CHAPTER 2
TRANSPORT DEMAND FORECAST

2.1 TRANSPORT DEMAND MODELLING

A detailed travel demand model is required to enable forecast of future travel demand, and to assess alternative strategies for handling this demand. It is not confined to just one model, but a series of inter-linked and inter-related models of varying levels of complexity, dealing with different facets of travel demand. Through these models, the result of transportation study process as a whole is checked and calibrated before it is used for future travel predictions.

In the present study, an attempt has been made to develop operational models for estimating future travel demand. The normal and easily available planning variables at zonal levels such as population, employment and school enrolment have been made use of in transport demand analysis.

The basic functions included in the transportation study process are:

- Trip-end prediction or trip generation and attractions – i.e., the determination of the number of person trips leaving a zone irrespective of destination and the number of trips attracted to a zone, irrespective of origin.
- Trip distribution – the linking of the trip origins (generation) with their destinations (attraction).
- Modal split – the division of trips between public transport modes and different private modes
- Assignment – the allocation of trips between a pair of zones to the most likely route(s) on the network.
- Evaluation – assessing the effectiveness of the network in meeting the transport demand.

The details of the planning process as adopted for this study is shown in **Figure 2.1**.

2.2 ZONING

The entire study area has been delineated into 159 zones as shown in **Figure 2.1** Among them 137 are the zones within the corporation area and the remaining zones are outside corporation area. Detailed list of all these zones is given in the **Annexure 2.1.**

The Population data for the year 2001 have been collected from the Census Department. Population projections for the year 2011and 2021 have been worked out in consultation with BDA. Population projection ward wise is presented in the **Annexure 2.2**.

Bangalore has a fairly high labour participation rate. Employment projection has also been done for the years 2011 and 2021 in consultation

with BDA, considering 2001 as the base year. Employment projection ward wise is presented in the **Annexure 2.3**.

Summary of population projection and employment projections is presented in the **Table 2.1**.

Table 2.1
Population and Employment projection

	2001(in lakhs)	2011(in lakhs)	2021(in lakhs)
Population	56.76	70.0	85.0
Employment	18.51	24.25	31.25

2.2 HOUSEHOLD SURVEY

2.2.1 Sample

Household cum opinion survey for a sample of about 10000 households were carried out spread over the study area. The samples have been drawn from the electoral list prepared by Government of Karnataka on stratified random sampling basis. Stratification of the sample was done to cover various income groups.

2.2.2 Survey format

The survey format was designed in three parts; the first part covered the socio-economic profile of the house hold providing details like House-hold size, education levels, Income, Vehicle ownership, type of dwelling unit etc., the second part of the proforma covers the individual trip information of the members of the household, which provides details of trips performed on the previous day by the hose-hold members and the third part of the proforma consists of opinion survey of the members of the Household for their preference to shift to METRO in terms of extra fare, frequency of trains and time saving.

2.2.3 Training of enumerators

The enumerators with minimum graduate qualifications were selected and were trained in-house by RITES experts to carryout the survey. Pilot survey was carried out to obtain the response from the Households and minor modifications were carried out in the proforma based on the pilot survey. The pilot survey also helped as training for the enumerators.

2.2.4 Field Survey

The samples for each zone were drawn from the electoral list and addresses of the selected households were provided for the enumerators to carryout the survey. Incase the house was locked; the enumerators visited the same house on the next day. In case they fail again, adjacent house was selected to carryout the survey. The survey was carried out after 6 pm on weekdays and during day time on week ends so that the head of the household and other members are available.

2.2.5 Outputs /Results

The following outputs are derived from the analysis of the Household survey cum opinion surveys

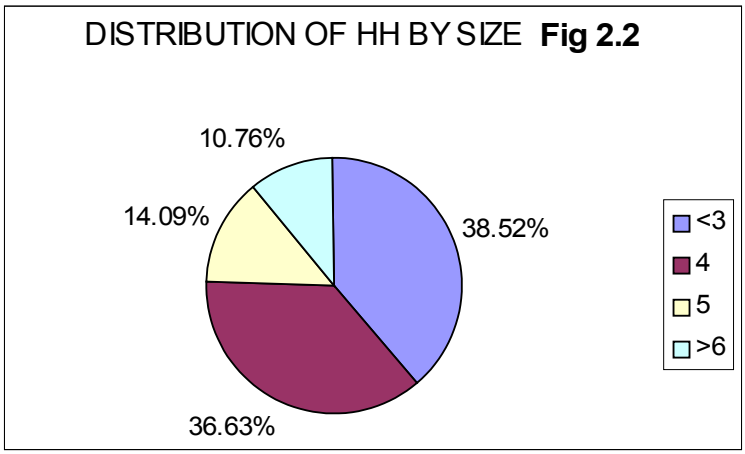
1. Zone wise distribution of House holds according to type of dwelling unit, Household size, Household income, and vehicle ownership.
2. Zone wise distribution of individuals by their occupation, education, mode of transport used, expenditure of transport.
3. Distribution of trips by mode and purpose
4. Trip length frequency distribution by time
5. Passenger preference to shift to METRO form bus and private modes

2.2.6 Distribution of Households by size

The distribution of households by size is presented in **Table 2.2 and Fig. 2.2.** It can be observed from the table below that 38.52% of the household size is less than or equal to 3, 36.63% have household size between 3 and 4, 14.09% have household size between 4 and 5 and only 10.76 % of the households surveyed had size more than 5.

Table 2.2 - Distribution of household by size

Household by Size	Total H H (in Lakhs)	Percentage
upto3	1.16	38.52%
3-4	1.47	36.63%
4-5	0.70	14.09%
>5	0.75	10.76%
Total	**4.08**	**100.00%**

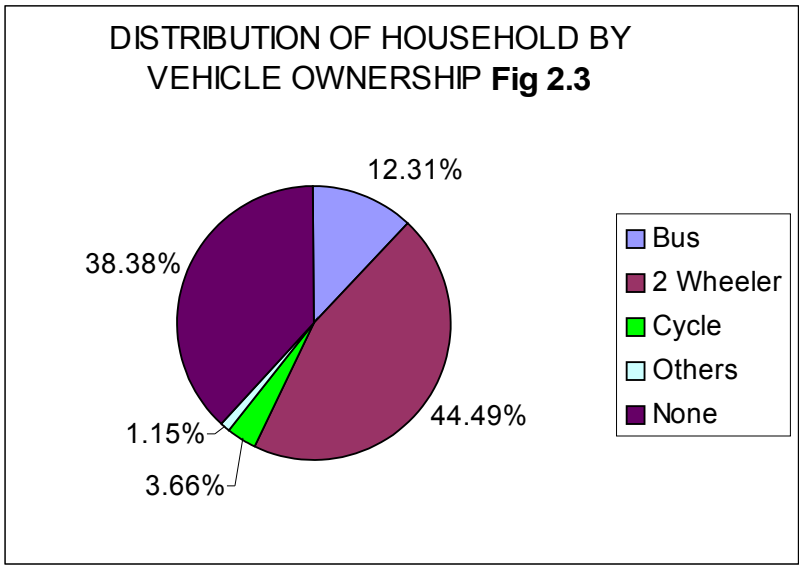


2.2.7 Distribution of household by vehicle ownership

The distribution of the house-holds showing their vehicle ownership is presented in the **Table 2.3 and Fig.2.3**. It is observed that 12.31% of the households own car, 44.49% of the households own two wheelers, 3.665 own cycle, 1.15 % own other vehicles like cycle rickshaw, bus etc and 38.385 does not own any vehicle.

Table 2.3 - Distribution of Household by Vehicle Ownership

Vehicle Ownership	Total	Percentage
Car	1230	12.31%
2 Wheeler	4445	44.49%
Cycle	366	, 3.66%
Others	115	1.15%
None	3834	38.38%
Total	**10000**	**100.00%**



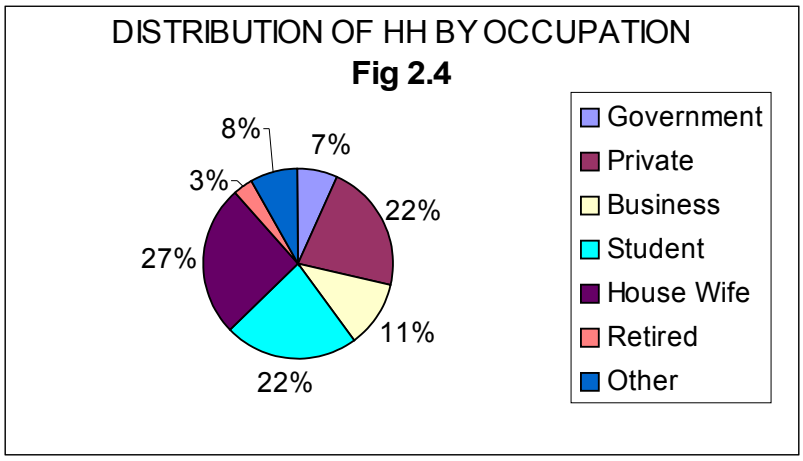
2.2.8 Distribution of Households by occupation

The distribution of household by occupation is presented in **Table 2.4 and Figure 2.4.** It can be observed from the above table that 6.81% are Government employees, 22.18% work in private firms, 11.12% are Businessmen. 11.12 % of the samples surveyed were students and rest in other categories as shown in the table below

Table 2.4-Distribution of Household Population by occupation

Occupation	No. of Samples	No. Of Households	% Age
Government	2780	681	6.81%
Private	9052	2218	22.18%
Business	4541	1112	11.12%
Student	9112	2234	22.34%
House Wife	10705	2624	26.24%
Retired	1339	328	3.28%
Other	3256	803	8.03%
All Occupations	**40785**	**10000**	**100.00%**

Figure 2.4

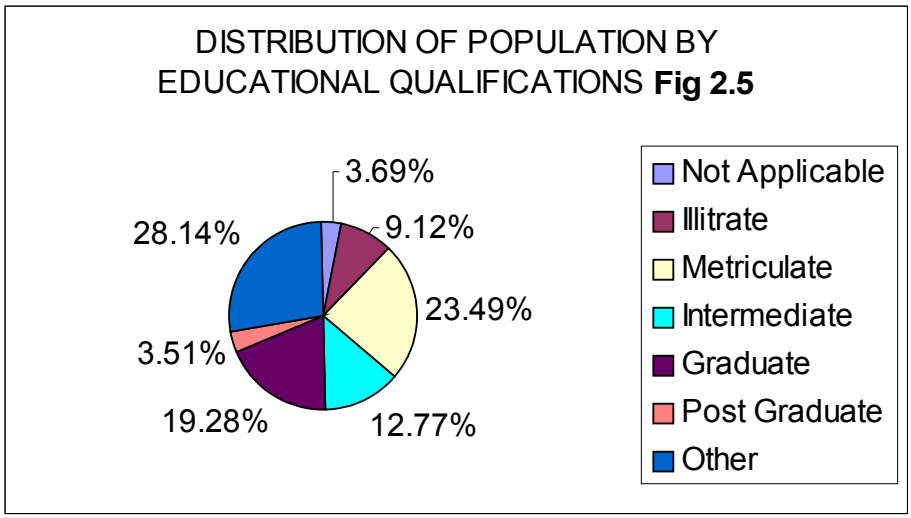


2.2.9 Distribution of Households by Education

Distribution of Households by educational Qualifications is presented in **Table 2.5 and Figure 2.5.** It can be observed from the table that 9.12% of the samples interviewed were illiterates, 23.48 % matriculates, 19.28 graduates and 3.51 % postgraduates.

Table 2.5 Distribution of Household Members by Education

Education Level	Total	Percentage
Not Applicable	369	3.69%
Illiterates	912	9.12%
Matriculate	2349	23.49%
Intermediate	1277	12.77%
Graduate	1928	19.28%
Post Graduate	351	3.51%
Other	2814	28.14%
Total	10000	100.00%

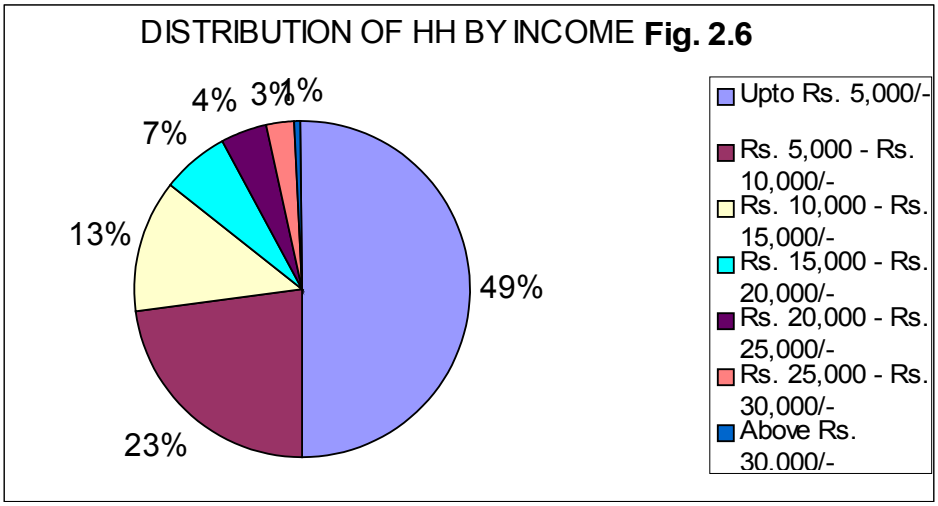


2.2.10 Distribution of Household by Income range

The distribution of the Households by income is presented in **Table 2.6 and Figure 2.6.** It can be observed from the table that 49.76% of the households have income up to Rs. 5000/-, 22.89% in the range Rs 5000 to Rs 10000/-, 13.04% in the range of Rs. 10000/- to Rs 15000/-. Only 6.51% and 7.85% of the households fall in the income category of Rs 15000 to Rs 20000/- and above Rs 20000/- respectively

Table 2.6: Distribution of Household by Income range

Income Rage	No. Of Units	No. Of Households	% Age
Upto Rs. 5,000/-	20377	4976	49.76
Rs. 5,000 – Rs. 10,000/-	9336	2289	22.89
Rs. 10,000 – Rs. 15,000/-	5319	1304	13.04
Rs. 15,000 – Rs. 20,000/-	2656	651	6.51
Rs.> 20,000 -	3187	780	7.80
Total	**40875**	**10000**	**100.00**

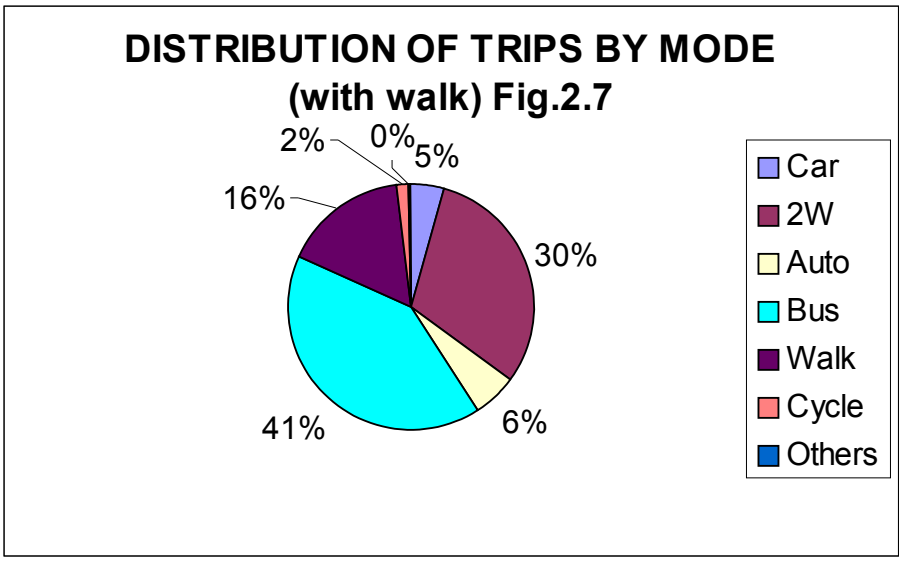


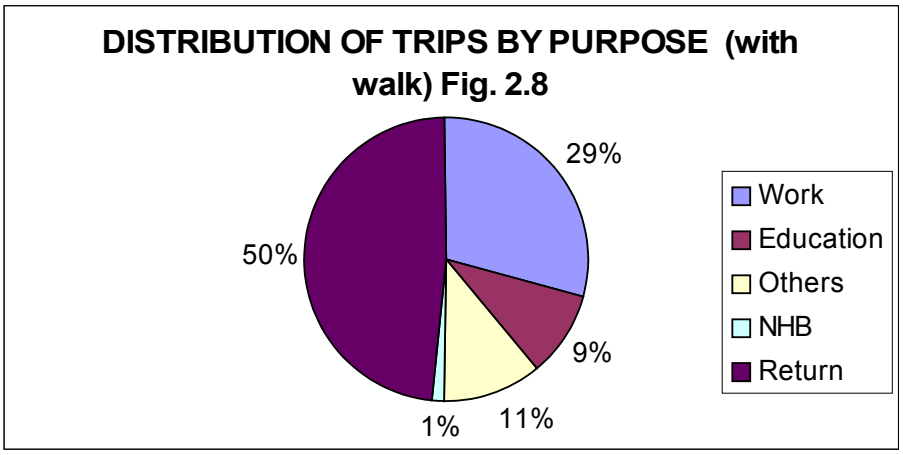
2.2.11 Trip Information

The trip information obtained from the survey has been analyzed with respect to distribution of total trips by mode and purpose. The trips by various mode and by purpose with walk trips is presented in **Table 2.7 and Fig. 2.7 to 2.10.**

