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Research Paper

FORCASTING, ANALYSIS AND DESIGN FOR UPGRADING GUNJOOR-SARJAPUR ROAD VIA MULLUR: A CASE STUDY

Ranjitha J[1]* and Varshini K C A[2]

*Corresponding author:***Ranjitha J** ✉ *ranjitha15@gmail.com*

Bangalore is one of the major cities of our country and growing very largely day by day. The city expansion is taking place in all the directions and connectivity to different parts of the city is a must as overall development of the city has to be achieved. The road network should be improved to well connect the new layouts with the city center. Sarjapur is a major part of the city and has to well be connected and easily reachable under high traffic volume conditions. So to ensure the fast movement, the Gunjoor-Mullur – Sarjapur Road development project has been taken up. Existing single lane is widened to double lane and single stretch is maintained at some location by improving the shoulder conditions. The demand for future traffic is estimated by taking the present volume data and analyzing it for different parameters. The present study deals with topographical survey of the area and site appreciation. And the collection of traffic data and analysis to design the signal timings, junction turning characteristics. The horizontal and vertical curves are improved. Realignment is done wherever necessary. Geotechnical investigations are carried out wherever needed.

Keywords: California Bearing Ratio, Distress, Pavement, Traffic forecasting

INTRODUCTION

Bangalore is the capital city of the southern Indian state of Karnataka. It is the seventh largest city in India. It is also known as the Garden City because of its many beautiful gardens and parks. Though the origin of Bangalore is ancient, the present-day city was founded in the 16th century and has since continued to be an important administrative center. Because of the high concentration of IT industry, it also called the Silicon Valley of India. Bangalore is rated to one of the fastest growing cities in Asia with a current population of more than 10 million. During the last couple of decades, city has witnessed drastic increase in population, change in land use pattern of the city, life style of the people and their commuting habits and the revolutionary

[1] Department of Civil Engineering, DSCE, Bangalore, India.
[2] Highway Technology, DSCE, Bangalore, India.

changes that has taken place in the automobile industry. This has contributed to the growth of vehicular traffic in an enormous way.

The vehicle population in all cities in India started growing rapidly since later part of 1980s. Bangalore is no exception. It has always had a reputation of having more two wheeler users. The liberalization policy of the country made availability of not only vehicles, but also loans for buying vehicles. With the rapid growth of IT sector in Bangalore, the affordability of larger segment of employees increased for ownership of vehicles, more specially two wheelers. Coupled with inadequacy of comfortable and convenient public transport gave an impetus to more and more commuters shifting to cars and two wheelers for their commuting in Bangalore. The number of registered motor vehicles has crossed 2.5 million in 2011-2012 and is growing at a rate of over 12% per annum. The two wheelers, which constitute about 72% of the total registered vehicles, are growing at a rate of about 13% per annum. Lately, cars have been growing even faster than two wheelers. Vehicle ownership has grown from 58 to 365 per 1000 population. The trend is likely to continue. This will result in higher use of personalized modes of transport particularly cars unless extensive and convenient public transport system is provided.

The combined effect of all these on the road network of Bangalore is delay and congestion beyond tolerable limits. Vehicular conflicts at the intersections are being eliminated by traffic signals but at the expense of delays and long queues. The peak hour has spread over a longer period of time, since there are no perceptible capacity augmentation / conflict reduction measures.

In view of the above facts, road commuters are experiencing inconvenience and increased road user cost due to increase in the following factors.

- Intra city commuting time.
- Traffic congestions.
- Number of junctions and intersections.
- Junction delays.
- And increased rate of accidents, health hazards, etc.

Hence, there is an urgent necessity to decongest these roads and intersections.

As a comprehensive development program for improvement of road network, the Bruhath Bangalore Mahanagara Palike (BBMP) has planned Improvements and Strengthening of Roads, strengthening of pavement base and sub-base, improvement to pedestrian facilities, improvements to Drainage Facility, etc., for Roads. This response is the answer to the severe strain on the urban infrastructure, which is inevitable due to the very rapid rate of growth in traffic. Travel demands of passengers have increased many folds in the last two decades. Unfortunately growth in the infrastructure is not commensurate with the growing demands of traffic. There is an exigent need to effectively manage the traffic and transportation systems to optimize the solutions with short term and long-term measures.

