International Journal of Engineering Research and General Science Volume 3, Issue 2, March-April, 2015
ISSN 2091-2730

Investigation on Level of service based on traffic projections for State Highway

Manu B K[1] , Dr. M R Rajashekhara[2]

[1]Post Graduate Student Highway Technology, [2]Professor, Dept of Civil Engineering, D.S.C.E, Bangalore [1]manubk@ymail.com
(9902642991)

ABSTRACT

Transportation planning and highway network being the benchmark of any road project and the level of service stands as a deciding factor for its success. Providing an appropriate level of service to meet the present and future demands of the traffic is of prime importance to avoid economic loss due to congestion and delays due to drop in operating speed that result due to reduction in level of service. It also results in noise and air pollution thus, degrading the environmental quality.

Four typical stretches are selected in the present study for which widening is planned. Present investigation deals with change in level of service due to increased traffic volume year after year till planning horizon of 2035. Traffic volume is projected based on the future growth of traffic worked out on the basis of projected traffic assuming about 7.5% considering a block period of 5 years considering the practicality.

The level of service drop due to increase in traffic volume has been worked out for the planning period of 20 years for each block period. This facilitates the planning authorised to work out the expansion of road network and highway widening programs and also to deal with financial matter.

Keywords*:* Traffic volume, level of service, block period, planning period, widening, future growth, projected traffic

INTRODUCTION

The objective of this study is to estimate rational traffic growth rates and forecast traffic for the design period based on available /collected data and secondary data,to propose road widening scheme based on future traffic in a planned manner and Level of Service during design year of 20 years which facilitates to work out the financial scheme for the project.

In this present study, average daily variation of traffic is calculated from the classified volume count, seasonal factors are estimated from monthly petrol and diesel sales aiding the calculation of annual average daily traffic. Traffic projections are made for the design year of 20 considering a growth rate of 7.5% as per IRC 37-1984(due to insufficient secondary data)for all homogeneous sections of the state highway. Volume to capacity ratio is calculated dividing the design period in to 4 block periods of 5 year each, based on which widening schemes are predicted.

LITERATURE REVIEW

Traffic data is the foundation of highway transportation planning and is used in making numerous decisions. Since accurate traffic data is a very crucial element in the transportation planning process, understanding and implementing the process accurately can lead to better design decisions

In a comprehensive manner, traffic forecasting is the process of predicting the number of vehicles or people that are going to use different transportation facilities in the future. This process begins with the collection of data on present traffic. This traffic data is combined with secondary data, such as population and economic growth rates, employment rate, trip rates, travel costs etc., to develop a traffic demand model for the current situation [1][5] Combining this with projected data for population, employment etc. results in prediction of future traffic, typically estimated for each segment of the transportation infrastructure in question[4] .

Traffic forecasting for the highways is mainly categorized with commercial vehicles as, they contribute more to the volume than passenger vehicles but, having said that avoiding the passenger vehicles may create errors in the estimation when adopted for the design and also when opened to the end design having to bear with the underestimation.

Growth rates are more reasonable when adopted through regressive iterations and correlation between various primary and secondary data. Although accuracy in forecasting is of imaginary value ,having a broadly analysed data is of confident in nature.

STUDY AREA CHARACTERISTICS

State Highway 86 usually referred to as Omalur - Sankari - Thiruchengode - Paramathi road, is one of the major State Highways in Tamil Nadu. It passes through the districts of Salem and Namakkal. The total length of SH-86 is 80.00 kms. The highway provides connectivity to major places such as Omalur, Sankari, Thiruchengode and Paramathi.

The project corridor section of SH-86 under study that is, **Omalur-Sankari-Thiruchengode-Paramathy road (SH 86) Km 0 to Km 45** passes through Salem district and has six urban settlements along the corridor that attract /generate traffic – Omalur,Mecheri,Tharamangalam,Pappampadi ,Konganapuram and Sankari.

Carriageway of the candidate roads is of bituminous surface with two lane configuration of approximately 7 m width. Entire project road is lined with earthen shoulder on either side of the carriageway.