Table 2.7 Distribution Of trips by Mode and Purpose with Walk

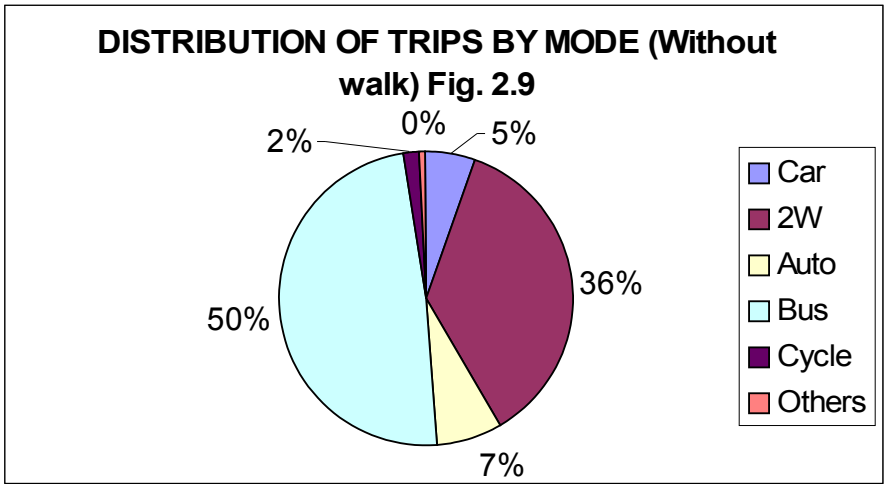
	Work	Education	Others	NHB	Return	Total
Car	90607	7789	36468	2514	133484	270862
2W	704629	84535	122507	7028	887952	1806651
Auto	133060	17084	51835	15008	126166	343153
Bus	586870	281700	318628	39462	1207253	2433913
Walk	203565	139966	132386	10816	479475	966208
Cycle	26476	21151	2105	700	49285	99717
Others	4774	3190	2236	863	10872	21935
Total	1749981	555415	666165	76391	2894487	5942439

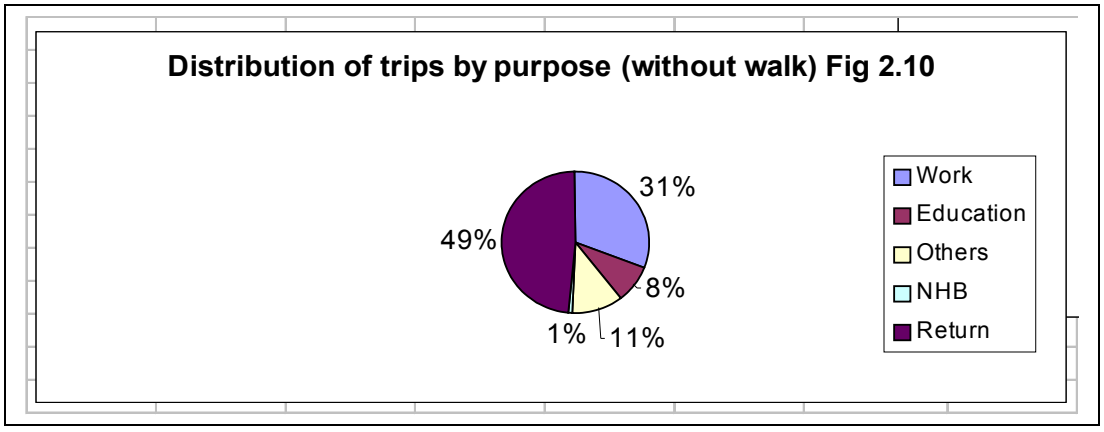




It can be observed from the above table that 58.52 lakh inter zonal trips are performed including walk trips. Walk trips constitute about 17% of the total interzonal trips, bus trips will be 41 %, two wheeler trips 31% and auto trips constitutes 4%. The distribution of the vehicular trips without walk trips is presented in **Table 2.8**. It can be observe that 49.5 lakh vehicular trips are performed per day. This includes 63964 non-home based trips. For the purposes of Modeling, non-home based trips are not considered. The total bus trips including chartered buses constitute about 50% of the Vehicular trips, Car 6% and Two wheelers constitute about 37% of the vehicular trips 37%.

Table 2.8 Distribution Of trips by Mode and Purpose without Walk						
	Work	**Education**	**Others**	**NHB**	**Return**	**Total**
Car	90607	7789	36468	2514	133484	270862
2W	704629	84535	122507	7028	887952	1806651
Auto	133060	17084	51835	15008	126166	343153
Bus	586870	281700	318628	39462	1207253	2433913
Cycle	26476	21151	2105	700	49285	99717
Others	4774	3190	2236	863	10872	21935
Total	1546416	415449	533779	65575	2415012	4976231





OUTER CORDON SURVEY

Classified traffic Volume survey along with OD survey of passengers and goods vehicles (both incoming and outgoing) were carried out at 10 outer cordon locations at the radial Highways and MDR emerging out from

Bangalore. The location of outer cordon locations is presented in **Figure 2.11**.

The survey locations are as follows:

1	NH 7	Beyond outer ring road (Allalsandra)
2	Old Madras Road	Check post at White field road crossing
3	Airport Road	Beyond Outer ring road intersection
4	Sarjapur Road	LC of Salem railway line
5	Hosur Road	Beyond Electronic city
6	Bannergatta Road	Beyond Hulimavu
7	Mysore Road	Beyond Mayanahalli
8	Magadi Road	Beyond Gollarapalya
9	Tumkur Road	12th Mile NH4
10	Kanakapura Road	Beyond Vasantpura

2.3.1 Intensity of traffic at outer cordon location

Table 2.9 –Intensity of Traffic (Average Daily Traffic)

SINo	Locations	ADT (16 hours)	
		Vehicles	PCUs
1	Bellary Road	32324	49769
2	Sarjapur Road	3954	5338
3	Kanakapur Road	12633	20352
4	Mysore Road	5387	10383
5	OM Road	19149	29763
6	Airport Road	31984	43129
7	Magadi Road	11069	16175
8	Tumkur Road	34924	61807
9	Hosur Road	30745	54867
10	Bannergatta Road	12178	17740

Intensity of traffic at the outer cordon location is presented in **Table 2.9**. It is observed from the above table that the highest traffic is observed on Tumkur Road 30745 vehicles (54867 pcus) followed by Hosur Road 30745 vehicles (54867 pcus). Traffic volume is also found to be high on the Bellary Road. On the Airport Road, the traffic is high due to the diversion from Old madras Road for the construction of Cable stage Bridge.

2.3.2 Peak hour traffic

Peak hour traffic at the outer cordon locations is presented in **Table 2.10**. It is observed that on National highways the NH4 and NH& the peak

percentage is 11.56 and 7.48 respectively, while on other roads it varies from 6.8 % to 9.2%.

Table 2.10 – Peak hour traffic at outer cordon locations

SL.N	Location	Veh	Morning Peak			Evening Peak			
			%ADT	PCUs	%ADT	Veh	%ADT	PCUs	%ADT
1	Bellary Road	2658	8.22	3760	7.55	2634	8.15	3722	7.48
2	Sarjapur Road	367	9.29	482	9.03	371	9.37	495	9.27
3	Kanakapur Road	1148	9.09	1730	8.50	1029	8.15	1514	7.44
4	Mysore Road	536	9.96	1079	10.39	510	9.47	957	9.22
5	OM Road	1478	7.72	2065	6.94	1631	8.52	2392	8.04
6	Airport Road	3020	9.44	3599	8.35	3117	9.75	4477	10.38
7	Magadi Road	854	7.72	1179	7.29	929	8.39	1308	8.09
8	Tumkur Road	2472	7.08	4086	6.61	2478	7.09	4239	6.86
9	Hosur Road	2315	7.53	3570	6.51	3361	10.93	6345	11.56
10	Bannergatta Road	1155	9.48	1559	8.79	866	7.11	1237	6.97

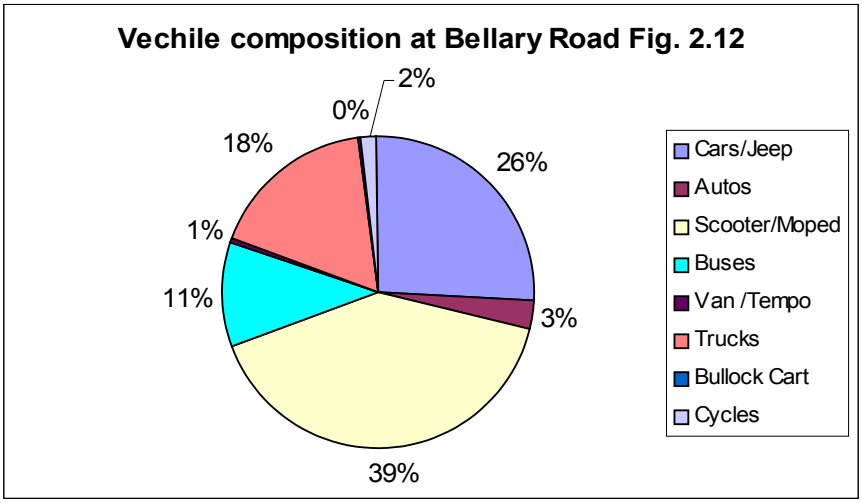
2.3.3 Composition of traffic at outer cordon location

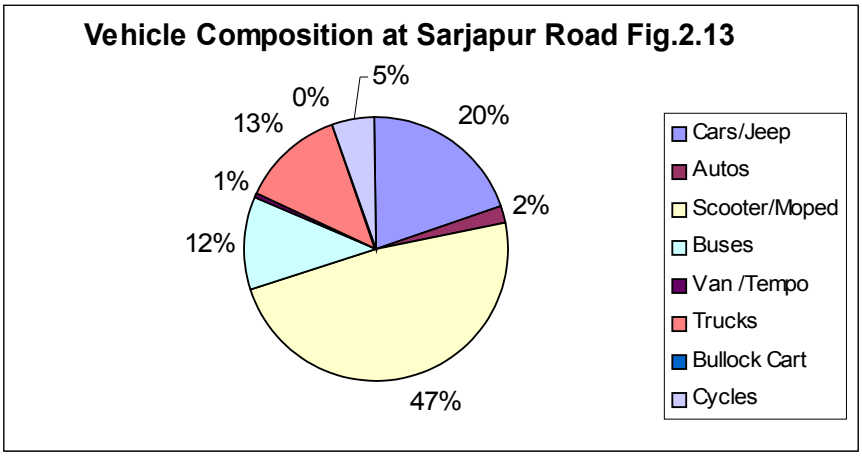
The composition of traffic at outer cordon location is presented in **Table 2.11 and Figures 2.12 to 2.22**. It can be observed from the above table that the composition of cars varies from 14.7% to 29.41%, two wheelers 29 to 40%, autos 2 to 7.5%, buses 7 to 13%, goods vehicles 12.8 to 26% and slow moving vehicles are negligible.

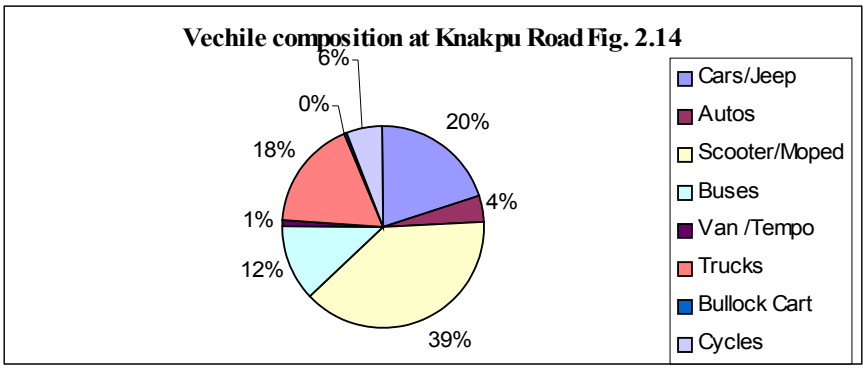
Table 2.11 - Composition of traffic at Outer Cordon location

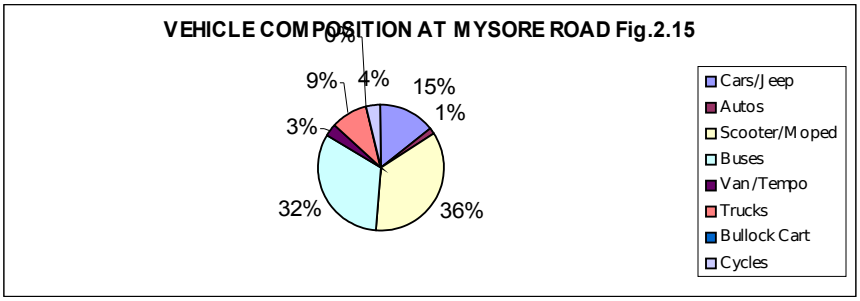
Location	Cars/Jeep	Autos	Scooter/ Moped	Buses	Van /Tempo	Trucks	Bullock Cart	Cycles	Total Vehicle
Bellary Road	8446	897	13001	3506	213	5668	30	564	32324
	26.13%	2.77%	40.22%	10.85%	0.66%	17.54%	0.09%	1.75%	
Sarjapur Road	792	79	1890	457	24	506	2	205	3954
	20.03%	2.00%	47.79%	11.55%	0.61%	12.80%	0.06%	5.17%	
Kanakapura Road	2567	538	4809	1558	140	2252	37	732	12633
	20.32%	4.26%	38.07%	12.33%	1.11%	17.82%	0.30%	5.79%	
Mysore Road	792	78	1890	1727	187	503	6	205	5387
	14.70%	1.45%	35.08%	32.06%	3.47%	9.33%	0.10%	3.80%	
OM Road	3867	1447	7255	2110	230	3160	24	1057	19149
	20.19%	7.55%	37.88%	11.02%	1.20%	16.50%	0.13%	5.52%	
Airport Road	9407	1231	13517	2401	309	4203	43	872	31984
	29.41%	3.85%	42.26%	7.51%	0.97%	13.14%	0.13%	2.73%	
Magadi Road	1686	814	5308	1165	68	1549	26	453	11069
	15.23%	7.35%	47.95%	10.52%	0.61%	13.99%	0.24%	4.09%	

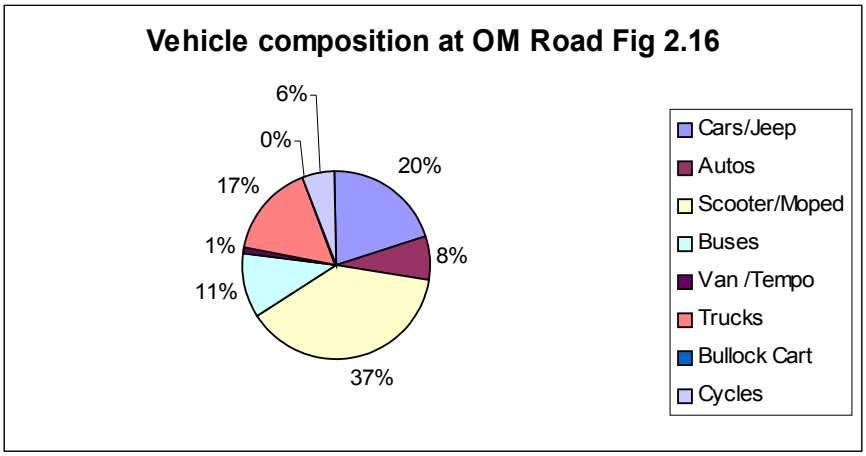
Tumkur Road	7123	1801	11114	3953	351	9169	25	1388	34924
	20.39%	5.16%	31.82%	11.32%	1.01%	26.25%	0.07%	3.97%	
Hosur Road	8009	795	8956	4242	428	7961	7	348	30745
	26.05%	2.59%	29.13%	13.80%	1.39%	25.89%	0.02%	1.13%	
Bannergatta Road	2504	563	5366	1338	77	1867	13	451	12178
	20.56%	4.62%	44.06%	10.98%	0.63%	15.33%	0.11%	3.70%	