PROJECT LOCATION

The Project Corridor comes under Bruhath Bangalore Mahanagara Palike which is

located in South Eastern Part of Bangalore City, which connects Sarjapur main Road with SH-35 which further connects to Varthur, White field and NH-4. The Project Corridor is located in thickly populated area except for Mullur village. The land use pattern around the project location consists of built up area, agricultural land, forest area and a few small scale industrial land. The existing project road stretch starts at km 0.000 from Gunjoor Road and ends at km 3.600 at Sarjapur Road (Via Mullur). The entire project road stretch of 3.6 km is intermediate lane bituminous carriageway with 0.5 m to 1.0 m earthen shoulder.

Key Map

Figure 1: Key Map of Project Stretch

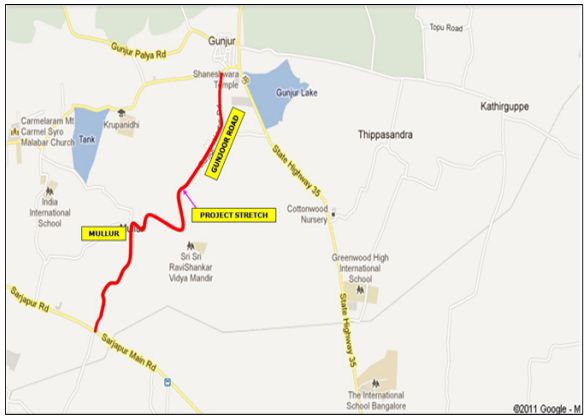


Figure 2: Locations at Start and End Points of Project Stretch (0.00-3.600 Km chainage)

Project Outline

The Project essentially consists of conducting Feasibility Studies including Preparation of Detailed Project Report for upgrading the entire stretch from Gunjur to Sarjapur Road via Mullur.

Objectives of the Study

The objective of the study is to prepare detailed project report which includes:

1. Upgradation of existing 5.5 m Carriageway to 7.5 m Carriageway;
2. Site Inventory;
3. Traffic forecast and analysis;
4. Pavement design;
5. Preparation of typical cross section drawings;
6. Preparation of detailed drawings; and
7. Abstract of project cost.

METHODOLOGY

Geotechnical Investigation

Sampling of subgrade soil samples along the project road has been completed. The soil samples have been tested according to IS: 2720 for relevant engineering properties and it has been used for detailed design of bituminous overlay on existing pavement and for design of new pavement.

To obtain the Geotechnical and Materials characteristics of project stretch, an extensive study of the existing pavement sub-base were carried out. Accordingly the entire stipulated tests have been performed and the summary of test results along with the recommendations has been attached.

- The soil type observed during investigation and test results is silty sand and clayey.
- The CBR value of existing sub grade varies between 4% and 8.0%.

Classified Traffic Volume Counts

Hourly traffic counts were conducted simultaneously in both the directions at each survey location to obtain data on the magnitude of traffic flow and the traffic composition. The survey was carried out by manual vehicle counting and classifying the vehicles passing the survey stations in both the directions, in 15 min interval for 72 h. The counts were made separately for motorized and non-motorized traffic as per the vehicle classification system recommended by IRC. The classified traffic data obtained is shown in Table 1.

Table 1: Classified Traffic Data

Vehicle type	Traffic
2 wheeler	1262
Car/jeep/3wheeler	519
Bus	51
LCV	168
Single, 2-axle truck	19
Multi axle truck	0
Agricultural tractor &trailer	123
Cycle rickshaw	8
Animal drawn vehicle	0

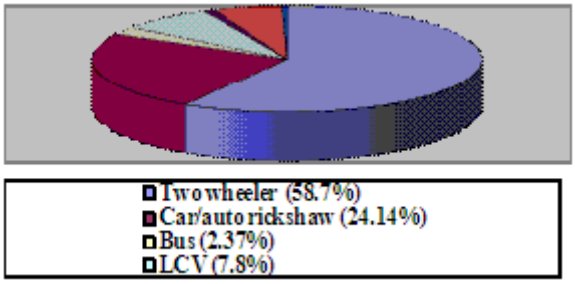
Average Daily Traffic (ADT)

Hourly traffic data collected at the count stations for each day was totalled to obtain the daily traffic volume. The three day traffic volumes were then averaged to obtain the Average Daily Traffic (ADT) at individual survey station.