The project stretch routes predominantly through plain terrain and in parts through rolling terrain. The land use is agricultural with pockets of major & minor built-ups.

APPROACH

After thorough site inspections the project corridor has been divided in to 4 homogeneous based on locations of major traffic generators as indicated below

Table 1: Homogeneous sections for corridor 1-Omalur-Sankari-Thiruchengode- Paramathy road.

Sl.no	sections	Chainage
1	Omalur to Tharamangalam	Km 0.000 to Km 10+500
2	Tharamangalam to Konganapuram	Km 10+500 to Km 28+500
3	Konganapuram to Sankari	Km 28+500 to Km 36+200
4	Sankari to pullipalayam	Km 40+000 to Km 45+000

Data collection

Traffic Volume count survey was done to estimate the Average Daily traffic (ADT) and Annual Average Daily Traffic (AADT) on the homogeneous sections. The survey was done on all homogenous section for seven continuous days covering both week days and weekends (7 X 24hrs). The count was recorded at 15-minute intervals for each vehicle category. Primary and secondary data collected on the project stretch are as mentioned below

Primary Data:

7-day Continuous Traffic Volume Count (manual count method was adopted) was carried out on the study stretch 24hrs a day in divided sessions. Strict adherence to IRC codes and manuals were followed for the traffic survey carried out. The main objective of the survey is to estimate the classified vehicular volumes on the selected roads. The counts were conducted for peak hours on a week day.

Secondary Data:

- Fuel sales data along the study stretch
- Previous year vehicle registration data of the influencing zones and Tamil Nadu state.
- Previous year data on Per capita Income, Net State Domestic Product (NSDP).

6. Estimation of Average daily traffic

Table 2: Average daily traffic for all homogeneous sections

Type of Vehicles	ADT at KM 7	ADT at km 23	ADT at Km 33	ADT at km 40
Standard Bus	338	258	291	394
Mini Bus(<3T)	48	17	8	14
Mini Bus(>3T)	74	124	103	72
Car/Jeep/Van	1014	927	848	1269
Two Wheelers	4626	2869	3568	5620
Auto Rickshaws	59	31	27	100
Mini Truck (<3T)	484	500	485	364
Type of Vehicles	**ADT at KM 7**	**ADT at km 23**	**ADT at Km 33**	**ADT at km 40**
Mini Truck (>3T)	235	361	278	80
Two Axle Trucks	948	765	945	457
Three Axle Trucks	1114	1093	1503	376
MAV	441	478	612	123
Others (MT)	3	56	94	99
Tractor+Trailer	18	7	14	7
Tractor	4	9	7	5
Cycles	108	30	25	24
Cycle Rick.	1	0	0	0
Carts	0	0	0	0
Carts (Iron Wheeled)	0	0	0	0
Others (NMT)	0	0	3	1
Total Vehicles	9515	7525	8811	9005
Total PCU	13712	12252	14877.5	9170.5

- Passenger car unit for the above analysis is adopted from IRC 64-1990
- Peak hour traffic for all the sections is listed as below

Table 3: Peak hour traffic details

Sl. No.	Location (KM)	Peak Hour Volume (PCU)	Total Volume (PCU)	Peak Hour share (%)	Peak Hour
1	7.0	776	13,714	5.66%	16:00 - 17:00
2	23.0	672	12,250	5.49%	16:00 - 17:00
3	33.0	813	14,879	5.46%	17:00 - 18:00
4	40.0	635	9,177	6.92%	08:00 - 09:00

Estimation of annual average daily traffic

The traffic plying on any road generally varies over different periods of the year depending on the cycle of different socio-economic activities in the regions through which it passes. Therefore, in order to have a more realistic picture of the traffic on the project road, it is required to assess its seasonal variation to estimate the annual average daily traffic (AADT)

Due to the absence of monthly toll data or any similar data, fuel sales data from the fuel stations from all the project corridors has been used. The ADT observed during the survey duration is multiplied by a seasonal correction factor (SCF) to derive an AADT.

