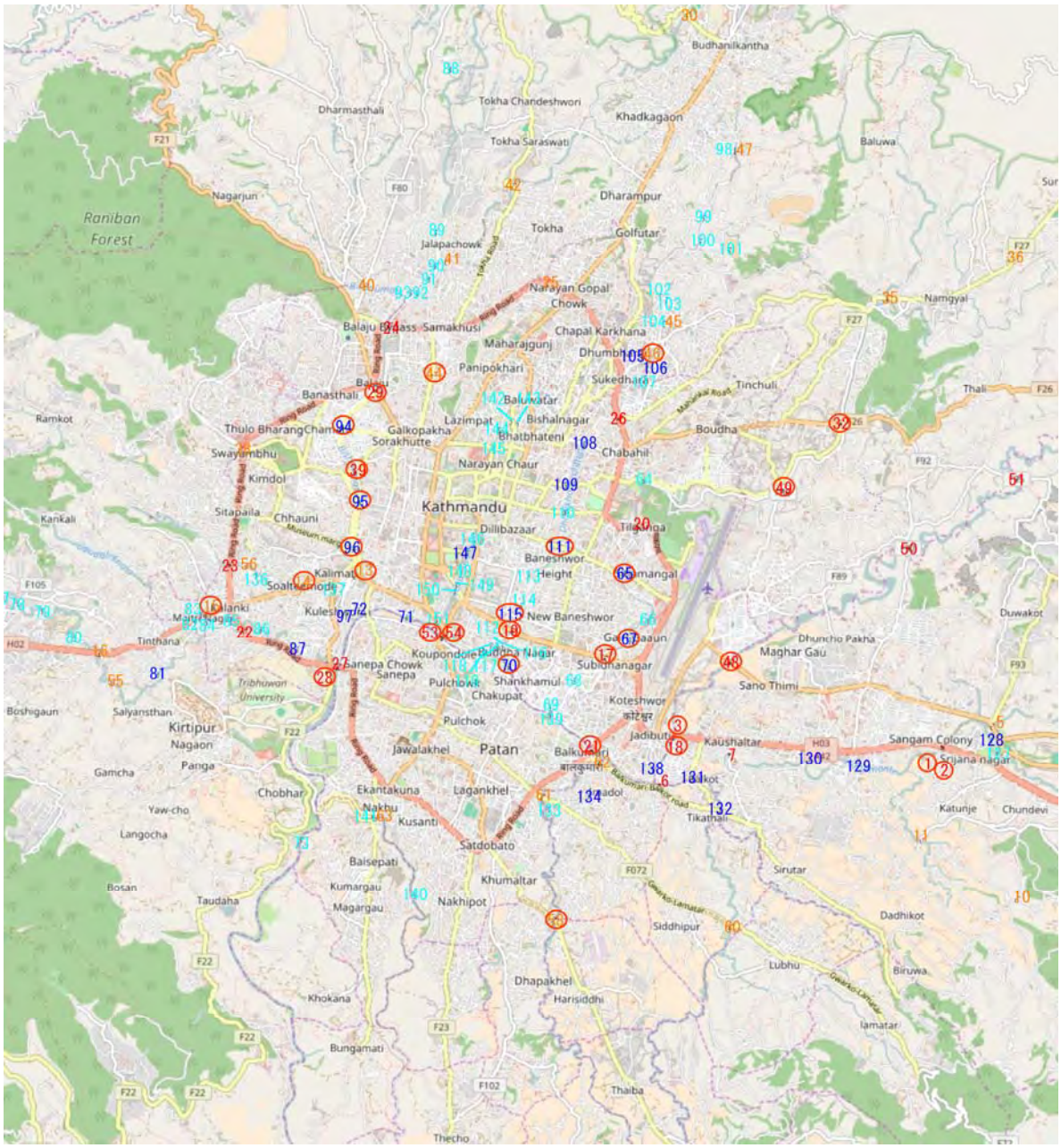
5.4.1 Survey Overview

The damage assessment of bridges by the team for PRNE and ERAKV classifies the bridges into 5 levels based on response ductility factor and seating length. Although the assessment has certain credibility, other important factors such as age of bridges and importance of route should be taken into consideration to prioritize the bridges for aseismic reinforcement.

The field survey of existing bridges was conducted to judge the necessity of aseismic reinforcement measures. Soundness and seating length were evaluated by short range visual inspection.

5.4.2 Bridge Location

Twenty nine bridges on the emergency transportation road and having multiple spans were examined. The location map of the target bridges is shown in the figure below.



※ Target bridges are

Figure 5.4.1 Location Map of the Target Bridges

5.4.3 Inspection Results

The list of the inspection results is shown in the table below.