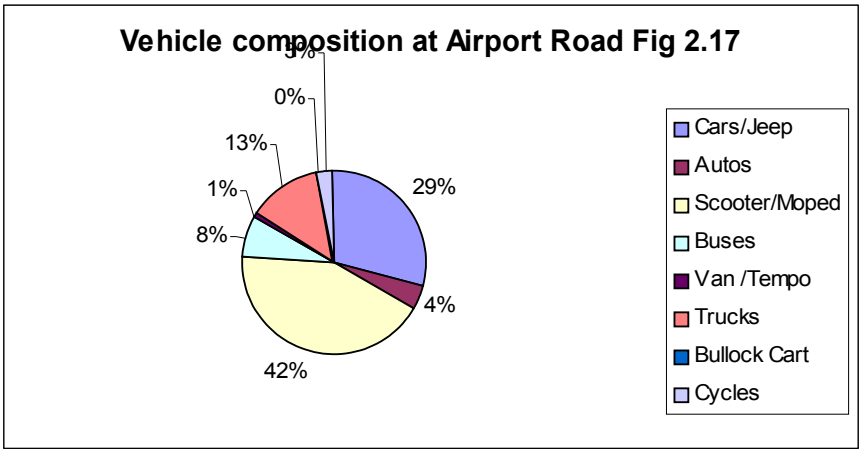


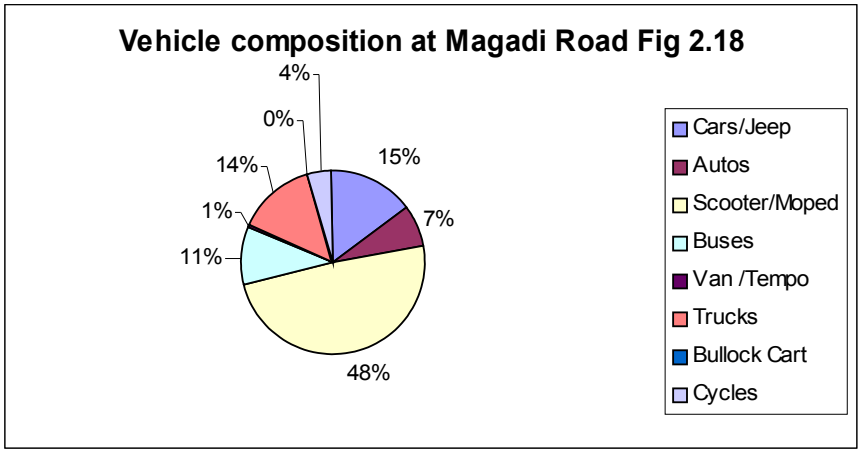


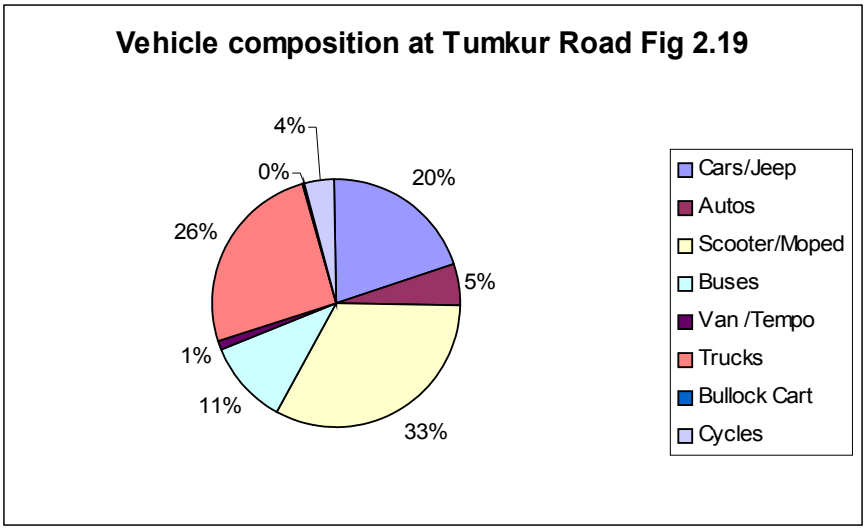

Vechile composition at Knakpu Road Fig. 2.14
6%
0%
20%
18%
4%
1%
12%
39%
Cars/Jeep
Autos
Scooter/Moped
Buses
Van /Tempo
Trucks
Bullock Cart
Cycles

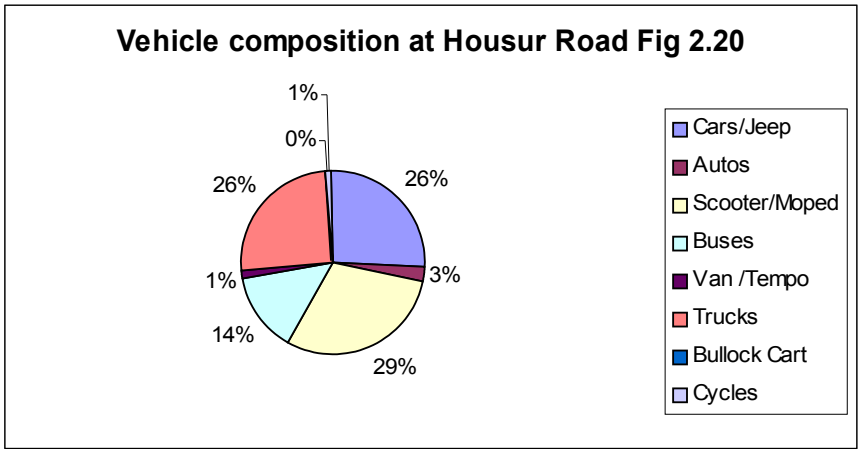

VEHICLE COMPOSITION AT MYSORE ROAD Fig.2.15
0%
9%
4%
15%
1%
3%
32%
36%
Cars/Jeep
Autos
Scooter/Moped
Buses
Van/Tempo
Trucks
Bullock Cart
Cycles

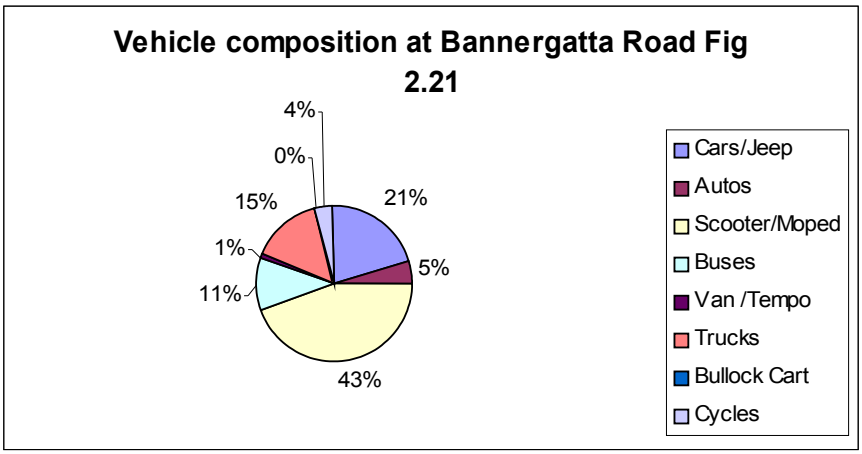

Vehicle composition at OM Road Fig 2.16
6%
0%
20%
17%
1%
8%
11%
37%
Cars/Jeep
Autos
Scooter/Moped
Buses
Van /Tempo
Trucks
Bullock Cart
Cycles


Vehicle composition at Airport Road Fig 2.17
3%
0%
13%
1%
29%
8%
4%
42%
Cars/Jeep
Autos
Scooter/Moped
Buses
Van /Tempo
Trucks
Bullock Cart
Cycles


Vehicle composition at Magadi Road Fig 2.18
4%
0%
15%
14%
7%
1%
11%
48%
Cars/Jeep
Autos
Scooter/Moped
Buses
Van /Tempo
Trucks
Bullock Cart
Cycles


Vehicle composition at Tumkur Road Fig 2.19
4%
0%
20%
26%
5%
1%
11%
33%
Cars/Jeep
Autos
Scooter/Moped
Buses
Van /Tempo
Trucks
Bullock Cart
Cycles


Vehicle composition at Housur Road Fig 2.20
1%
0%
26%
26%
3%
1%
14%
29%
Cars/Jeep
Autos
Scooter/Moped
Buses
Van /Tempo
Trucks
Bullock Cart
Cycles



2.3.4 Hourly variation of traffic

Hourly variation of traffic is presented in **Figures 2.22 to 2.31**. It can be observed from the figures that two distinct peak is observed in the morning and evening peak hours between 8 am to 10am and 6pm to 7 pm respectively

Figure 2.22

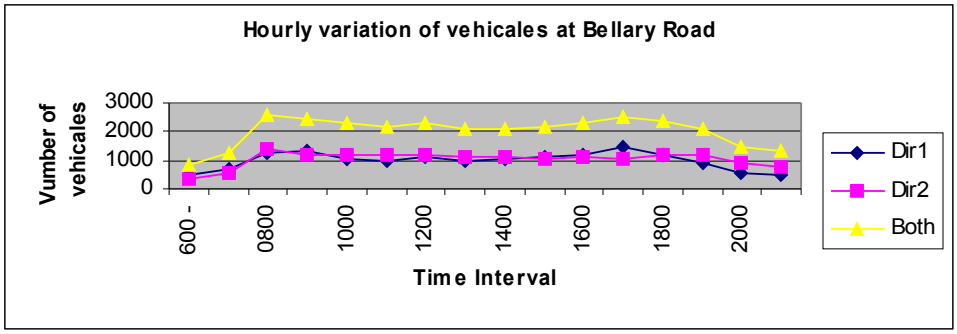


Figure 2.23

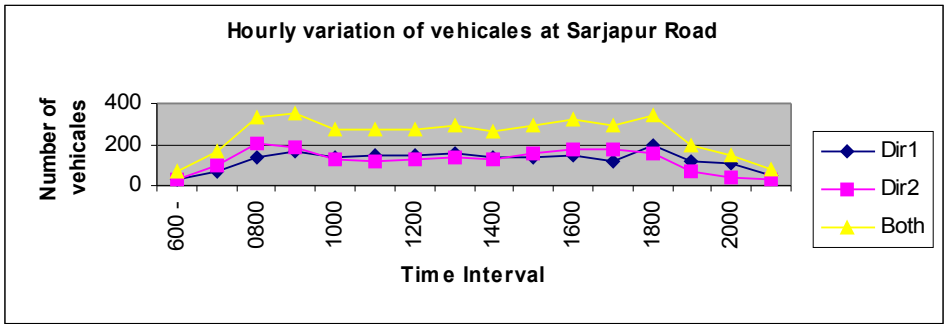


Figure 2.24

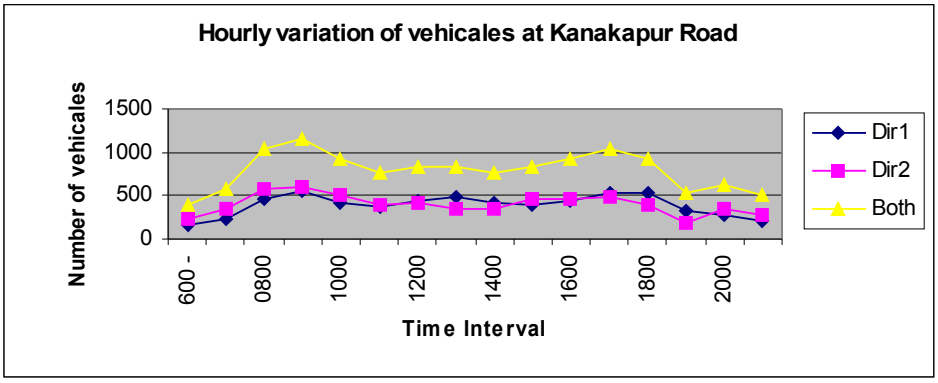


Figure 2.25

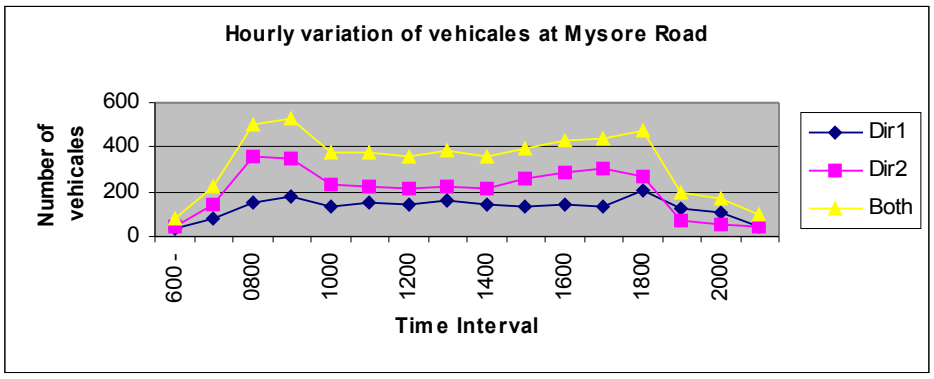


Figure 2.26

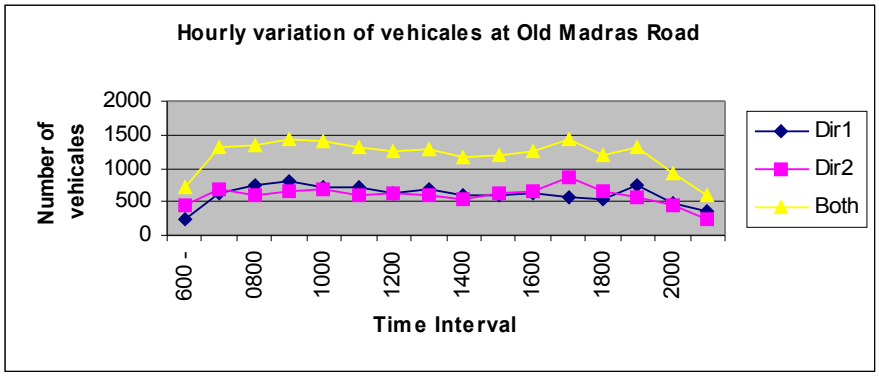


Figure 2.27

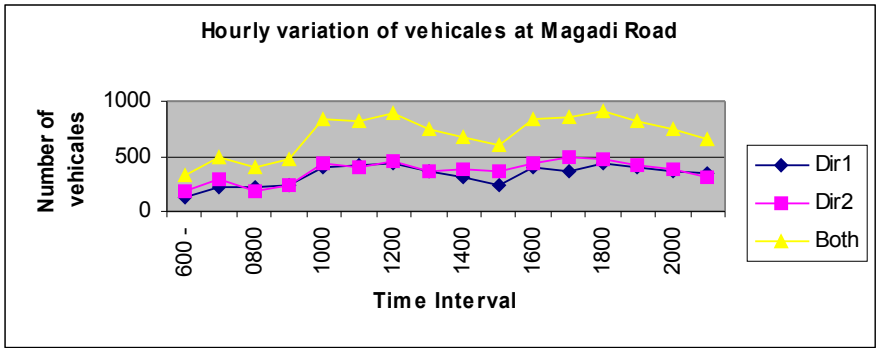


Figure 2.28

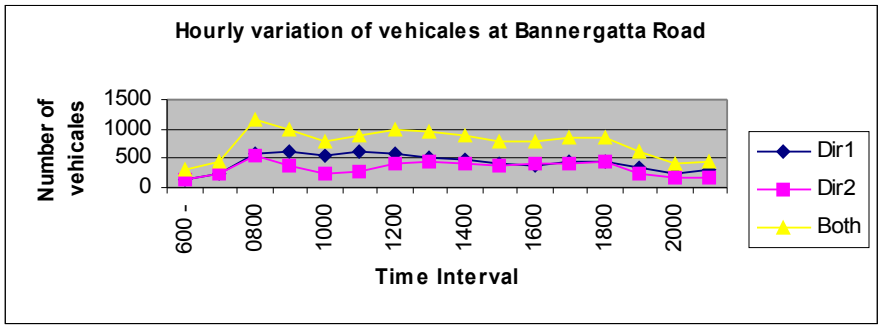


Figure 2.29

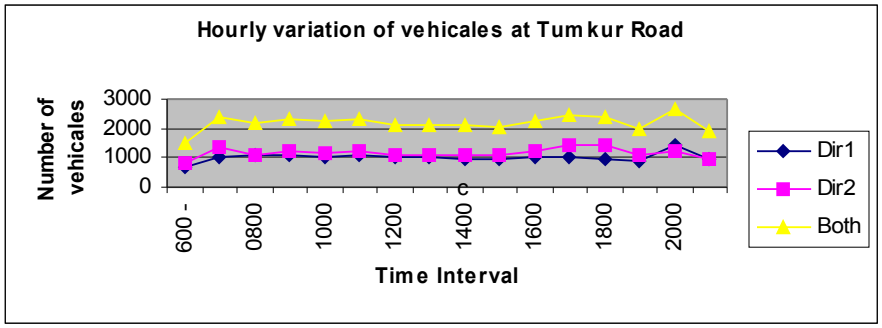
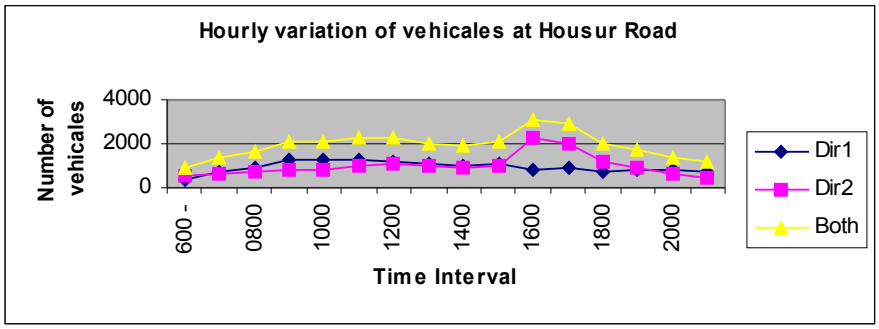