Table 4: Estimated seasonal factors

Veh Type	Seasonal Factor
Car/Jeep/van	1.05
Mini Bus	1.00
Bus	1.00
Mini Truck (<3T & >3T)	1.03
Truck	1.03
Others	1.00
MAV	1.03

The AADT for the base year (2015) on all the homogeneous sections is shown in **Table 5**

Table 5: Annual average daily traffic of all homogeneous sections

Location	**KM 7.0**	**KM 23.0**	**KM 33.0**	**KM 40.0**
Passenger Vehicles				
Standard Bus	338	258	291	394
Mini Bus(<3T)	48	17	8	14
Mini Bus(>3T)	74	124	103	72
Car/Jeep/Van	1065	973	890	1332
Two Wheelers	4626	2869	3568	5620
Auto Rickshaws	59	31	27	100
Commercial Vehicles				
Mini Truck (<3T)	499	515	500	375
Mini Truck (>3T)	242	372	286	82
Two Axle Trucks	976	788	973	471
Three Axle Trucks	1147	1126	1548	387
MAV	454	492	630	127
Others	3	56	94	99
Slow Moving Vehicles				
Tractor+Trailer	18	7	14	7
Tractor	4	9	7	5
Cycles	108	30	25	24
Location	**KM 7.0**	**KM 23.0**	**KM 33.0**	**KM 40.0**
Cycle Rick.	1	0	0	0
Carts	0	0	0	0
Carts (Iron Wheeled)	0	0	0	0
Others	0	0	3	1
Total Vehicles	**9,662**	**7,667**	**8,967**	**9,110**
Total PCU	**14,030**	**12,561**	**15,247**	**9,341**
Passenger Vehicles	**6,210**	**4,272**	**4,887**	**7,532**
Commercial Vehicles	**3,321**	**3,349**	**4,031**	**1,541**
Slow Moving Vehicles	**131**	**46**	**49**	**37**

Traffic projections and volume to capacity ratio

Due to insufficient secondary data, projections to the present traffic volume are carried considering a growth rate of 7.5% (IRC 64-1990) for a design period of 20 years.

Correspondingly volume to capacity ratio is calculated for the annual average daily traffic projections using 15,000(PCU/day) as the design service volume as per IRC 64-1990

year	km 7	v/c ratio
2013	14030	0.94
2014	15082	1.01
2015	16213	1.08
2016	17429	1.16
2017	18736	1.25
2018	20141	1.34
2019	21752	1.45
2020	23492	1.57
2021	25371	1.69
2022	27401	1.83
2023	29593	1.97
2024	32108	2.14
2025	34837	2.32
2026	37798	2.52
2027	41011	2.73
2028	44497	2.97
2029	48502	3.23
2030	52867	3.52
2031	57625	3.84
2032	62811	4.19
2033	68464	4.56
2034	74626	4.98
2035	81342	5.42

year	km 23	v/c ratio
2013	12561	0.84
2014	13503	0.9
2015	14516	0.97
2016	15605	1.04
2017	16775	1.12
2018	18033	1.2
2019	19476	1.3
2020	21034	1.4
2021	22717	1.51
2022	24534	1.64
2023	26497	1.77
2024	28749	1.92
2025	31193	2.08
2026	33844	2.26
2027	36721	2.45
2028	39842	2.66
2029	43428	2.9
2030	47337	3.16
2031	51597	3.44
2032	56241	3.75
2033	61303	4.09
2034	66820	4.45
2035	72834	4.86

year	km 33	v/c ratio
2013	15247	1.02
2014	16391	1.09
2015	17620	1.17
2016	18942	1.26
2017	20363	1.36
2018	21890	1.46
2019	23641	1.58
2020	25532	1.7
2021	27575	1.84
2022	29781	1.99
2023	32163	2.14
2024	34897	2.33
2025	37863	2.52
2026	41081	2.74
2027	44573	2.97
2028	48362	3.22
2029	52715	3.51
2030	57459	3.83
2031	62630	4.18
2032	68267	4.55
2033	74411	4.96
2034	81108	5.41
2035	88408	5.89

year	km 40	v/c ratio
2013	9341	0.62
2014	10042	0.67
2015	10795	0.72
2016	11605	0.77
2017	12475	0.83
2018	13411	0.89
2019	14484	0.97
2020	15643	1.04
2021	16894	1.13
2022	18246	1.22
2023	19706	1.31
2024	21381	1.43
2025	23198	1.55
2026	25170	1.68
2027	27309	1.82
2028	29630	1.98
2029	32297	2.15
2030	35204	2.35
2031	38372	2.56
2032	41825	2.79
2033	45589	3.04
2034	49692	3.31
2035	54164	3.61