Table 5.4.1 List of the Inspection Results

New S.N	Bridge Name	Road Name	Emergency Road	River/Stream	Bridge Length (m)	Width (m)	Span Number	Bridge Type	Verification of the Seating Length			Judgment Result		Notices	Countermeasure
									Measurement Result	INDIANS ROADS CONGRESS Minimum Seating Length	(Minimum Seating Length) ×1.5	Abutment	Pier		
1	Hanumante	Araniko Highway	First Emergency	Hanumante (OLD)	50.40	12.50	3	RCT	A1,A2: 750, P1,P2: 570	377	566	OK	OK		
2	Hanumante	Araniko Highway	First Emergency	Hanumante	50.40	9.10	3	RCT	A1 610, P1,P2: 575, A2: 800	377	566	OK	OK		
3	Manohara	Araniko Highway	First Emergency	Manohara	80.00	13.00	5	RCT	A1: 720, P1: 570, P3: 580, A2: 750	375	563	OK	OK		
13	Bishnumati	Tribhuvan Highway	First Emergency	Bishnumati Khola	83.10	13.60	8	RCT	A1: 530, P1: 545, P7: 500, A2: 530	361	541	OUT	OUT	Concrete shear crackeat the crossbeam end	Desirable to be replaced
14	Manamati	Tribhuvan Highway	First Emergency	Manamati Khola	12.70	19.60	2	RCC Slab	—	—	—	OK	OK		
15	Khadkulo	Tribhuvan Highway	First Emergency	Khadkulo	10.70	22.00	2	RCT	—	—	—	OK	OK		
17	Bagmati	Araniko Highway	First Emergency	Bagmati Nahar	84.00	20.45	5	RCT	A1: 860, P4: 550, A2: 840	377	566	OK	OUT		Aseismic reinforcement measure (Widening of the seating length)
18	Manohara	Araniko Highway	First Emergency	Manohara	84.00	20.45	5	RCT	A1: 900, P1: 550, P3: 575, A2: 800	377	566	OK	OK		
19	Dhobi Khola	Araniko Highway	First Emergency	Dhobi Khola	50.90	20.52	3	RCT	A1: 720, P1: 550, A2: 790	377	566	OK	OUT		Aseismic reinforcement measure (Widening of the seating length)
21	Manohara River	Kathmandu Ringroad	First Emergency	Manohara River	112.00	15.50	7	RCT	A1: 550, P1,P6: 585, A2: 940	375	563	OK	OK		
28	Balkhu Khola	Kathmandu Ringroad	Second Emergency	Balkhu Khola	42.00	15.50	3	RCT	A1: 820, P1: 585, A2: 900	370	555	OK	OK		
29	Bishnumati Khola	Kathmandu-Nuwakot-Dhadrcher-	High Way	Bishnumati Khola	60.00	12.80	4	RCT	A1: 600, P1: 445	373	559	OK	OUT	Pile exposure by scouring	Desirable to be replaced
32	Bagmati	Chabahil-Sankhu	High Way	Bagmati	86.75	9.50	4	RCT	A1: 780, P1: 525	377	565	OK	OUT		Aseismic reinforcement measure (Widening of the seating length)
39	Bishnumati	Shobhabhagwati-Nilkhanpauwa-Halchok	Second Emergency	Bishnumati Khola	74.10	12.30	2	RCT	A1: 1600, A2: 1700	428	641	OK	OK		
44	Samakhusi Khola	Samakhusi-Tokhagaun-Dandagaun-Gurje-Tadi-Gangate	Second Emergency	Samakhusi Khola	10.60	6.90	2	RCC Slab	—	—	—	OK	OK		
46	Damaged South	Kapan-Manalkatar Damaged Bridge South	Second Emergency	Damaged	15.30		2	Steel Plate Girder	—	—	—	OK	OK		
48	Manohara	Jadibuti-Thimi-Sallaghari	Second Emergency	Manohara Khola	60.20	10.95	3	RCT	P1: 675	385	578	OK	OK	Determine that the seating length on abutment has been secured by long range visual inspection	
49	Bagmati River	Gokarna-Jorpati-Gothatar	Second Emergency	Bagmati River	50.05	5.00	3	RCT	A1: 690, A2: 630	377	565	OK	OK		
53	Bagmati	Jayanepal-Bhaisepati-Tikabharab	High Way	Bagmati (New)	154.45	14.30	6	Steel Plate Girder	A1,A2 Box type abutment, P1,P5: 970	399	599	OK	OK		
54	Bagmati	Jayanepal-Bhaisepati-Tikabharab	High Way	Bagmati (Old)	153.60	10.67	6	Steel Plate Girder	A1: 1500, P5: 1150, A2: 1500	399	599	OK	OK		
65	Sinamangal Bridge		Second Emergency	Bagmati River	58.30	7.60	4	RCT	Unmeasureble	371	557	OK	OK	Determine that the seating length has been secured by long range visual inspection	
67			Second Emergency	Bagmati River	30.55	7.50	2	RCCT	A1: 780, P1: 825	373	560	OK	OK		
70	Sankhamul Bridge		Second Emergency	Bagmati River	50.45	11.70	3	RCCT	A1: 940, A2: 800	377	566	OK	OK		
94			Second Emergency	Bishnumati River	36.00	6.75	2	RCT	A2: 625	380	570	OK	OK	Inclination of the P1 pier	Desirable to be replaced
95	Dallu Bridge		Second Emergency	Bishnumati River	60.00	7.30	3	Steel Plate Girder	A1: 770, P1: 725	385	578	OK	OK		
96	Tankeshwori Bridge		Second Emergency	Bishnumati River	76.40	11.75	5	RCCT	A1: 775, P1: 535, A2: 725	373	560	OK	OUT		Aseismic reinforcement measure (Widening of the seating length)
111	Sebo pul		Second Emergency	Dhobi Khola River	55.00	12.70	3	RCCT	P1: 475	382	573	OK	OUT	Determine that the seating length on abutment has been secured by long range visual inspection	Aseismic reinforcement measure (Widening of the seating length)
115	Simrik Pul		Second Emergency	Dhobi Khola River	38.00	7.30	3	Steel Plate Girder RCC hollow slab	A1,A2: Rigid, P1: 720, P2: 740	367	550	OK	OK		

※1 indicates a bridge for which replacement is desirable since severe damage was found.