The following observations are made from the analysis of traffic volume count surveys.

- A total of about 2150 vehicles (2170 PCU's) pass in this stretch in both directions per day.
- Goods vehicles account for 14.42% and passenger vehicle account for 85.21% of total traffic. Non-motorized traffic constitutes about 0.004% of total vehicles.
- Among passenger vehicles two wheelers are the dominant, constituting about 68.8% whereas cars, auto rickshaws constitutes 28.33%, buses are about 2.78%. These traffic volumes reduce during night hours.
- Goods traffic consists of LCV's (54.19%), HCV's (6.13%) and agriculture tractor (39.67%).

Figure 3: Traffic Composition of the Project Road



Traffic Forecasting

Traffic projections were made by applying the constant growth rates discussed above the base year (2014) traffic. Mode wise projections are undertaken over 10 year horizon period after the corridor is open to traffic.

Normal traffic comprises of traffic that is presently observed on the project corridor and will continue to use the project road in the future. Estimations and projections for each of the above components are described below.

Mode-wise traffic for the normal and induced categories is added to obtain the total corridor projected traffic. Projected traffic is used to carry out capacity analysis for the project road. The cardinal years projected traffic is presented in Table 2 and there is no multi axle and animal drawn vehicles in the project road.

Pavement Condition

The pavement condition survey has been carried out on the project road to assess the adequacy and effectiveness of existing pavement in serving the present traffic needs. The condition of the pavement has been evaluated based on the field measurements of primary pavement surface distresses like cracking, patching, potholes, rutting, edge breaks, utility cuts, etc. The total distresses of the project road has been visually estimated and represented in terms of percentage area affected. The total distress along the project road is shown in the Table 3.

Pavement Design

Flexible pavement design has been carried out using “IRC: 37-2001: Guidelines for the Design of Flexible Pavements”.

Design Speed

Design speed of 40 kmph has been adopted

Table 2: Cardinal Years Projected traffic

Year	Two wheeler	Car/3 wheeler	Bus	LCV	HCV	Agricultural Tractor	Cycle Rickshaw
2014	1262	519	51	168	19	123	8
2015	1357	558	55	180	20	132	8
2016	1459	600	59	194	22	142	9
2017	1568	645	63	209	24	153	9
2018	1686	693	68	225	26	164	10
2019	1812	745	73	242	28	176	10
2020	1948	801	78	260	30	189	11
2021	2094	861	84	280	32	203	11
2022	2251	926	90	301	34	218	12
2023	2420	995	97	324	37	234	12
2024	2602	1070	104	348	40	252	13
2025	2797	1150	112	374	43	271	14
2026	3007	1236	120	402	46	291	15

Table 3: Total Distress Along the Project Road	
Total cracking (%)	0.04
Edge breaking (%)	0.9
Potholes (%)	0.01
Utility cuts (%)	0.05
Rutting (%)	0.19

for the stretch from Sarjapur Road and Gunjoor Road via Mullur.

Carriageway Width

Width of the carriageway on the entire stretch varies from 5.0 m to 5.5 m. It is proposed to widen the existing carriageway to 2 lane bi-directional (7.5 m wide) with additional unpaved shoulders of 1.45 m on either side. The entire stretch is widened to 12 m Right Of Way (ROW). Existing ROW varies from 9.0 m to 11.50 m.

Design Life

A 10-year design life has been used in the design of flexible pavement.