Table 6: Traffic projections and corresponding volume to capacity ratio

Analysis through block periods

Five year block period has been selected as the basis of this analysis, for the first 5 year block period design service volume of two lanes as per IRC guidelines is used (IRC IRC 37 1984 and IRC SP 73-2007) and for the rest of the block periods 4 lane design service volume is used. Using these design service volumes v/c(volume to capacity) ratio is calculated and average of these values is calculated for each block period. Based on these average values, widening scheme is predicted for each block period.And although analysis is carried out from year 2013,2015 is considered as the base year for futher analysis keeping in view with the fact of present

Nature of Terrain	LOS-B			LOS-C
	Two Lane without Paved shoulder(PCU/day)	**Two Lane with 1.5m Paved Shoulder**(PCU/day)	**Four Lane**(PCU/day)	**Four Lane**(PCU/day)
Plain	15,000	18,000	40,000	60,000
Rolling	11,000	13,000	40,000	60,000
Mountainous/Hilly	7,000	9,000	20,000	30,000

year running. All the analysis comprehend with Level of service "B" as per IRC guidelines and 2015 is considered as the base year

Table 7: Traffic Design Service Volume in PCU/Day

Table 8 Average values of v/c ratio for homogeneous section 1

Block periods	Average v/c ratio	For design service volumes(PCU/day)
2016 -2020	1.34	15000
	1.13	18000
2021-2025	0.74	40,000
2026-2030	1.12	40,000
	0.74	60,000
2031-2035	1.15	60,000

Table 9 Average values of v/c ratio for homogeneous section 2

Block periods	Average v/c ratio	For design service volumes(PCU/day)
2016 -2020	1.41	15000
	1.01	18000
2021-2025	0.67	40,000
2026-2030	1.008	40,000
	0.668	60,000
2031-2035	1.028	60,000

Table 10 Average values of v/c ratio for homogeneous section 3

Block periods	Average v/c ratio	For design service volumes(PCU/day)
2016 -2020	1.27	15000
	1.22	18000
2021-2025	0.81	40,000
2026-2030	1.22	40,000
	0.81	60,000
2031-2035	1.24	60,000

Table 11 Average values of v/c ratio for homogeneous section 4

Block periods	Average v/c ratio	For design service volumes(PCU/day)
2016 -2020	0.9	15000
		18000
2021-2025	0.496	40,000
2026-2030	0.74	40,000
2031-2035	1.14	40,000
	0.76	60,000

Conclusions and scope for further study

From the above average values of volume to capacity ratio, the following conclusions can be drawn with respect to widening scheme and level of service

- Homogeneous section 1 can cater four lanes from 2016 to 2025 and although it can cater 4 lane from 2026 to 2030 the Level of service will be at "C" hence, it needs to be upgraded to six lanes and the same widening scheme holds goods from 2031 to 2035.
- Homogeneous section 2 can cater 4 lane from 2016 to 2025 and although it can cater 4 lane at Level of service "C ",the section needs to be upgraded to six lanes to match with level of service "B" from 2026 to 2035
- Homogeneous section 3 can cater 4 lanes from 2016 to 2025 and for the same reason as above 2026 to 2035 can cater 6 lanes.
- Homogeneous section 4 can cater 2 lanes from 2016 to 2020, 4 lane from 2021 to 2030 and 6 lane from 2031 to 2035.

Above analysis can be further revised with the use of various secondary data's if available and an analysis of much broader sense can be carried out.

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