※2 indicates a bridge requiring aseismic reinforcement measures(Widening the seating length) due to the shortfall of seating length.

(1) Bridges for which replacement is desirable

Severe damage was found in 3 bridges out of the 29 target bridges for which it is thought that replacement should be conducted at an early stage.

The damage condition is as shown in the pictures below.

1) No.13 Bridge

Concrete shear cracks were confirmed at the crossbeam end (bearing support periphery) as a severe damage. Although detailed investigation is required to identify the cause, the following causes can be predicted.

(1) Insufficient load capacity due to increased live load after service

(2) Restraint of movement to the direction of bridge axis by rigid joint between bridge and bearing

If the current load condition continues, the following phenomenon shall occur.

(1) Crack enlarges due to the repetition of load

(2) Bearing support buckles as the result of enlarged crack

Similar damage may be found on bridges having single span and should be inspected in the furure.

(a)

(b)

(c)

Figure 5.4.2 Damage Situation in No.13 Bridge

[Proposal for Emergency Measures]

It is difficult to close the road since the bridge has no detour and the traffic volume is heavy. Therefore, it is conceivable to install temporary support by vent as an emergency measure.

An example of vent installation is shown in the figure below.

Figure 5.4.3 Example of Vent Installation

2) No.29 Bridge

The pile foundations of the pier are exposed due to scouring of the riverbed. Currently, it is thought that the support force under ordinary condition is secured, but there is a possibility of severe damage such as the collapse of the pier due to the destruction of the pile.

(a) (b)

Figure 5.4.4 Damage Situation in No.29 Bridge

3) No.94 Bridge

Although it is hard to understand from the picture, the P1 pier is inclined. It is unknown whether this inclination was from the time of construction, or whether it occurred as a result of the earthquake in 2015, or whether it gradually occurred due to live load under ordinary condition. However, since progress of inclination may cause severe damage including bridge collapse, it is necessary to carefully follow up observation. Since the inclination of the pier is not a favorable situation, we judged that it was a bridge that should be replaced at an early stage.

(a) (b)

Figure 5.4.5 Damage Situation in No.94 Bridge

(2) Bridges requiring aseismic reinforcement measures

As mentioned in the section "5.3 Aseismic Reinforcement Method", the basic approach is to widen the seating length because the purpose of this aseismic reinforcement measure is to prevent bridge collapse.

Minimum seating length is different depending on the applied standards. The methods for setting the minimum seating length in "STANDARD SPECIFICATIONS AND CODE OF PRACTICE FOR ROAD BRIDGES, INDIAN ROADS CONGRESS" that is often applied in Nepal, and Japan's "SPECIFICATIONS FOR HIGHWAY BRIDGES, JAPAN ROAD ASSOCIATION" are as follows.

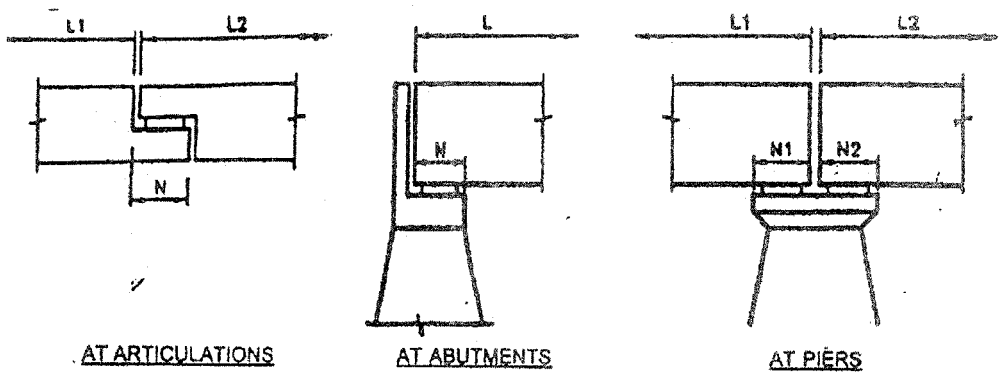
1) STANDARD SPECIFICATIONS AND CODE OF PRACTICE FOR ROAD BRIDGES, INDIAN ROADS CONGRESS

$N = 305 + 2.5L + 10H$ (mm)

Where

L: Span in meters

H: Average column height in meters



WHERE :

N = N1 = N2 = 305 + 2.5L + 10 H mm

L = SPAN IN METERS

H = AVERAGE COLUMN HEIGHT IN METERS

Fig. 16 Minimum Dimension for Support

Source）STANDARD SPECIFICATIONS AND CODE OF PRACTICE FOR ROAD BRIDGES

2) SPECIFICATIONS FOR HIGHWAY BRIDGES PART Ⅴ SEISMIC DESIGN, JAPAN ROAD ASSOCIATION

$S_{EM} = 0.7 + 0.005\,l$ (m)

Where

S_{EM}: Minimum seating length of a girder at the support (m)

l: Length of the effective span (m). When two superstructures with different span lengths are supported on one bridge pier, the longer of the two shall be used.