Figure 2.30



Screen Line / Mid block survey

Traffic volume survey at 30 mid block and screen line locations were carried out for 16 hours from morning 6 am to evening 10 pm . The screen line locations were selected at natural barriers like LC and Railway ROB's / RUB's and some locations on Ring Road. The mid blocks were selected on major roads where the METRO alignment is passing and other major Arterial roads in Bangalore.

2.4.1 Intensity of traffic at screen line location

The intensity of traffic at screen line location is presented in **Table 2.12**. It is observed that the highest traffic is along the Rajajinagar Entrance road 120236 vehicles (146048 Pcus). The traffic volume on major roads along the proposed East west corridor varies between 54772 vehicles (970905 pcus) to 120236 vehicles (146048 Pcus).

Table 2.12 Intensity of traffic at Screen Line location

SL.N	Location	Average Daily Traffic (16 hrs)	
		Total vehicles	Total PCUs
1	AIRPORT ROAD	31728	42940
2	KR ROAD	52621	64797
3	MYSORE ROAD	33659	49699
4	CHORD ROAD	66519	87951
5	MAGADI ROAD	14352	18628
6	JC ROAD	93524	105183
7	YESHWANTHPUR ROAD	59485	88873
8	BANASWADI ROAD	34550	37572
9	KORAMANGALA IRR	64900	67571
10	DR. M H MARIGOWDA ROAD	68325	95236
11	POST OFFICE ROAD	22201	29514
12	SOUTHEND ROAD	30479	34858
13	DIAGONAL ROAD	48109	52692
14	VANIVILAS ROAD	29644	35377
15	KH ROAD	84217	96823
16	MTR ROAD (LALBAGH ROAD)	52558	61027
17	RAJAJINAGAR ROAD	120236	146048
18	PLAT FORM ROAD	54772	70905
19	KUVEMPU ROAD	38951	46479
20	R V ROAD	52870	62606
21	TANNERY ROAD	50486	55010
22	MILLER ROAD	35391	51360
23	MATHIKERE MAIN ROAD	29333	32614
24	SHIVANANDA ROAD	65914	77439
25	ITC FACTORY ROAD	50115	54551
26	MGROAD	103424	118241

The traffic volume along the major roads falling on the north south corridor varies between 29664 vehicles (35377 pcus) to 52621 vehicles (64797 pcus) .

2.4.2 Peak hour traffic at Screen line locations

The peak hour traffic at the screen line location is presented in **Table 2.13**. It can be observed from the above table that in the morning peak the 5 of peak hour traffic vary from 8 to 13% while the same in the evening peak varies between 9 to 11%

Table 2.13_Peak Hour Traffic at Screen line location									
		Morning Peak				Evening Peak			
SL.N	Location	veh	%ADT	PCUs	%ADT	veh	%ADT	PCUs	%ADT
1	AIRPORT ROAD	3018	9.51%	3597	8.38%	3221	10.15%	4638	10.80%
2	KR ROAD	4973	9.45%	5285	8.16%	3556	6.76%	4483	6.92%
3	MYSORE ROAD	2977	8.85%	4165	8.38%	2859	8.49%	4061	8.17%
4	CHORD ROAD	7558	11.36%	8305	9.44%	5576	8.38%	7357	8.36%
5	MAGADI ROAD	1515	10.55%	1815	9.74%	1321	9.21%	1554	8.34%
6	JC ROAD	11718	12.53%	12179	11.58%	7394	7.91%	9017	8.57%
7	YESHWANTHPUR ROAD	5254	8.83%	7153	8.05%	4610	7.75%	6634	7.46%
8	BANASWADI ROAD	2761	7.99%	2912	7.75%	3100	8.97%	3155	8.40%
9	KORAMANGALA IRR	5772	8.89%	5812	8.60%	4600	7.09%	4759	7.04%
10	DR. M H MARIGOWDA ROAD	5673	8.30%	7588	7.97%	6019	8.81%	8770	9.21%
11	POST OFFICE ROAD	3191	14.37%	4035	13.67%	2043	9.20%	2660	9.01%
12	SOUTHEND ROAD	4122	13.52%	4246	12.18%	2390	7.84%	2870	8.23%
13	DIAGONAL ROAD	4178	8.68%	4559	8.65%	4004	8.32%	4389	8.33%
14	VANIVILAS ROAD	2594	8.75%	2978	8.42%	2490	8.40%	2825	7.98%
15	KH ROAD	8672	10.30%	9459	9.77%	8504	10.10%	9155	9.46%
16	MTR ROAD (LALBAGH ROAD)	4151	7.90%	4810	7.88%	5310	10.10%	5813	9.53%
17	RAJAJINAGAR ROAD	12059	10.03%	13928	9.54%	11593	9.64%	14369	9.84%
18	PLAT FORM ROAD	4176	7.62%	5682	8.01%	5930	10.83%	7283	10.27%
19	KUVEMPU ROAD	3387	8.70%	3903	8.40%	4145	10.64%	4898	10.54%
20	R V ROAD	4609	8.72%	5060	8.08%	5009	9.47%	5780	9.23%
21	TANNERY ROAD	5437	10.77%	5228	9.50%	4756	9.42%	18.28%	9.09%
22	MILLER ROAD	3136	8.86%	4302	8.38%	2961	8.37%	3987	7.76%
23	MATHIKERE MAIN ROAD	2599	8.86%	2749	8.43%	3721	12.69%	23.50%	11.73%
24	SHIVANANDA ROAD	7704	11.69%	8484	10.96%	7051	10.70%	8143	10.52%
25	ITC FACTORY ROAD	3323	6.63%	3485	6.39%	4655	9.29%	4918	9.02%
26	MGROAD	9368	9.06%	10297	8.71%	8543	8.26%	9584	8.11%

2.4.2 Composition of traffic at Screen line location

The composition of traffic at screen line location is presented in **Table 2.14** and **Figures 2.31 to 2.41** .It can be observed that the composition of the cars vary between 10.79% to 29.55, the Auto's vary between 18 to 25%, only on Airport Road the share of auto's is very less (4.01%). The two wheelers constitute the maximum share on the roads and their composition varies between 41.86% to 57.75% The composition of bus traffic was observed to vary between 1.24 % to 7.77% .The goods vehicles are banned in the city area and only on Chord Road it is allowed which can be observed from the table that on Chord Road the %

composition of Trucks is 10.1% . On other roads only lcv;s ply. The slow moving traffic is negligible in Bangalore.

Table 2.14 - Composition of Traffic at Screen line locations

Location	Cars/Jeep	Autos	Scooter /Moped	Buses	Van /Tempo	Trucks	Bullock Cart	Cycles	Total Vehicles
AIRPORT ROAD	9339	1271	13281	2430	262	4232	45	870	31728
	29.43%	4.01%	41.86%	7.66%	0.82%	13.34%	0.14%	2.74%	
KR ROAD	8424	10852	26117	3130	0	740	48	2370	51681
	16.30%	21.00%	50.53%	6.06%	0.00%	1.43%	0.09%	4.59%	
MYSORE ROAD	6651	2558	14033	3557	376	4449	98	1509	33231
	20.01%	7.70%	42.23%	10.71 %	1.13%	13.39%	0.29%	4.54%	
CHORD ROAD	11779	9707	34305	2981	391	6718	36	603	66519
	17.71%	14.59%	51.57%	4.48%	0.59%	10.10%	0.05%	0.91%	
MAGADI ROAD	1549	1264	8064	1108	503	1197	43	625	14352
	10.79%	8.81%	56.19%	7.72%	3.50%	8.34%	0.30%	4.35%	
JC ROAD	14490	15087	54962	3928	211	1750	34	3062	93524
	15.49%	16.13%	58.77%	4.20%	0.23%	1.87%	0.04%	3.27%	
YESHWANTHPUR ROAD	8037	9335	26542	4983	381	8219	45	1944	59485
	13.51%	15.69%	44.62%	8.38%	0.64%	13.82%	0.08%	3.27%	
BANASWADI ROAD	5403	6221	17474	1060	151	504	37	3700	34550
	15.64%	18.00%	50.57%	3.07%	0.44%	1.46%	0.11%	10.71 %	
KORAMANGALA IRR	19143	8953	31228	1264	16	714	13	3562	64893
	29.50%	13.80%	48.12%	1.95%	0.02%	1.10%	0.02%	5.49%	
DR. M H MARIGOWDA ROAD	10927	12390	31802	6622	523	4023	226	1813	68325
	15.99%	18.13%	46.55%	9.69%	0.76%	5.89%	0.33%	2.65%	
POST OFFICE ROAD	3721	5126	10130	1796	199	290	52	887	22201
	16.76%	23.09%	45.63%	8.09%	0.90%	1.31%	0.23%	3.99%	
SOUTHEND ROAD	4442	6619	15975	873	201	237	56	2076	30479
	14.57%	21.72%	52.41%	2.87%	0.66%	0.78%	0.18%	6.81%	
DIAGONAL ROAD	7544	9483	27783	692	597	413	59	1538	48109
	15.68%	19.71%	57.75%	1.44%	1.24%	0.86%	0.12%	3.20%	
VANIVILAS ROAD	4631	4795	15785	827	286	1428	18	1862	29632
	15.63%	16.18%	53.27%	2.79%	0.97%	4.82%	0.06%	6.28%	
KH ROAD	18752	13969	43236	3662	140	1488	50	2334	83632
	22.42%	16.70%	51.70%	4.38%	0.17%	1.78%	0.06%	2.79%	
MTR ROAD	9772	10813	27045	1415	159	1014	139	1539	51896

(LALBAGH ROAD)									
	18.83%	20.84%	52.11%	2.73%	0.31%	1.95%	0.27%	2.97%	
RAJAJINAGAR ROAD	16752	26557	63343	5931	203	1772	41	4824	119423
	14.03%	22.24%	53.04%	4.97%	0.17%	1.48%	0.03%	4.04%	
PLAT FORM ROAD	8065	12448	27255	3941	136	907	21	1507	54279
	14.86%	22.93%	50.21%	7.26%	0.25%	1.67%	0.04%	2.78%	
KUVEMPU ROAD	4461	9698	16741	1659	107	801	82	5402	38951
	11.45%	24.90%	42.98%	4.26%	0.27%	2.06%	0.21%	13.87 %	
R V ROAD	12339	8148	26413	2398	129	1733	5	1712	52875
	23.34%	15.41%	49.95%	4.53%	0.24%	3.28%	0.01%	3.24%	
TANNERY ROAD	1210	14024	19363	889	96	662	28	14215	50486
	2.40%	27.78%	38.35%	1.76%	0.19%	1.31%	0.06%	28.16 %	
MILLER ROAD	4773	6396	15722	942	22	5310	9	2216	35391
	13.49%	18.07%	44.42%	2.66%	0.06%	15.00%	0.03%	6.26%	
MATHIKERE MAIN ROAD	4359	2724	18087	1990	142	721	16	1294	29333
	14.86%	9.29%	61.66%	6.78%	0.48%	2.46%	0.06%	4.41%	
SHIVANANDA ROAD	12573	12634	33671	3351	0	641	15	2258	65142
	19.30%	19.39%	51.69%	5.14%	0.00%	0.98%	0.02%	3.47%	
ITC FACTORY ROAD	8250	10436	22767	489	86	383	23	4886	47320
	17.43%	22.05%	48.11%	1.03%	0.18%	0.81%	0.05%	10.33 %	
MGROAD	25155	18149	49688	4425	234	30	15	4183	101879
	24.69%	17.81%	48.77%	4.34%	0.23%	0.03%	0.01%	4.11%	