Traffic Considerations

The projected traffic for the design period for each category of vehicles has calculated. The

Table 4: Design Traffic Calculations

Calculation of design traffic (million standard axles)

Design life		Vehicle type			
	Year	Bus	LCV	HCV	Agriculture tractor with trailer
		AADT both directions			
Design period	2014	51	168	19	123
Construction period	2015	55	180	20	132
	2016	59	194	22	142
1	2017	63	209	24	153
2	2018	68	225	26	164
3	2019	73	242	28	176
4	2020	78	260	30	189
5	2021	84	280	32	203
6	2022	90	301	34	218
7	2023	97	324	37	234
8	2024	104	348	40	252
9	2025	112	374	43	271
10	2026	120	402	46	291

design period for pavement design is considered as 10 years and hence the horizon year is 2026. The proposed road is assumed to be open for traffic in the year 2017. The traffic loading at the end of 10 years, i.e., 2026 is 5.412 MSA. The traffic loading in terms of MSA is calculated for the sections as given in Table 5 and the calculation of design traffic (million standard axles) is tabulated in Table 4.

Existing Pavement

Existing Layer thickness is 50 mm Bituminous Layer over 150 mm Granular Layer.

Design Thickness

The pavement subgrade has a minimum CBR of 8%. The expected traffic loading at the end of 10 year design life is 5.412 MSA. The recommended pavement layers as per IRC 37-2001 for the proposed road is given below

Semi Dense Bituminous concrete	25 mm
Dense Bituminous Macadam	50 mm
Wet Mix Macadam as Base	250 mm
Granular Sub Base	215 mm
Subgrade	500 mm
Total Pavement Thickness	540 mm

Project Costing and Estimation

Abstract block Estimate for widening of Road Connecting Sarjapur Road to Gunjoor Road via Mullur has been worked out based on detailed engineering design and as per the present rates provided by the Consultant. As part of Detailed Project Report, Rate Analysis of each of the item has been prepared by adopting PW, P & IWTD SR 2013 – 14

Table 5: Calculation of Design Traffic (million standard axles)

Calculation of design traffic(million standard axle)				
Cumulative design traffic (MSA)				
Design life	**Bus**	**LCV**	**HCV**	**Agricultural Tractor**
2017-2021	0.15	1.163	0.057	0.851
2022-2026	0.366	2.833	0.139	2.074
Total traffic in MSA	5.412			

Table 6: Abstract of Project Cost

S.No.	Items of work	No.	Length (m)	Breadth (m)	Area (Sqm)	Rate per Sqm (Rs.)	Amount (Rs.)
1.	Construction of Road and Drain	1	3600.00	7.50	27000.00	2000	54000000.00
2.	Add 10% for Shifting of Utilities						540000.00
3.	Miscellaneous and rounding off						60000.00
						Total	**54600000.00**

Bangalore Circle and NHSR 2010 – 11, National Highways Circle, Bangalore. Provision of 10% of Construction cost is made in the cost estimate for raising and or shifting electric supply lines, telephone lines, OFC lines and other utilities.

CONCLUSION

The Project Corridor is located in South Eastern Part of Bangalore City, which connects Sarjapur main Road with SH – 35 which further connects to Varthur, White field and NH – 4. The Project Corridor is located in so thickly populated area except for Mullur village. Length of the project corridor is 3.6 km. The Study Area caters to considerable local and through amount of traffic commuting between Sarjapur Road and SH - 35. Further, the spurt in the development of Software Industries near Sarjapur Road and Whitefield has resulted in change of the Land Use Pattern. Further, Bruhat Bangalore Mahanagara Palike Government of Karnataka has decided to take up the development of various Arterial and Sub Arterial roads in and around Bangalore city where the intensity of traffic has increased significantly and there is a requirement for augmentation of capacity for safe and efficient movement of traffic. This being the Background, the Bruhath Bangalore Mahanagara Palike has proposed to upgrading the stretch from Gunjur to Sarjapur Road via Mullur for a total length of 3.6 km in order to provide Uninterrupted, Seamless Traffic Flow and to Increase Level of Service along the Corridor.

For the proposed Improvement Scheme, total Cost of the Project has been worked out as Rs. 5.46 cr.

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