(1) The seating length of a girder at its support shall not be less than the value obtained from Eq. (16.2.1). In the case where the value is less than that obtained from Eq. (16.2.2), the design seating length shall not be less than the value from the latter equation. Here, the seating length shall be measured in the direction perpendicular to the front line of the bearing support when the direction of soil pressure acting on the substructure differs from the bridge axis, as in cases of a skew bridge or a curved bridge.

$$S_E = u_R + u_G \geqq S_{EM} \quad \cdots\cdots (16.2.1)$$

$$S_{EM} = 0.7+0.005\,l \quad \cdots\cdots (16.2.2)$$

$$u_G = \varepsilon_G L \quad \cdots\cdots (16.2.3)$$

where

S_E : Seating length of a girder at the support (m). S_E is the length of the superstructure from the end of girder to the edge of the top of the substructure, or the girder length on the halving joint, as shown in Fig. 16.2.1.

u_R Maximum relative displacement between the superstructure and the edge of the top of the substructure due to Level 2 Earthquake Ground Motion (m). In calculating u_R, the effects of the unseating prevention structure and the structure limiting excessive displacement shall not be considered. When soil liquefaction and lateral spreading as specified in Chapter 8 may affect displacement of the bridges, such effects shall be considered.

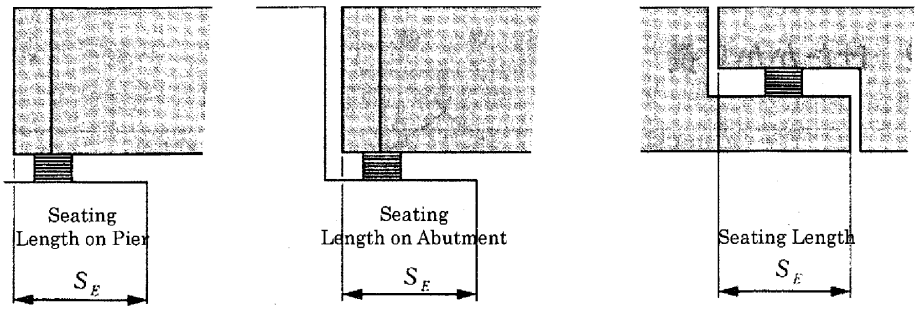
u_G : Relative displacement of the ground caused by seismic ground strain (m)

S_{EM}: Minimum seating length of a girder at the support (m)

ε_G : Seismic ground strain. ε_G can be assumed as 0.0025, 0.00375 and 0.005 for Ground Types I, II and III, respectively.

L : Distance between two substructures for determining the seating length (m).

l : Length of the effective span (m). When two superstructures with different span lengths are supported on one bridge pier, the longer of the two shall be used.



(a) Girder End Support (b) Halving Joint

Fig16.2.1 Seating Length

Source）SPECIFICATIONS FOR HIGHWAY BRIDGES PART Ⅴ SEISMIC DESIGN

The calculation formula of the minimum seating length in SPECIFICATIONS FOR HIGHWAY BRIDGES is applied from the standard in 1980. In that standard, although it is stated "it was prescribed taking into consideration the case of the past earthquake disaster", we could not confirm any further basis.

On the other hand, the seating length in STANDARD SPECIFICATIONS AND CODE OF PRACTICE FOR ROAD BRIDGES, INDIAN ROADS CONGRESS is the converted length in AASHTO (AMERICAN ASSOCIATION OF STATE HIGHWAY AND TRANSPORTATION OFFICIALS) in meters (Eq. 4.7.4.4-1). Since the seating length is increased by seismic zone in the standards of AASHTO (Table 4.7.4.4-1), it is considered that it is evaluated as an equation associated with the magnitude of the seismic motion. Furthermore, since this equation is applied also in the United States and India, which are the countries applied this standard, despite experiencing numerous huge earthquakes in the past, it can be thought that the equation has reliability. Also, according to "Seismic Hazard Assessment, Central Nepal South Scenario Earthquake (Correction Factor : x1/1 : Maximum assumed earthquake)" by ERAKV, the maximum PGA (Peak Ground Acceleration) in the Kathmandu Valley is about $0.4 < PGA \leqq 0.6$ (g) , whereas it is assumed to be about 1.5 (g) in the standards of AASHTO, it is considered that the standards of AASHTO can be applied to the Kathmandu Valley sufficiently.

Therefore, verification is carried out by applying the minimum seating length in STANDARD SPECIFICATIONS AND CODE OF PRACTICE FOR ROAD BRIDGES, INDIAN ROADS CONGRESS that is often applied in Nepal. Here, it is assumed that the parameter H (H: Average column height in meters) used in this formula is H = 3m for convenience because measurement of H is partially difficult in river and underground.

Also, in AASHTO and SPECIFICATIONS FOR HIGHWAY BRIDGES, installation of unseating prevention structures together with the seating length is specified. However, since installation of unseating prevention structure is not carried out in this countermeasure, it is necessary to secure a margin for the seating length in order to reliably prevent bridge collapse. In this case, the margin amount of the seating length is increased by 1.5 times due to the difference in acceleration in the standards of AASHTO (Table 4.7.4.4-1), so it is necessary to secure 1.5 times the seating length. Such a way of thinking is often adopted also in Japan.