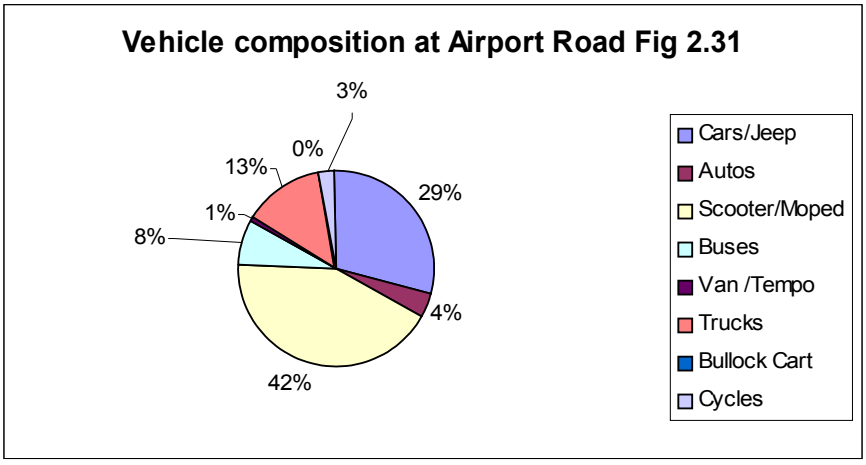


Figure 2.32

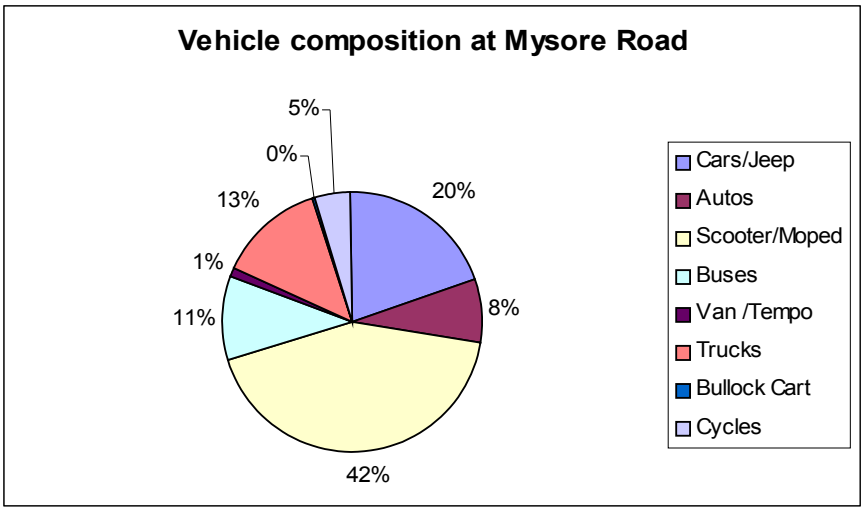


Figure 2.33

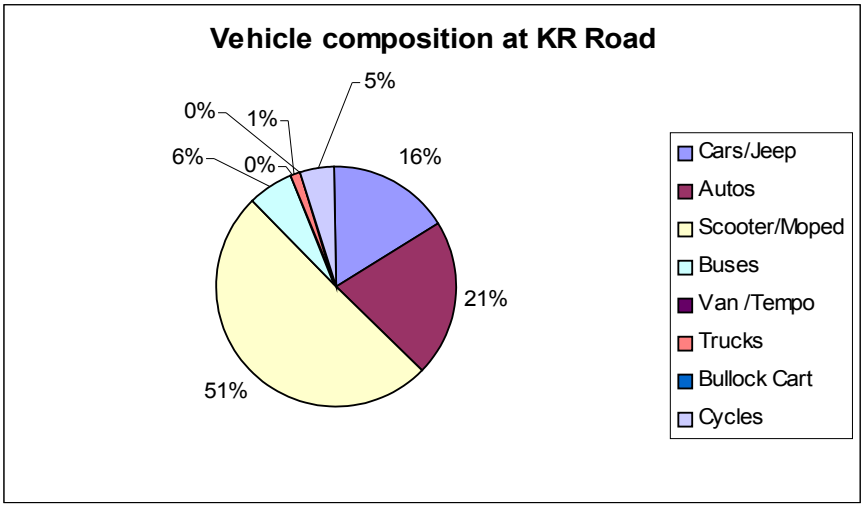


Figure 2.34

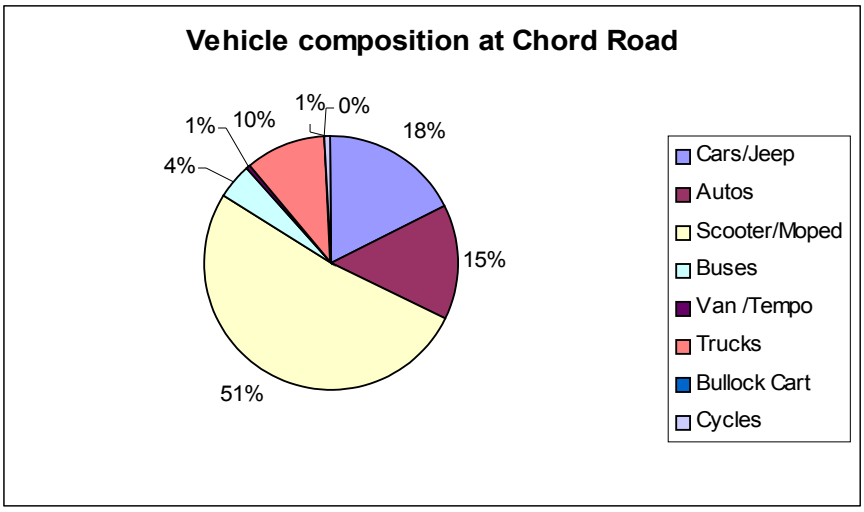
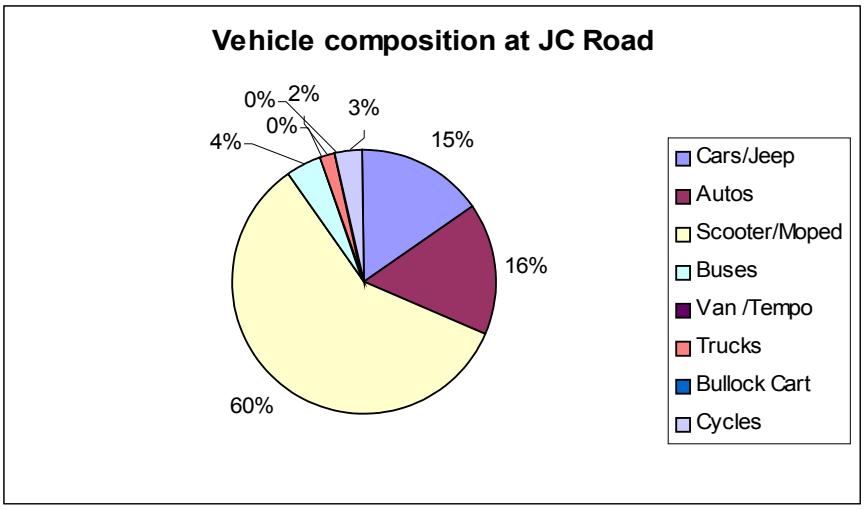


Figure 2.35



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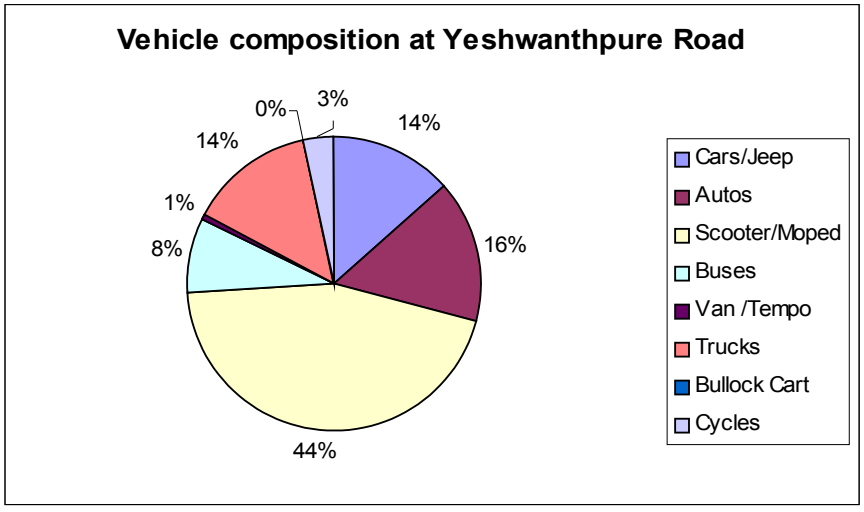

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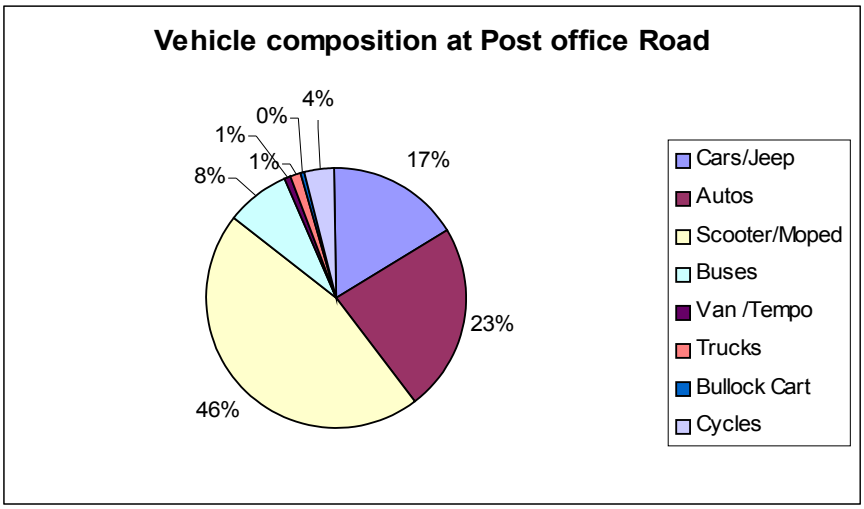


Figure 2.38

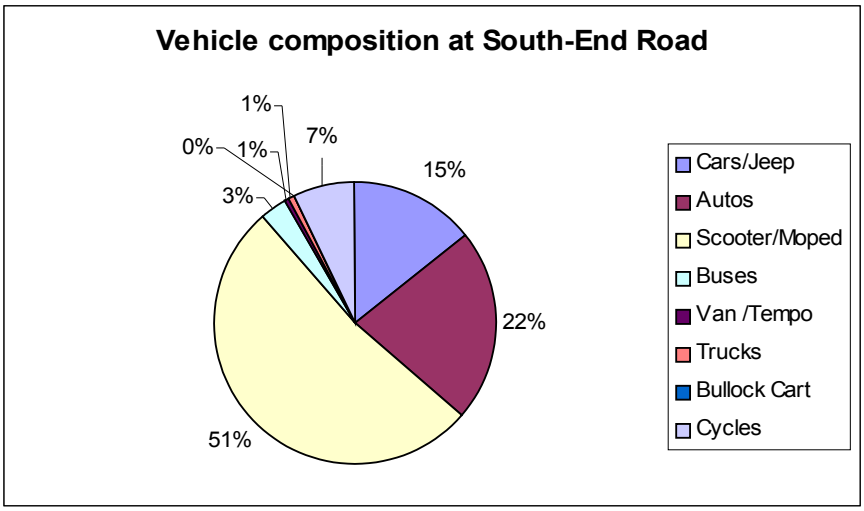
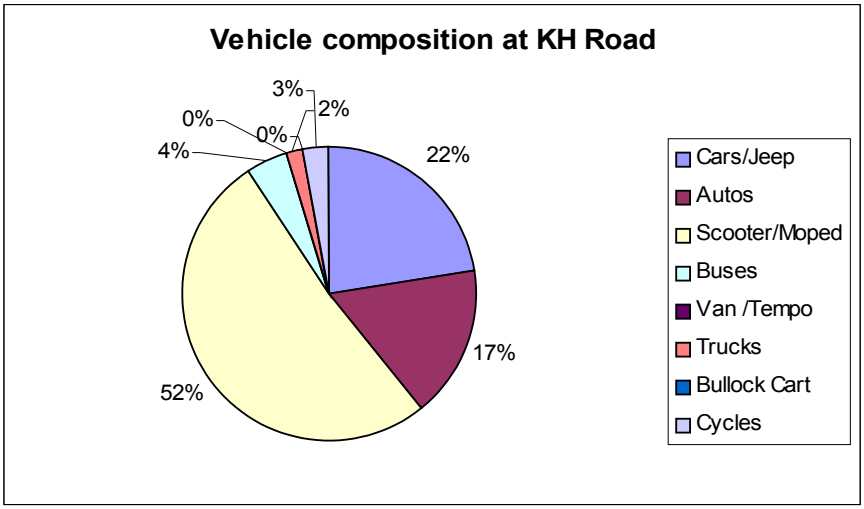


Figure 2.39



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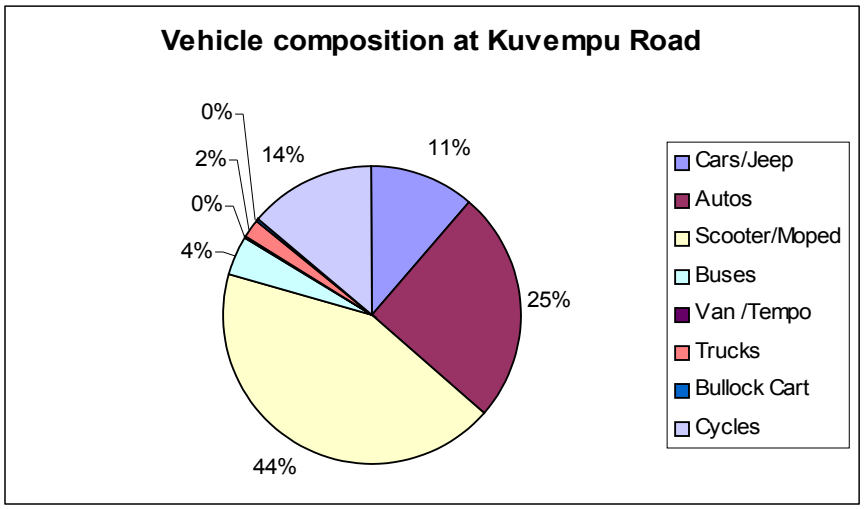

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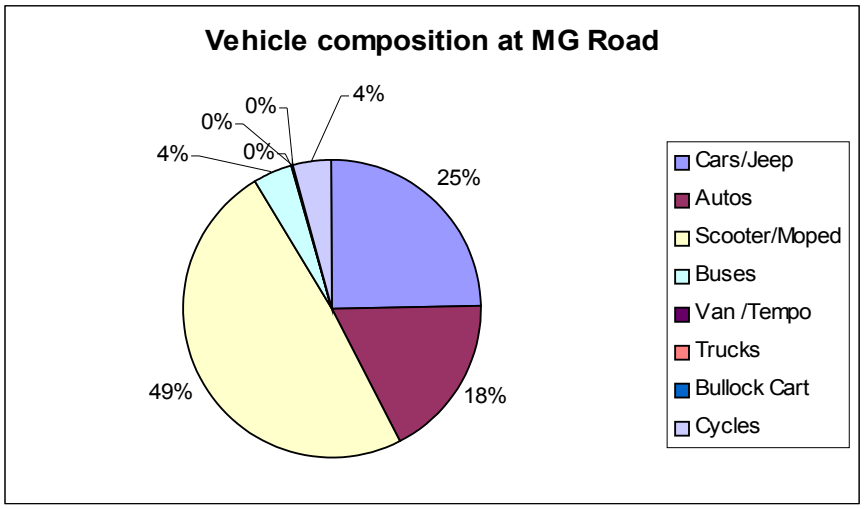


2.4.3 Hourly variation of traffic at screen line locations

Hourly variation of traffic at screen line locations is presented in **Figures 2.42 to 2.52**. It can be observed from the figures that there are two distinct peaks in the morning and evening peak hours. The evening peak is more tapered / spread out compared to morning peak. On K. R Road we see a pronounced afternoon peak due to college trips around this area. On the one way roads like J C Road and Post office Roads morning peak towards the CBD is more significant.