Therefore, it is verified whether 1.5 times of the minimum seating length is secured in this verification.

4.7.4.4—Minimum Support Length Requirements

Support lengths at expansion bearings without restrainers, STUs, or dampers shall either accommodate the greater of the maximum displacement calculated in accordance with the provisions of Article 4.7.4.3, except for bridges in Zone 1, or a percentage of the empirical support length, N, specified by Eq. 4.7.4.4-1. Otherwise, longitudinal restrainers complying with Article 3.10.9.5 shall be provided. Bearings restrained for longitudinal movement shall be designed in compliance with Article 3.10.9. The percentages of N, applicable to each seismic zone, shall be as specified in Table 4.7.4.4-1.

The empirical support length shall be taken as:

$$N = (8 + 0.02L + 0.08H)(1 + 0.000125S^2) \quad (4.7.4.4\text{-}1)$$

where:

N = minimum support length measured normal to the centerline of bearing (in.)

L = length of the bridge deck to the adjacent expansion joint, or to the end of the bridge deck; for hinges within a span, L shall be the sum of the distances to either side of the hinge; for single-span bridges, L equals the length of the bridge deck (ft)

H = for abutments, average height of columns supporting the bridge deck from the abutment to the next expansion joint (ft)

for columns and/or piers, column, or pier height (ft)

for hinges within a span, average height of the adjacent two columns or piers (ft)

0.0 for single-span bridges (ft)

S = skew of support measured from line normal to span (degrees)

C4.7.4.4

Support lengths are equal to the length of the overlap between the girder and the seat as shown in Figure C4.7.4.4-1. To satisfy the minimum values for N in this Article, the overall seat width will be larger than N by an amount equal to movements due to prestress shortening, creep, shrinkage, and thermal expansion/contraction. The minimum value for N given in Eq. 4.7.4.4-1 includes an arbitrary allowance for cover concrete at the end of the girder and face of the seat. If above average cover is used at these locations, N should be increased accordingly.

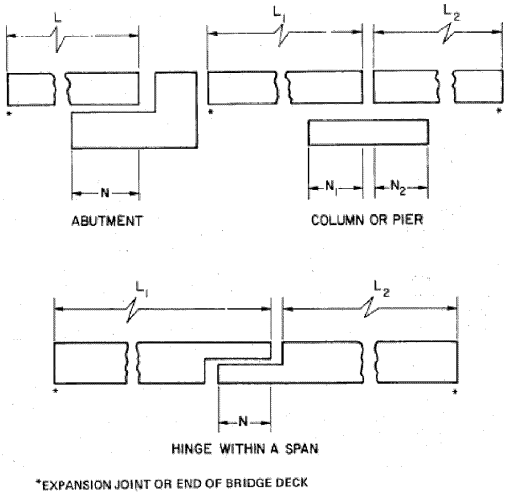


Figure C4.7.4.4-1—Support Length, *N*

Table 4.7.4.4-1—Percentage *N* by Zone and Acceleration Coefficient A_S, Specified in Eq. 3.10.4.2-2

Zone	Acceleration Coefficient, A_S	Percent, N
1	<0.05	≥75
1	≥0.05	100
2	All Applicable	150
3	All Applicable	150
4	All Applicable	150

Source）AASHTO LRFD BRIDGE DESIGN SPECIFICATIONS

The verification results are shown in the table below.

Table 5.4.2 List of the Verification Results of the Seating Length

New S.N.	Bridge Name	Bridge Length (m)	Width (m)	Span Number	Verification of the Seating Length					Notices	Countermeasure
					Measurement Result	INDIANS ROADS CONGRESS		Judgment Result			
						Minimum Seating Length	(Minimum Seating Length) ×1.5	Abutment	Pier		
1	Hanumante	50.40	12.50	3	A1,A2:750, P1,P2:570	377	566	OK	OK		
2	Hanumante	50.40	9.10	3	A1:810, P1,P2:575, A2:800	377	566	OK	OK		
3	Manohara	80.00	13.00	5	A1:720, P1:570, P3:580, A2:750	375	563	OK	OK		
13	Bishnumati	83.10	13.60	8	A1:520, P1:545, P7:500, A2:530	361	541	OUT	OUT	Concrete shear cracksat the crossbeam end	Desirable to be replaced
14	Manamati	12.70	19.60	2	—	—	—	OK	OK		
15	Khadkulo	10.70	22.00	2	—	—	—	OK	OK		
17	Bagmati	84.00	20.45	5	A1:860, P4:550, A2:840	377	566	OK	OUT		Aseismic reinforcement measure (Widening of the seating length)
18	Manohara	84.00	20.45	5	A1:800, P1:550, P3:575, A2:800	377	566	OK	OK		
19	Dhobi Khola	50.90	20.52	3	A1:720, P1:550, A2:790	377	566	OK	OUT		Aseismic reinforcement measure (Widening of the seating length)
21	Manohara River	112.00	15.50	7	A1:950, P1,P6:585, A2:940	375	563	OK	OK		
28	Balkhu Khola	42.00	15.50	3	A1:820, P1:585, A2:900	370	555	OK	OK		
29	Bishnumati Khola	60.00	12.80	4	A1:600, P1:445	373	559	OK	OUT	Pile exposure by scouring	Desirable to be replaced
32	Bagmati	66.75	9.50	4	A1:780, P1:525	377	565	OK	OUT		Aseismic reinforcement measure (Widening of the seating length)
39	Bishnumati	74.10	12.30	2	A1:1600, A2:1700	428	641	OK	OK		
44	Samakhusi Khola	10.60	6.90	2	—	—	—	OK	OK		
46	Damaged South	15.30		2	—	—	—	OK	OK		
48	Manohara	60.20	10.95	3	P1:675	385	578	OK	OK	Determine that the seating length on abutment has been secured by long range visual inspection	
49	Bagmati River	50.05	5.00	3	A1:690, A2:630	377	565	OK	OK		
53	Bagmati	154.45	14.30	6	A1,A2:Box type abutment, P1,P5:970	399	599	OK	OK		
54	Bagmati	153.60	10.67	6	A1:1500, P5:1150, A2:1500	399	599	OK	OK		
65	Sinamangal Bridge	58.30	7.60	4	Unmeasureble	371	557	OK	OK	Determine that the seating length has been secured by long range visual inspection	
67		30.55	7.50	2	A1:780, P1:825	373	560	OK	OK		
70	Sankhamul Bridge	50.45	11.70	3	A1:940, A2:800	377	566	OK	OK		
94		36.00	6.75	2	A2:620	380	570	OK	OK	Inclination of the P1 pier	Desirable to be replaced
95	Dallu Bridge	60.00	7.30	3	A1:770, P1:725	385	578	OK	OK		
96	Tankeshwori Bridge	76.40	11.75	5	A1:775, P1:535, A2:725	373	560	OK	OUT		Aseismic reinforcement measure (Widening of the seating length)
111	Seto pul	56.00	12.70	3	P1:475	382	573	OK	OUT	Determine that the seating length on abutment has been secured by long range visual inspection	Aseismic reinforcement measure (Widening of the seating length)
115	Simrik Pul	38.00	7.30	3	A1,A2:Rigid, P1:720, P2:740	367	550	OK	OK		

The seating length on pier is shorter than the seating length on abutment and it is only the pier part that does not satisfy the verification except for No.13 Bridge, which is a bridge for which replacement is desirable.

Bridges requiring widening of the seating length are 5 bridges (No.17, No.19, No.32, No.96, and No.111).

(3) Summary of Inspection Results

The summary of inspection results is shown in the table below.

Table 5.4.3 Summary of Inspection Results

(a) Bridges for which replacement is desirable（3 Bridges）

New S.N.	Bridge Name	Road Name	Emergency Road	River/Stream	Bridge Length (m)	Width (m)	Span Number	Bridge Type
13	Bishnumati	Tribhuvan Highway	First Emergency	Bishnumati Khola	83.10	13.60	8	RCT
29	Bishnumati Khola	Kathmandu-Dhunche-Rasuwagadhi	High Way	Bishnumati Khola	60.00	12.80	4	RCT
94			Second Emergency	Bishnumati River	36.00	6.75	2	RCT

(b) Bridges requiring aseismic reinforcement measure (Widening of the seating length) (5 Bridges)

New S.N.	Bridge Name	Road Name	Emergency Road	River/Stream	Bridge Length (m)	Width (m)	Span Number	Bridge Type
17	Bagmati	Araniko Highway	First Emergency	Bagmati Nahar	84.00	20.45	5	RCT
19	Dhobi Khola	Araniko Highway	First Emergency	Dhobi Khola	50.90	20.52	3	RCT
32	Bagmati	Chabahil-Sankhu	High Way	Bagmati	66.75	9.50	4	RCT
96	Tankeshwori Bridge		Second Emergency	Bishnumati River	76.40	11.75	5	RCCT
111	Seto pul		Second Emergency	Dhobi Khola River	56.00	12.70	3	RCCT

※*In all bridges, the part requiring widening of the seating length is on pier.*

5.5 Prioritization of Bridges that Implement Aseismic Reinforcement Measures

Priority of aseismic reinforcement measures is given to bridge for which it was determined in a survey of the existing bridges that aseismic reinforcement measures were necessary.

Priority order is set considering the following factors.

1) Importance of the route

The roads on the target bridges are (1) Highway, (2) First Emergency, (3) Second Emergency in order of importance.

Therefore, we evaluate (1) Highway as 3 points, (2) First Emergency as 2 points and (3) Second Emergency as 1 point.

2) Expected gravity of damage

Because the existing material (drawings and design documents) of the target bridges do not exist, expected gravity of damage is not clear. But it is assumed that the risk of bridge collapse will increase if the shortfall to the required seating length is large. Also, the longer the bridge length is, the higher the importance as a structure, and it is considered that the damage will be larger in the event of a disaster.

Considering the above factors, evaluation of 1 to 5 points is given to 5 bridges.

It is evaluated that the total value of 1) and 2) is a numerical value considering the importance of the route and the expected gravity of damage.

The results of evaluating the priority order shows in the table below.