Figure 2.42

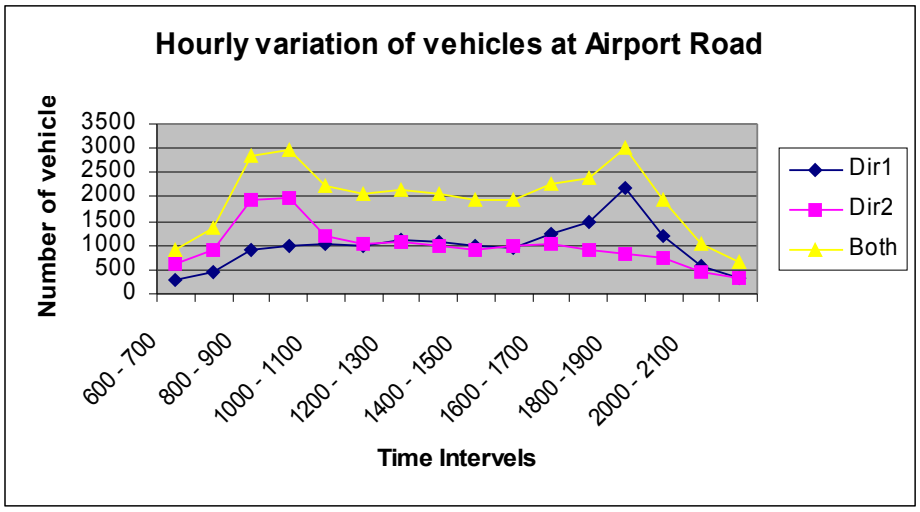


Figure 2.43

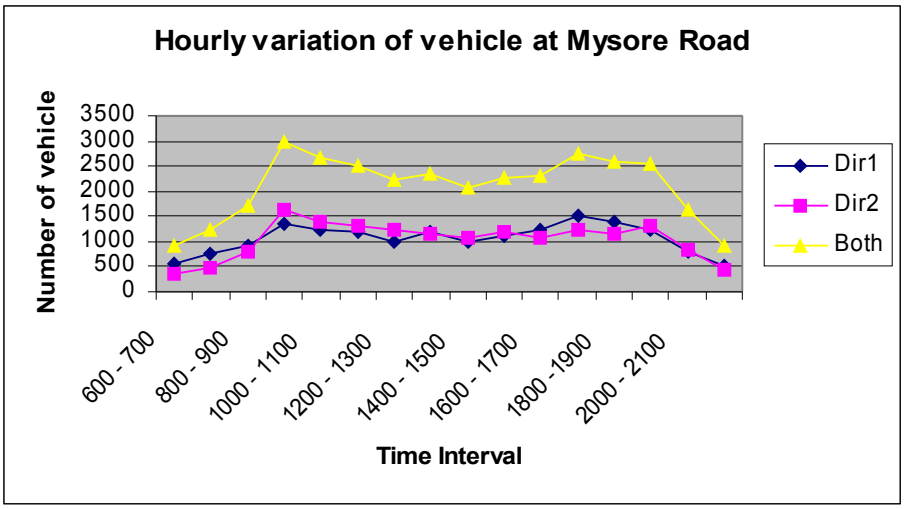


Figure 2.44

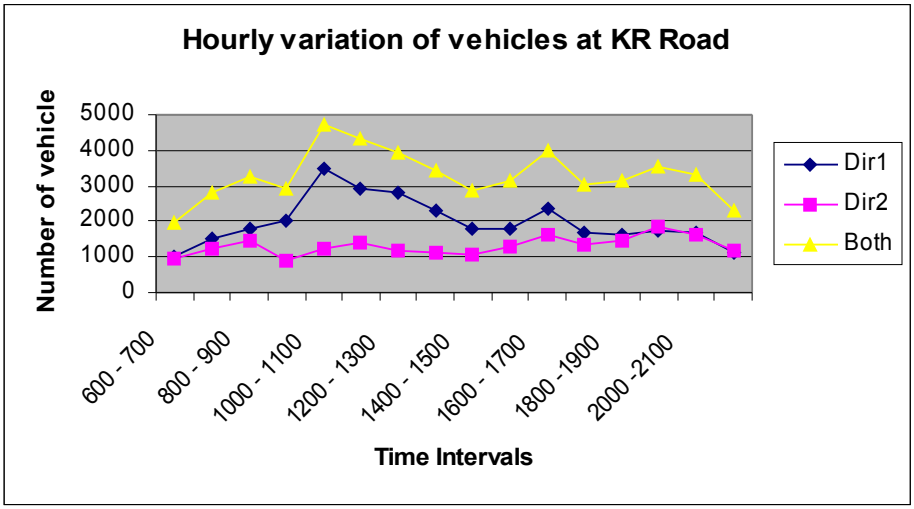


Figure 2.45

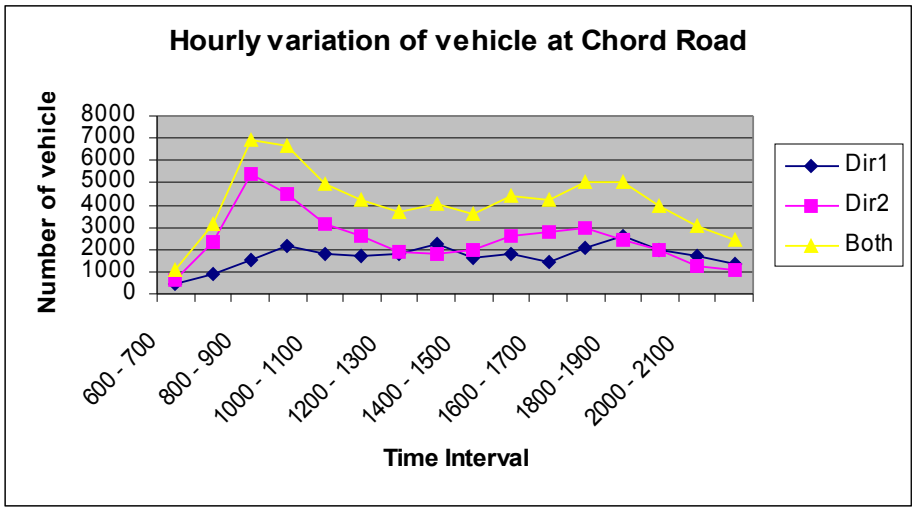
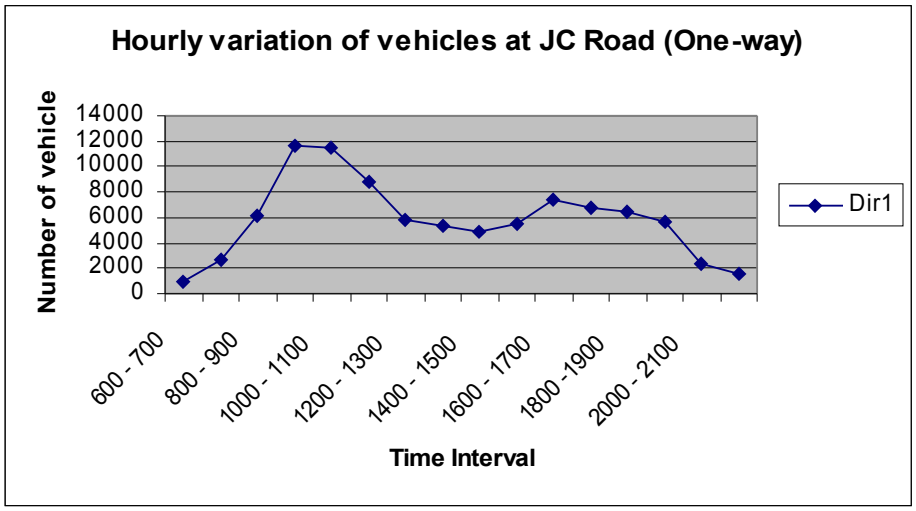


Figure 2.46



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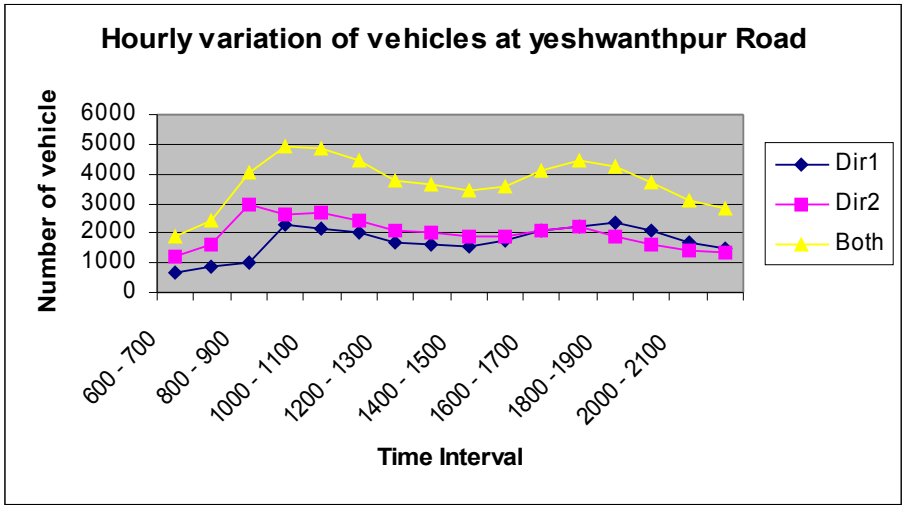


Figure 2.48

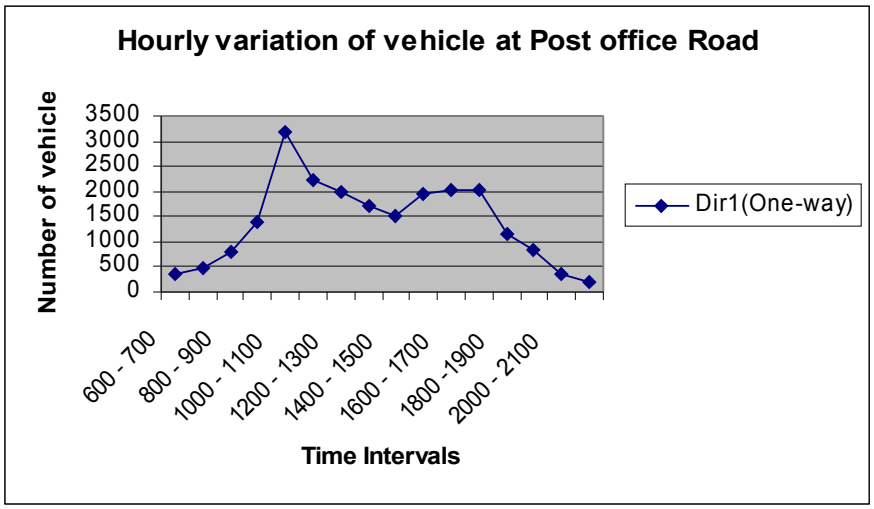


Figure 2.49

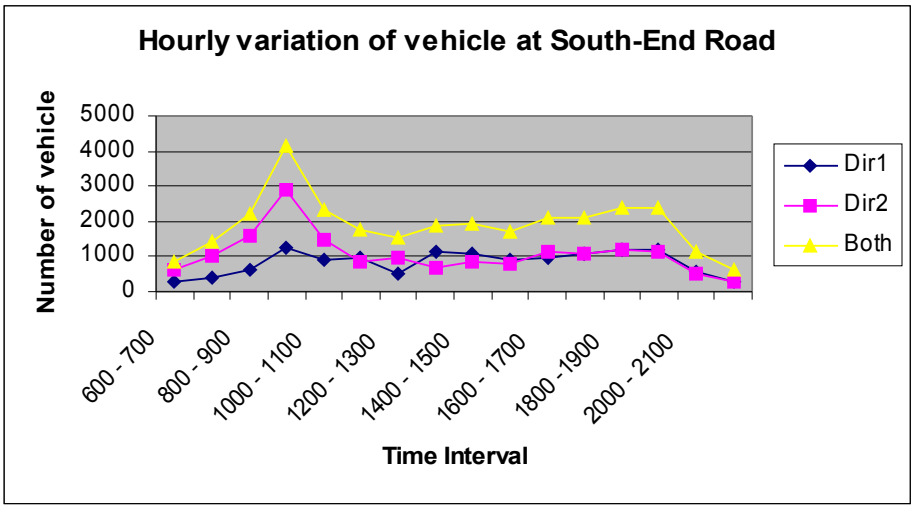


Figure 2.50

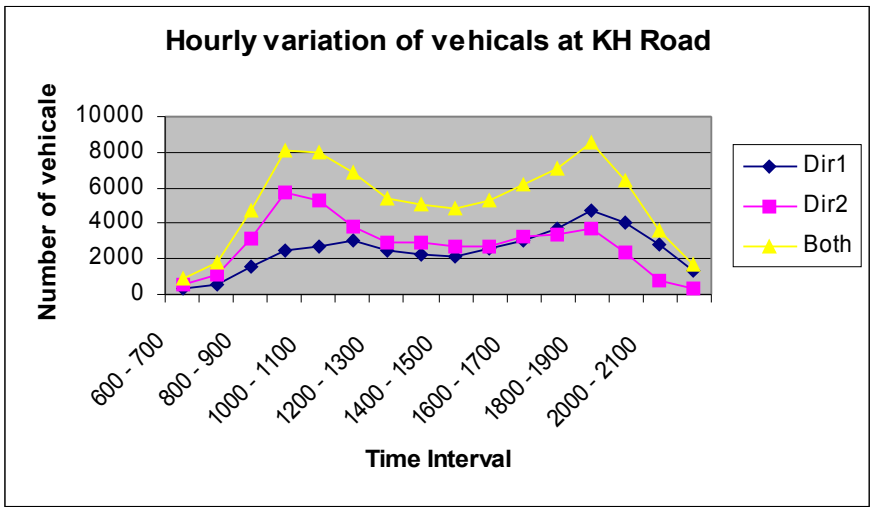


Figure 2.51

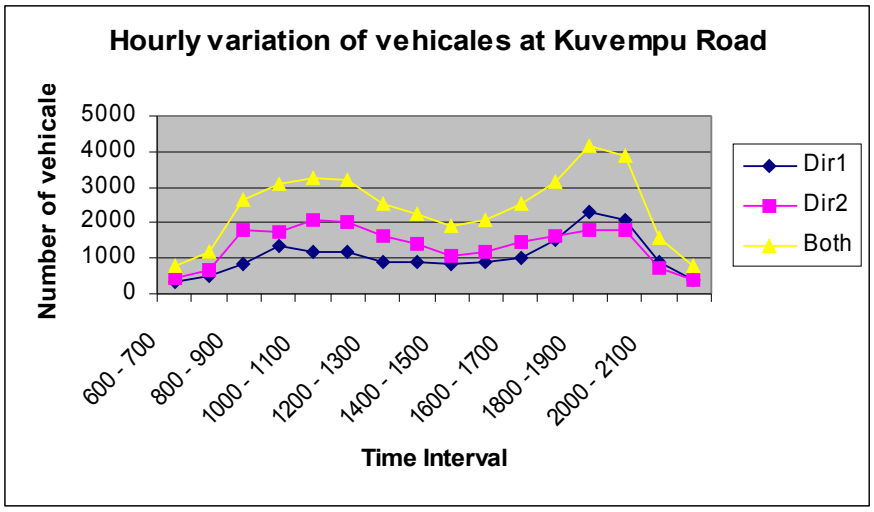
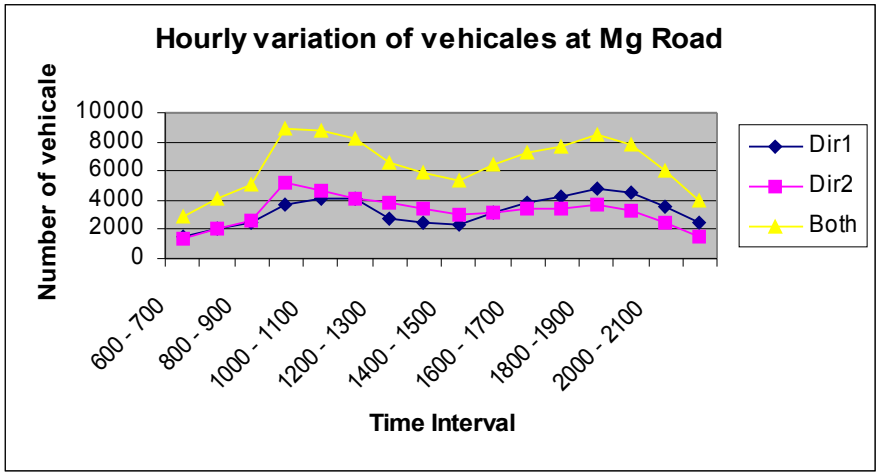


Figure 2.52



2.5 ROAD NETWORK INVENTORY

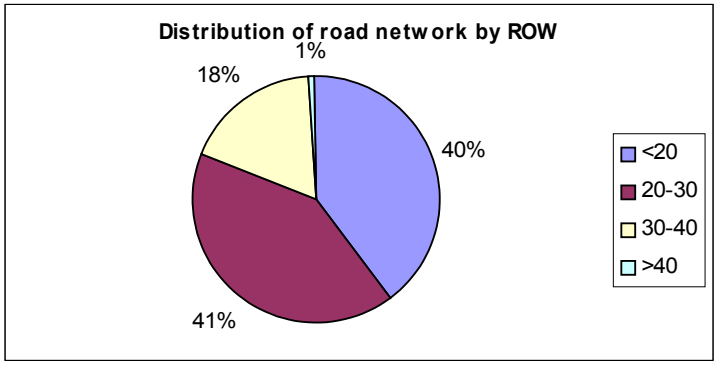
Road network inventory was carried out along the Major roads within the study area. The right of way, the carriageway width, other road features like median, footpath and lighting were captured. The details collected from the survey are given in the sections below.

2.5.1 Distribution of road network by Right of way (ROW)

Distribution of road network with respect to ROW is presented in the **Table 2.15** and **Figure 2.53**. It cane observed from the above table that 39.80% of the road length surveyed has ROW less than 20m, 41.15% has ROW between 20 to 30 meters, 18.16% has ROW between 30 to 40 meters, 00.89% has ROW greater than 40 meters.

Table 2.15 -Distribution of road network by ROW		
ROW (m)	**Length (Km)**	**Percentage**
<20	127.37	39.80
20-30	131.69	41.15
30-40	58.11	18.16
>40	02.83	00.89

Figure 2.53



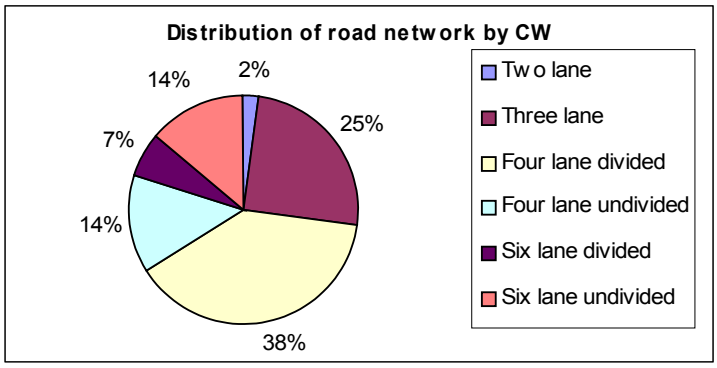
2.5.2 Distribution of road length with respect to carriageway width

Distribution of road length with respect to carriageway width is presented in **Table 2.16** and **Figure 2.54**. It can be observed that 2.24% is two lane roads, 25.09%is three lane roads, 38.49% is four lanes undivided roads, and while 13.91% of the surveyed road length is four lane divided road. 13.77% of the road length is six lane undivided and an additional length of 6.50% of the road length surveyed was observed to be six lane divided road which lie mostly on the outer ring road.