Table 5.5.1 Priority Order of Bridges that Implement Aseismic Reinforcement Measures

New S.N.	Bridge Length (m)	1) Importance of the Route	2) Expected gravity of damages		1) ＋2)	Priority Order
			Shortfall to the Required Seating Length	Points		
17	84.00	First Emergency…2	16mm	2	4	**4**
19	50.90	First Emergency…2	16mm	1	3	**5**
32	66.75	Highway…3	40mm	4	7	**1**
96	76.40	Second Emergency…1	25mm	3	4	**3**
111	56.00	Second Emergency…1	98mm	5	6	**2**

※No.17 Bridge and No.96 Bridge have the same total value of 1) ＋2) , but No.17 Bridge with high importance of the route set a higher priority.

5.6 Rough Estimation of Construction Cost

(1) Bridge for which replacement is desirable

We calculate the approximate construction cost for 3 bridges for which replacement is desirable. Since there are so many uncertainties, it is assumed that the bridge is replaced with the same bridge length as the existing bridge.

1) No.13 Bridge

The specifications of the No.13 Bridge are shown in the table below.

Table 5.6.1 No.13 Bridge Specifications

Bridge Name	Bishnumati
Road Name	Tribhuvan Highway
River	Bishnumati Khola
Bridge Length (m)	83.10
Width (m)	13.60
Span Number	8
Bridge Type	RCT

Here, in case of replacing, both the superstructure and the substructure should be newly built as well as the superstructure. The reason is as follows.

i) When building a new bridge, it is necessary to widen the width from the existing 13.60m to 18m. Therefore, since the weight of the superstructure increases, the risk of subsidence may be concerned if the existing substructure is used as it is.

ii) Existing bridge is not desirable for river flood control because of the large number of piers. Therefore, it is important to consider the arrangement of piers which makes the inhibition on flood control smaller.

The width of the bridge is supposed to be 18m.

3 spans (27.7m@3=83.1m) are considered reasonable for the bridge to be replaced.

Although various types of bridge can be applied in consideration of the span arrangement, a prestressed concrete T-girder bridge of the same type as the existing bridge is assumed.

Based on the recent achievements of bridges in Nepal, we assumed the unit price per square meter of the bridges as 70,000 NRs.

[Approximate Construction Cost]

70,000NRs × 83.10m×18.00m = 104,706,000 NRs ⇒ **105,000,000 NRs**

2) No.29 Bridge

The specifications of the No.29 Bridge are shown in the table below.

Table 5.6.2 No.29Bridge Specifications

Bridge Name	Bishnumati Khola
Road Name	Kathmandu-Dhunche-Rasuwagadhi
River	Bishnumati Khola
Bridge Length (m)	60.0
Width (m)	12.80
Span Number	4
Bridge Type	RCT

Here, in case of replacing, both the superstructure and the substructure should be newly built as well as the superstructure because the substructure has severe damage.

It is assumed that the bridge is replaced with the same width as the existing bridge.
2 spans (30.0m@2=60.0m) are considered reasonable for the bridge to be replaced.
Although various types of bridge can be applied in consideration of the span arrangement, a prestressed concrete T-girder bridge of the same type as the existing bridge is assumed.
Based on the recent achievements of bridges in Nepal, we assumed the unit price per square meter of the bridges as 70,000 NRs.

[Approximate Construction Cost]

70,000NRs × 60.0m×12.80m = 53,760,000 NRs ⇒ **54,000,000 NRs**

3) No.94 Bridge

The specifications of the No.94 Bridge are shown in the table below.

Table 5.6.3 No.94Bridge Specifications

Bridge Name	
Road Name	
River	Bishnumati River
Bridge Length (m)	36.0
Width (m)	6.75
Span Number	2
Bridge Type	RCT

Here, in case of replacing, both the superstructure and the substructure should be newly built as well as the superstructure because the substructure has severe damage.

It is assumed that the bridge is replaced with the same width as the existing bridge.
1 span is considered reasonable for the bridge to be replaced.
Although various types of bridge can be applied, a prestressed concrete T-girder bridge of the same type as the existing bridge is assumed.
Based on the recent achievements of bridges in Nepal, we assumed the unit price per square meter of the bridges as 70,000 NRs.

[Approximate Construction Cost]

70,000NRs × 36.0m×6.75m = 17,010,000 NRs ⇒ **17,000,000 NRs**

(2) Bridges requiring aseismic reinforcement measures

We calculate the approximate construction cost for 5 bridges requiring aseismic reinforcement. The widening of the seating length must be installed on both sides of piers.

In the table below, we will organize the necessary parts of the widening of the seating length in each bridge.

Table 5.6.4 Organization of Necessary Parts of the Widening of the Seating Length

New S.N.	Bridge Length (m)	Width(m)	Span Number	Number of piers	Number of installation points of widening of seating length	Priority Order
17	84.00	20.45	5	4	8	4
19	50.90	20.52	3	2	4	5
32	66.75	9.50	4	3	6	1
96	76.40	11.75	5	4	8	3
111	56.00	12.70	3	2	4	2

In the case of reinforced concrete bridge piers, the widening of the seating length is generally widened by a reinforced concrete structure, and in the case of steel bridge piers, it is generally widened by a steel structure. Since all 5 of the target bridges have reinforced concrete piers, we assume a structure widened by a reinforced concrete structure.