Table 2.16- Distribution of road network by CW Width

CW (m)	**Length (Km)**	**Percentage**
Two lane	07.17	02.24
Three lane	80.27	25.09
Four lane divided	123.15	38.49
Four lane undivided	44.52	13.91
Six lane divided	20.80	06.50
Six lane undivided	44.08	13.78
Total	**320**	**100.00**

Figure 2.54



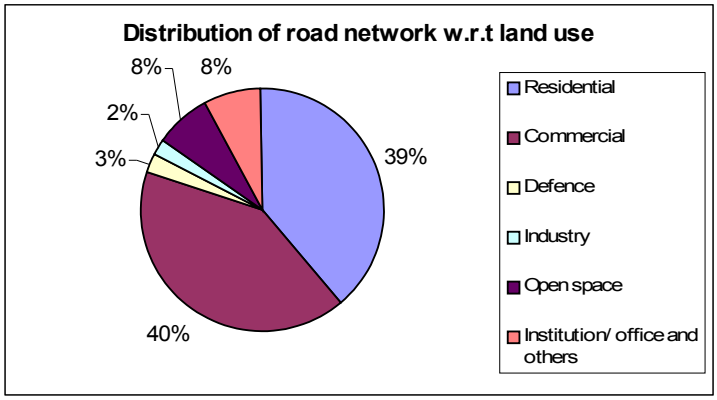
2.5.3 Distribution of road network with respect to land use

Distribution of road network with respect to Abutting land use along the roads surveyed in presented in **Table 2.17** and **Figure 2.55**. It can be observed from the table that 39.01% is residential, 40.59% is commercial, 2.78% defense, and 2.31% industries, 7.59% open space and rest 7.72% were institutional and others.

Table 2.17 -Distribution of road network with respect to land use

Land use	Length (Km)	Percentage
Residential	124.84	39.01
Commercial	129.89	40.59
Defence	08.88	2.78
Industry	07.39	2.31
Open space	24.30	7.59
Institution/ office and others	24.72	7.72
Total	**320**	**100.00**

Figure 2.55



2.5.4 CAPACITY OF THE ROAD SYSTEM

As per the CDP-2001, only three types of roads on whom mass transport can operate would exist in the year 2001. The types of roads and their capacities are given in **Table 2.18**

TABLE 2.18

TYPES OF ROADS AND THEIR CAPACITIES

Road Type	Capacity in PCUs per Hour*
2-Lane	2000
4-Lane Divided	4000
6-Lane Divided	6000

*IRC Norms modified for the present study

2.6 SPEED AND DELAY SURVEY

Speed and delay survey was carried out on all major corridors in the study area. Moving car method was used to carry out the survey. The delays and the cause of delays were also recorded and the journey and the running speeds along these corridors are worked out.

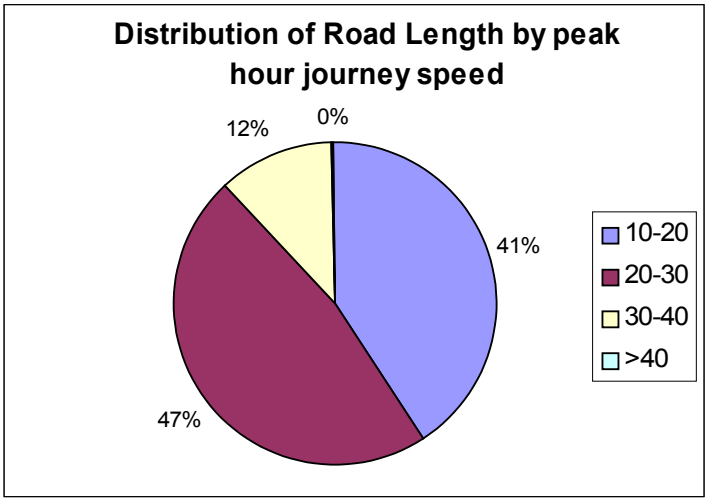
2.6.1 Journey speed

Distribution of journey speed with respect to the road length is presented in the **Table 2.19** and **Figure 2.56** . It is observed that the 40.815 of the road length has journey speed less than 20 Kmph, on 47.27% of the road length, the observe journey speed was in between 20 to 30 Kmph., only at 11.915 of the road length, the speeds were more than 30 Kmph

Table 2.19 --Distribution of Road length by peak hour journey speed

Speed (Kmph)	Length (Km)	Percentage
10-20	57.50	40.81
20-30	66.60	47.27
30-40	16.50	11.71
>40	00.300	0.21
Total	140.90	100.00

Figure 2.56



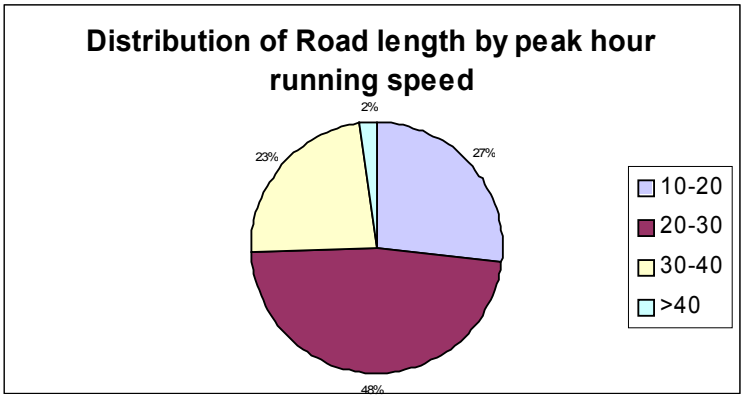
2.6.2 Running speed

Distribution of running speed with respect to the road length is presented in the **Table 2.20 and Figure 2.57**. It is observed that the 27.04 % of the road length has journey speed less than 20 Kmph, on 47.48 % of the road length, the observe journey speed was in between 20 to 30 Kmph., and at 25.37% of the road length, the speeds were more than 30 Kmph

Table 2.20 -Distribution of Road length by peak hour running speed

Speed (Kmph)	Length (Km)	Percentage
10-20	38.10	27.04
20-30	66.90	47.48
30-40	32.90	23.35
>40	3.00	2.13
Total	**140.90**	**100.00**

Figure 2.57



2.6.3 Speed Flow Relationship

In addition to the capacity values, the speed flow relationships of the three types of links are required for modifying the speeds for each incremental loading. A Mathematical model was developed for each link type. These mathematical models are as follow: -

2-lane:

$$S = S_f (1.0 – 0.578 (V/C)^{2.8}$$

4-lane divided:

$$S = S_f (1.0 – 0.636 (V/C)^{2.5}$$

6-lane divided:

$$S = S_f (1.0 – 0.605 (V/C)^{2.4}$$

Where,

S = Speed in kmph
S_f = Free flow speed in kmph
V = Assigned volume in PCUs
C = Capacity of road link in PCUs

The initial free flow speeds taken for the assignment of public and private modes are summarized in **Table 2.21**.

TABLE 2.21
FREE FLOW SPEEDS

Mode	**Free Flow Speed in kmph***		
	2-lane	4-lane	6-lane
Public Transport	15	20	25
Private Transport	30	35	40

IRC Norms modified for the present study

2.7 BUS STOP/TERMINAL SURVEY

Bus stop survey was carried out at 569 bus stops and 34 terminals. Both directions were taken thus the total number of bus stops covered were 1148. The total trips observed from the survey was about 26 lakh trips out of which 3.7 lakh trips were interchange trips.

The bus stop wise boarding at terminals and bus stops is presented in **Annexure 2.4 and 2.5**.

2.8 SELECTION OF CORRIDORS

Selection of corridors for a Metro system depends on many factors , Viz:

- Traffic origin and Destination (OD) pattern;

- Location of work centers and Central business district(CBD)
- Roads right-of-way;
- Integration with other modes : and
- Major bus routes

Traffic pattern at present in Bangalore is generally from residential areas in the periphery of the work places and educational institutions at the centre. This traffic pattern requires of two main corridors, that is East-west and North –South for Bangalore city. East –West and North _South corridors have therefore been proposed for Bangalore Metro Phase1. These corridors are elevated along the major roads where there is sufficient right –of way .In locations where the right –of-way is limited, particularly in the CBD area, Underground section is proposed.

Alignments of these two corridors have been planned to provide proper integration with both road and rail-based public transport , connecting places like city railway station, New Bus Terminus at Mysore Road, Yeshvantapur railway station , Baiyappanahalli railway station and the major bus terminus at Subhash Nagar.

The alignment of the above corridors has also been planned to act as complementary to the bus system as it has avoided major parallel road – based systems . The selected corridors cover most of the locations covered by the earlier approved ELRTS corridor in phase 1.

2.9 COMPARISON BETWEEN ELRTS ANS METRO ALIGNMENT

2.9.1 East- West Corridor

The East-West corridor of the ELRTS (Elevated Light rail transit System) starts at Aranganagudda at the outer ring road and takes a left turn to the Mysore Road. It passes through the Chord Road unto the toll gate junction and continues on the chord Road unto Kuvempu Road, where it turns right the alignment goes along the Kuvempu Road and turns right to Sampige Road and reaches Majestic via the Platform Road. The alignment continues on the K .G Road towards the Hudson Circle and takes RRMR Road to reach the Richmond circle. It passes through the Residency Road and reach M G Road at mayo hall and goes on the M G Road till Trinity Church circle and takes Old Madras Road to reach the Depot opposite to Indiranagar bus depot. The entire section is elevated.

The proposed metro East-West corridor starts at Mysore Road ORR junction and passes through the Chord Road and takes a right turn towards the Magadi Road. Till the end of the Magadi Road, the section is elevated, where it starts going under ground, and the under ground section cuts across the Bangalore city railway station yard and passes through the K G Road and reach Vidhan Sowda via the Post office Road,

it skirts the Cubbon park to reach the M G Road, it is under ground up to the Brigade Road junction and starts ramping up and is elevated from the Mayo hall junction. It passes through Swami Vivekananda Road and turns right to CMH Road to reach 100 ft Road India Nagar where it turns right to reach Old madras Road and goes along the NH4 to reach the depot near Baiyappanahalli railway station.

The Metro alignment is underground in the central congested areas and this has reduced the route length to reach the CBD from the outer areas.

2.9.2 North – South Corridor

The proposed North South Corridor of the ELRTS was in between Shivajinagar and Jayanagar via J C Road and R V Road. This was not considered in the first phase

The North -South alignment of the Metro starts at Yeshvantapur and passes through the Chord Road in front of ISCON Temple. It takes right turn at Kuvempu Road and goes along it till the railway over Bridge of the Tumkur line. It takes a right turn and run parallel till the Binny mill. Till this point the section is elevated. It them ramps down and will be under ground section beyond the Swastik area. The Majestic will be an interchange station. The under ground section will cut across the most congested old city area if Chickpet and passes through the city market to reach the Basaweshwara circle at K.R Road. Then it ramps up to be an elevated section and reaches Lalbagh via Vanivilas Road and takes the R. V Road to reach south end. The alignment continues on the R V Road to reach the R.V Road terminal.

The North south alignment of the Metro passes through the most congested parts of the OLD city i.e. city market, Chickpet and Sultan pet, this was possible, since the central portion of the Metro is under ground, where the elevated sections are impossible due to heavily built up areas

The ELRTS alignment also covers the Yeshvantapur, Chord Road, Kuvempu Road, Platform Road, K R Road, R V Road and Jayanagar but avoids the CBD area of Majestic, Chickpet and Sultanpet.

Even though the ELRTS and METRO alignments connects the East - west and the North-south points of Bangalore,. The ELRTS takes circuitous route to connect the ends without serving the inner areas of the city which are congested. But Bangalore metro, while connecting these extreme ends passes through the congested areas as underground facility serving the central areas to the maximum.

2.10 TRIP CATEGORIZATION

The passenger transport demand in terms of daily passenger trips has been broadly categorized as intra-city and inter-city trips. The intra-city trips have further been considered as inter-zonal-trips and intra-zonal trips. The inter-zonal trips are the most important, so far as transport system development is concerned and have further been classified as home-based trips and non-home based trips. Home based trips for the purposes of transport modeling, have been classified as work trips, education trips and other trips. The non-home based trips and intercity trips, which do not form a significant proportion of total transport demand, are not being modeled due to inherent difficulty and non-availability of data. The proportion of non-home based trips, and inter-city trips which was around 10 percent of total home-based trips as observed in the base year (2001), is also being assumed for horizon year (2021). For studying the distribution of trips by mode, the trips were classified as by public transport (mass modes) and by different fast modes including private and hired motorized vehicles.

2.11 TRIP GENERATION

The first of the sub-models in the study process is that which predicts the number of trips starting and finishing in each zone. The techniques developed attempt to utilize the observed relationships between travel characteristics and the urban environment and are based on the assumption that 'trip making' is a function of three basic factors:

- Land use pattern and development in the study area,
- Socio-economic characteristics of the trip-making population of the study area, and
- Nature, extent and capabilities of the transportation system in the study area

Mathematically, trip generation can be expressed as:

Trips Generated = Function (socio-economic, locational etc. variables)

Various techniques for developing the trip generation sub-models are available and notable among them are:

- Regression Analysis
  - Category Analysis or Cross Classification Analysis

A typical regression analysis for trip generation model is

$$G = A_o + \sum_{I=1}^{k} a_{ij} x_i$$

Where

G	=	No. Of trips (produced/attracted) in a zone for a specific purpose.
A_0	=	Constant term to be calibrated.
$a_o, a_1 \ldots\ldots aK$	=	Coefficients to be determined by the regression analysis
$X1, x_{2.}$	=	Zonal planning input factor (independent) variable)

The significance of the regression equation is tested on the basis of R^2 value and the t-statistics value (for each of the coefficients).

Typical inputs for trip generation sub-models are population, employment, vehicle ownership, household income, residential density, etc. These models are developed using standard computer programs.

Population is a major influencing factor for trip generation. As it is one of the major variables in the trip end models used for obtaining the future trip ends, it has an influence in the over all trip productions / attractions.

For the generation of trip generation sub-models, analysis has been carried out at zonal level utilizing regression analysis technique for home based work, home based education and home based other purpose trips. The generalized form of the trip generation equation to be developed is as under: -

$$Y=A+BX$$

Where Y=Trips produced or attracted

A=Constant term

B=Trip rate to be determined from least square Analysis

X=Independent variable e.g., population, employment, Vehicle ownership etc.,

The results of calibration of different models are in **Table 2.22**

Table 2.22

Trip Generation for Total Trips

	Co-off.
Intercept	- 560.934
X Variable	0.332527

R^2 = 0.91

By using the above table the value of R Square was found to be 0.911184 in **Table 2.23** (**Assuming Population in zones as the variable**).

Table 2.23
Trip attraction for total trips

	Co-off.
Intercept	1594.905
X Variable	0.943939

By using above expression the value of R^2 was found to be 0.495816 (**Assuming Employment in zone as variable).**

The population and employment projections for the horizon years is presented below in **Table 2.24**

Table 2.24

Year	Population(Lakhs)	Employment(Lakhs)
2001	56.76	18.51
2011	70.00	24.26
2021	85.00	31.25

2.12 PER CAPITA TRIP RATE (PCTR)

Adopted Per Capita Trip Rate for the years 2001, 2011 and 2021 are as given in the **Table 2.25**. The increment over base year value has been done using growth rates as adopted in Chennai and Delhi for similar studies

Table 2.25
Adopted PCTR (Vehicular) Value

Year	PCTR Value
2001 (observed)	0.82
2011	0.9
2021	1.0

2.13 TRIP DISTRIBUTION

2.13.1 Basic Principle

Trip distribution or 'interzonal transfers', is that part of transportation planning process, which relates a given number of travel origins for every zone of the study area, to a given number of travel destinations located within other zones of the study area. It is not necessarily concerned with the mode of travel used for a given trip or the routes, which could be taken

to complete this trip. Rather it is concerned with establishing the links between a numbers of zones for which trip generation calculations have primarily been made. In other words, the output of trip generation sub-model becomes the input for trip distribution model.

For the purpose of the present study, synthetic or 'inter-area travel formulae' methodology has been adopted in which an attempt is made to understand the causal relationships, which are projected onto the future and the appropriate travel pattern is synthesized.

The underlying principle in this model is that:

'Travel between any two points will increase with increase of attraction for such travel, but will decrease as the resistance (deterrence) to travel increases'.

2.13.2 Gravity Model

In the present study the Gravity Model has been used for trip distribution. For any given trip purpose, the generalized relationship is more usually expressed as-

$$\mathbf{T_{ij} = KP_i A F (C_{ij})} \quad \textbf{---- (4.1)}$$

Where,

T_{ij} = trips from zone **i** to **zone j**
K = a constant
P_i = total number of trips produced in zone i
A_j = total number of trips attracted to zone j, and

F (C_{ij}) is the deterrence or trip decay function and is based on the generalized cost of the journey from zone I to j:

The deterrence function is usually in one of the three basic forms:

A power function

$$\mathbf{F (C_{ij}) = C_{ij}^{-a}} \quad \textbf{------ (4.2)}$$

An exponential function

$$\mathbf{F (C_{ij}) = e^{-aC}ij} \quad \textbf{------ (4.3)}$$

A gamma function (Tanner Function)

$$\mathbf{F (C_{ij}) = C_{ij}^{-a} e^{-bC}ij} \quad \textbf{----- (4.4)}$$

Where a & b are impedance parameters

For the purpose of this study the exponential function form, which has been used in many studies and has been found to be particularly appropriate for shorter-distance, intra-urban trips has been used.

The constant K in the general formula represents effectively the two balancing constants a and b combined together, one each for correcting the number of trip generations and attractions.

Thus $\mathbf{K = a_i b_j}$ **------ (4.5)**

Where $\mathbf{Pi = a_i \sum_j T_{ij}}$ **------ (4.6)**

$\mathbf{Aj = b_j \sum_i T_{ij}}$ **------ (4.7)**

The determination of each of the constants in the distribution model i.e., calibration of the model has been done from the base year matrix for total vehicular trips.

In recent years, the favored and most commonly used measure of deterrence is the perceived inter-zonal deterrence cost – that is, what the traveler unconsciously thinks it costs him to travel from one place to another. For each pair of zones, generalized cost for a public transport trip or by any other mode is determined. For any inter-zonal trip, the cost between each of the two zone centroids, and between them and the appropriate actual network nodes is added to establish the least-cost journey through the whole network between the zones. For example, for a trip including one or more public transport links and walk links thereto, the public transport deterrence cost would be made up of:

a) Walking time to bus stop (from notional centroid link)
b) Waiting time at bus stop
c) Traveling time on bus
d) Interchange waiting time – where appropriate,
e) Further travel time where appropriate
f) Walking time from final bus stop to destination (by notional centroid link).

For the purposes of analyses in this study, the C_{ij} value, is taken in terms of travel time for different modes Travel time matrices have been computed and 'skim trees' built representing shortest travel paths between each pair of zones taking road congestion into consideration.

2.13.3Formulation Adopted

For the distribution of home-based trips for different purposes, standard formulation of Gravity Model is to be utilized. The Output of trip generation sub-model is primarily the input to trip distribution sub-model along with a

deterrence function. Form of Gravity Model to be utilized for its calibration is as under

$$T_{ij}^{n} = P_i^{n} [A_j^{n} \exp(-a^{n} C_{ij}^{m}) / \sum A_i^{n} \exp(-a^{n} C_{ij}^{m})] \quad \text{------ (2.8)}$$

Where,

T_{ij}^{n} = the number of trips produced in zone I and attracted to zone j for nth purpose (work, education, other)

P_i^{n} = the total number of trips produced in zone I for nth purpose

A_i^{n} = the total number of trips attracted to zone j for nth purpose

An = Parameter calibrated for base year for nth purpose

C_{ij}^{m} = Composite Travel time between pair of zones i & j by mode m

Calibration of the Model

The sequence of activities involved in the calibration of Gravity Model is shown in **Figure 2.58.** Only the home based trips for different purposes (work, education and other), which have been modeled, have been simulated for comparison with the observed flows.

The calibrated value of Beta was found to be 0.01724747

R^2 value was found to be 0.99.

2.14 MODAL SPLIT

The observed modal split between public and private transport is 45:55. With introduction of Metro, the modal split in favor of public transport is assumed to be 65% by the year 2011 and 70% by 2021.

The growth rate for the city traffic is taken as 3% for the horizon years.

2.15 TRIP ASSIGNMENT

2.15.1 Trip assignment is the process of allocating a given set of trip interchanges to a specific transportation system and is generally used to estimate the volume of travel on various links of the system to simulate present conditions for validation purposes and to use the same for horizon years for developing forecast scenarios. The process requires as input, a complete description of either the proposed or existing transportation system, and a matrix of inter-zonal trip movements. The output of the process is an estimate of the trips on each link of the transportation system, although the more sophisticated assignment techniques also include directional turning movements at intersections.

The purposes of trip assignment are, broadly:

1. To assess the deficiencies of the existing transportation system by assigning estimated future trips to the existing system – **Do Nothing Scenario**.

2. To evaluate the effects of limited improvements and extensions to the existing transportation system by assigning estimated trips to the network which included these improvements.
3. To develop system development priorities by assigning estimated future trips for intermediate years to the transportation system proposed for these years.
4. To test alternative transportation system proposals by systematic and readily acceptable procedures.
5. To provide design hours volumes and turning movements.

2.15.2 Assignment Procedure Adopted

For the purpose of this study, Capacity restrained assignment technique has been followed. In this method of assignment, private and public transport trip matrices are loaded onto their respective networks, using an incremental assignment method. The trip matrices are assigned to the shortest paths generated successively by assignment of small lots each of 10% increment of the matrices. Updating the private and public transport networks, using the speed flow relationships of the links until all the two matrices - both Public and Private, are assigned, advances the incremental assignment. This methodology is presented in **Figure 2.59**.

2.15.3PCU Conversion Factor

The results from the incremental assignment, which is in terms of person trips, have to be converted to PCU trips for updating the link speeds. As the occupancy levels of the private modes are quite different from the road-based public transport modes, separate passenger to PCU conversion factors were derived for the two types of travel. For this purpose, the city was divided into three regions each one having a different mix of traffic characteristics. The factors used for the three regions are given in **Table 2.26**

Goods vehicles and other slow moving vehicles use the roads simultaneously. Thus the capacity comparison and speed modifications must take movement of these vehicles in mixed traffic conditions into account. Thus, after the person trips are converted to vehicles trips in terms of PCUs, the goods traffic factor is added to boost up the value to incorporate the mixed flow conditions because of goods vehicles and the slow moving vehicles.

TABLE 2.26
PCU CONVERSION FACTORS

Region	PCU Conversion Factors		
	Pvt Vehicles	Pub. Tpt. Vehicles	Goods Vehicles
Core area	0.067579	0.415010	1.2045
Intermediate area	0.067108	0.360208	1.2393
Outer area	0.067010	0398979	1.2814

2.16 SUMMARY OF TRANSPORT DEMAND PROJECTIONS

2.16.1 Section Loading

The traffic assignment was carried out on the selected east west and north south METRO corridors. The loading on the proposed METRO corridors is presented in **Table 2.27**

Table 2.27

Summary of Transport demand projections

Year	Number of passengers (Lakhs/day)	Passenger – km/km of corridor (lakhs	Mean trip length
2007	8.2	196005	6.62
2011	10.2	245050	7.07
2021	16.1	362828	7.12

8.2 lakh passengers are expected to travel on the metro per day. The projections for the years 2011 and 2021 are 10.2 lakh and 16.1 lakh passengers per day

The maximum section loading is observed between Tollgate and majestic on East west corridor and Malleswaram to city Market on the North south Corridor

The maximum range of PHPDT on the system by 2007 will be 20000, by 2011 will be 27000 and by 2021 the maximum range of PHPDT is projected to be of the order of 40000. The section wise loading and PHPDT is presented in **Annexure 2.6**

2.17.2Station loading

The station loading at all the 17 stations on the East west corridor and 13 stations on the north south corridor are presented in **Table 2.28**. It can be observed that station loadings are high at Vijay nagar (32505), Hosahalli (62171) and Majestic (30408) on the East west corridor, while on the North south corridor, station loads are high at Yeshvantapur (37691), The station loading at Malleswaram, Swastika and Kuvempu road and Majestic stations in the range of 43000to 45000.

Table 2.28-DAILY BOARDING/ALIGHTING PASSENGERS

STATION NO.	STATION NAME	2007	2011	2021
1	MYSORE ROAD TERMINAL	8364	10712	14240
2	DEEPANJALI NAGAR	20001	24740	34838
3	VIJAYA NAGAR	32505	39009	69050
4	HOSHALLI	62171	70287	92010
5	TOLLGATE	24264	28776	44284
6	MAGADI ROAD	23721	25700	62151
7	CITY RAILWAY STATION	28000	38300	63979
8	MEJESTIC	30408	38700	75938
9	CENTRAL COLLEGE	15864	18400	27533
10	VIDHAN SAUDHA	17843	21780	42820
11	CRICKET STADIUM	15000	18000	24000
12	M G ROAD	25781	33561	37531
13	TRINITY CIRCLE	12580	17260	22521
14	ULSOOR	10902	15337	21841
15	C.M.H ROAD	17000	24603	36990
16	INDRA NAGAR	18083	18365	27825
17	OLD MADRAS ROAD	12995	16997	32129
18	BAIYAPANAHALLI	15949	28350	45400
19	YESHWANTHPUR	37691	45000	61500
20	MAHALAXMI	16651	18600	28800
21	RAJAJI NAGAR	23306	32785	65507

22	**KUVEMPU**	**36285**	**45600**	**68400**
23	**MALLESWARAM**	**44486**	**54983**	**75906**
24	**SWASTIK**	**43982**	**52800**	**74177**
25	**MAJESTIC**	**46542**	**57246**	**89799**
26	**CHIKPETE**	**22977**	**26200**	**47200**
27	**CITY MARKET**	**17683**	**21979**	**36054**
28	**K R ROAD**	**9326**	**14900**	**29682**
29	**LAL BAGH**	**19900**	**24924**	**35386**
30	**SOUTH END CIRCLE**	**12870**	**15500**	**38325**
31	**JAYANAGAR**	**32805**	**40900**	**65468**
32	**R V ROAD TERMINAL**	**64074**	**79729**	**118698**

2.17.3 Trip length frequency distribution

The trip length frequency distribution of the Metro trips is presented in **Annexure 2.7a and 2.7b**. It can be observed that the average trip length for the years 2007, 2011 and 2021 are 6.62, 6.07 and 7.7 km respectively.

2.18 OPINION SURVEY

Opinion survey was carried out to obtain reveled preferences of the commuters about Shifting to METRO. The respondents were queried with respect to their willingness to pay extra with respect to bus fare, their requirements about the frequency of trains, feeder bus requirement and parking requirement at the proposed Metro Station.

2.18.1 Willingness to shift to METRO

The **Table 2.29** reveals that almost all the respondents are willing to shift to METRO if provided some facilities are given which is discussed in subsequent sections

Table 2.29: METRO Requirement

METRO Requirement	No. Of Units	% Age
Yes	9928	99.28
No	72	0.72
Total	**10000**	**100.00**

Acceptable Walking Distance of the Metro station from the house is presented in the **Table 2.30**. 48% of the respondents prefer a walking distance up to 250 meters, 38.84% accept walking to Metro Station up to 500 meters, while the rest 13.16% accept walking distance to Metro Station more than 500 meters.

Table 2.30-Acceptable Walk Distance from Home to METRO Station

Distance	No. Of Units	% Age
Up to 250Mts.	4800	48.00
250 to 500 Mts.	3884	38.84
500 to 750 Mts.	797	07.97
Up to 1 Km.	519	05.19
Total	**10000**	**100.00**

Table 2.31 shows the acceptable walking distances from the Metro Station to their offices. It can be observed that 45.56% are willing to walk up to 250 meters from Metro Station to their office, while 41.98 % prefer accessibility of the Metro Station within 5000 meters from their work place. Rests are willing to walk more than 500 meters.

Table 2.31 -Acceptable Walk Distance from METRO Station to Office

Distance	No. Of Units	% Age
Up to 250Mts.	4556	45.56
250 to 500 Mts.	4198	41.98
500 to 750 Mts.	788	07.88
Up to 1 Km.	458	04.58
Total	**10000**	**100.00**

Table 2.32 shows the acceptable number of interchanges while using the MRT system. 65.19% of the respondents prefer only one inter-change, 30.70% accept two interchanges only 4.11 % accept more than two interchanges during a trip.

Table 2.32-Acceptable Interchanging Trips

Interchanges	No. Of Units	% Age
One	6519	65.19
Two	3070	30.70
Three	322	03.22

Four	89	00.89
Total	**10000**	**100.00%**

The results of the opinion survey on willingness to shift to METRO if feeder bus is provided are presented in **Table 2.33**. It can be observed that 89.92% of the respondents are ready to shift to METRO if feeder bus is provided to link the Metro Station to attract people outside the catchment area of the Metro Stations it is a good incentive to provide the feeder buses.

Table 2.33 -Acceptable to Shift with Feeder Bus

Feeder Bus	No. Of Units	% Age
Yes	8992	89.92
No	1008	10.08
Total	**10000**	**100.00**

The options on the desirable frequency to shift to METRO are presented in **Table 2.34**. It can be observed from the above table that 48.61% are willing to shift to METRO if the frequency is 5 Minutes, 32.66% are ready to shift if the frequency is 10 minutes, 13.86% are ready to shift even if the frequency is 15 minutes and only 5.77 % are willing to shift if the frequency is more than 15 minutes. The above figures correspond to Morning peak. The comparative figures for off-peak and evening peak are presented in the table below:

Table 2.34 - Acceptable Frequency of METRO

Frequency	Morning		Mid day		Evening	
	No. of Units	% age	No. of Units	% age	No. of Units	% age
Upto 5 Min.	4861	48.61	1573	15.73	4618	46.18
10 Min	3266	32.66	4433	44.33	3216	32.16
15 Min.	1386	13.86	1972	19.72	1524	15.24
20 Min.	258	02.58	1266	12.66	372	03.72
30 Min.	229	02.29	756	07.56	270	02.70
	100.00	**100.00**	**100.00**	**100.00**	**100.00**	**100.00**

Table 2.35 shows the acceptable time savings the respondents expect to Shift to METRO. 25.09% accept a saving of 10 minutes, 41.88 % expect a time saving of 10 - 20 minutes, 23.35% expect a time saving 0f 20- 30 minutes. Rest of the members expect time saving of more than half an hour for single trip.

Table 2.35 -Acceptable Time Saving		
Time Save	**No. Of Units**	**% Age**
Upto 10 Min.	2509	25.09
10 - 20 Min	4188	41.88
20 - 30 Min.	2335	23.35
30 - 40 Min.	615	06.15
40 - 50 Min.	221	02.21
50 - 60 Min.	95	00.95
More than 60 Min.	37	00.37
	10000	**100.00**

It can be observed from the **Table 2.36** that 88.84 % of the respondents prefer monthly passes to travel in the METRO.

Table 2.36 -Preference to Monthly seasonal passes		
Seasonal Pass	**No. Of Units**	**% Age**
Yes	8884	88.84
No	1116	11.16
Total	**10000**	**100.00**

Table 2.37 shows that 78.89% of the respondents prefer to have parking facilities at Metro Stations

Table 2.37 - Preference to Parking Facility at METRO Station		
Parking facility	**No. Of Units**	**% Age**
Yes	7989	79.89
No	2011	20.11
Total	**10000**	**100.00**

Table 2.38 depicts the willingness of the respondents to pay extra fare over and above the existing bus fares. It can be observed from the table that 27.76% are willing to pay the existing bus fare, 48.51% are willing to pay 1.25 times the existing bus fares, 13.31 % are willing to pay 1.5 times the bus fare, only 10.4% are ready to pay twice or more the current bus fares.

Table 2.38-Willingness to pay Extra Fare		
Extra Fare	**No. Of Units**	**% Age**
Upto 3 Times	284	02.84
2.5 Times	182	01.82

2 Times	576	05.76
1.5 Times	1331	13.31
1.25 Times	4851	48.51
Same fare	2776	27.76
	10000	**100.00**