In the case of widening by the reinforced concrete structure, the minimum widening amount should be about 300mm in consideration of the workability of the reinforced bar, concrete placing, etc. In all 5 bridges, expanding the seating length by 300mm will satisfy the standard requirement, so this figure was adopted as the widening amount.

Although the shape of the widened part should be determined by design calculation for each bridge, here we assume the shape as shown below in all 5 bridges.

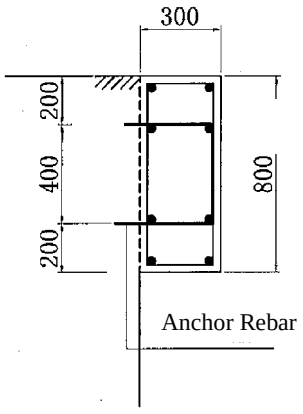


Figure 5.6.1 Assumed Model of Widened Part of Seating Length

We estimate that the construction cost of widening of the seating length (per 1 place, per 1 meter) is about 20,000 NRs/m.

The approximate construction cost of widening the seating length for each bridge is as shown in the table below.

Table 5.6.5 Approximate Construction Cost of Widening of the Seating Length

New S.N.	Bridge Length (m)	Width(m)	Installation Place of Widening of the Seating Length	Total Installation Extension of the Seating Length(m)	Approximate Construction Cost (NRs)
17	84.00	20.45	8	163.60	3,272,000 ⇒ **3,000,000**
19	50.90	20.52	4	82.08	1,641,600 ⇒ **1,500,000**
32	66.75	9.50	6	57.00	1,140,000 ⇒ **1,000,000**
96	76.40	11.75	8	94.00	1,880,000 ⇒ **2,000,000**
111	56.00	12.70	4	50.80	1,016,000 ⇒ **1,000,000**

※*Assumed that (Width) = (Pier width in a direction perpendicular to the bridge axis) because the pier size has not been measured.*

(3) Approximate construction cost allocation plan

Approximate construction cost is estimated and included into the cost estimate for the short-term (Year 2020), the middle-term (Year 2025), and the long-term (Year 2030) based on the prioritization. Approximate construction costs are listed in the table below.

Table 5.6.6 List of Approximate Construction Cost

New S.N.	Countermeasure	Bridge Length (m)	Width(m)	Priority	Approximate Construction Cost (NRs)
13	Replacement	83.10	18.00	—	105,000,000
29		60.00	12.80	—	54,000,000
94		36.00	6.75	—	17,000,000
17	Aseismic Reinforcement	84.00	20.45	4	3,000,000
19		50.90	20.52	5	1,500,000
32		66.75	9.50	1	1,000,000
96		76.40	11.75	3	2,000,000
111		56.00	12.70	2	1,000,000

The following table shows the allocation of approximate construction costs for the short-term (Year 2020), the middle-term (Year 2025), and the long-term (Year 2030) based on the prioritization.
Here, the 3 bridges for which replacement is desirable were allocated to each phase from descending order of urgency. For the 5 bridges requiring aseismic reinforcement measure, the high priority No.32 Bridge was allocated as a pilot project in the short-term (Year 2020) , and because the amount is small, the remaining 4 bridges were allocated in the middle-term (Year 2025).

Table 5.6.7 Allocation Plan for Each Phase of Approximate Construction Costs

Phase	New S.N.	Countermeasure	Bridge Length (m)	Width(m)	Priority	Approximate Construction Cost (NRs)
Short-term (Year 2020)	13	Replacement	83.10	18.00	—	105,000,000
	32	Aseismic Reinforcement	66.75	9.50	1	1,000,000
					Subtotal	**106,000,000**
Middle-term (Year 2025)	29	Replacement	60.00	12.80	—	54,000,000
	17	Aseismic Reinforcement	84.00	20.45	4	3,000,000
	19		50.90	20.52	5	1,500,000
	96		76.40	11.75	3	2,000,000
	111		56.00	12.70	2	1,000,000
					Subtotal	**61,500,000**
Long-term (Year 2030)	94	Replacement	36.00	6.75	—	17,000,000
					Subtotal	**17,000,000**
					Total	**184,500,000**

5.7 Bridge Inspection Pictures <Reference>

The 3 bridges for which replacement is desirable and the 5 bridges requiring aseismic reinforcement measures are shown in the pictures that follow.

1) No.13 Bridge (Replacement)

(a)

(b)

Figure 5.7.1 No.13 Bridge

2) No.29 Bridge (Replacement)

(a)

(b)

Figure 5.7.2 No.29 Bridge

3) No.94 Bridge (Replacement)

(a)

(b)

Figure 5.7.3 No.94 Bridge

4) No.17 Bridge (Widening of the seating length)

(a)

(b)

Figure 5.7.4 No.17 Bridge

5) No.19 Bridge (Widening of the seating length)

(a)

(b)

Figure 5.7.5 No.19 Bridge

6) No.32 Bridge (Widening of the seating length)

(a)

(b)

Figure 5.7.6 No.32 Bridge

7) No.96 Bridge (Widening of the seating length)

(a)

(b)

Figure 5.7.7 No.96 Bridge

8) No.111 Bridge (Widening of the seating length)

(a)

(b)

Figure 5.7.8 No.111 Bridge