Comparison and Assessing Level of Service at National Highway

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Abstract

The Level of Service is a qualitative measure describing operational conditions within a traffic stream, and their perception by drivers or passengers. The present research primarily aims at analyzing and comparing the level of services for national highways of a new metropolitan city Nagpur by using Highway Capacity Software (HCS-2000) and Highway Capacity Manual (HCM-2000). The research presented here mainly aims at assessment of the level of service at national highway midblock sections. The field survey is carried out to capture the traffic volume as well as the corresponding average spot speed of traffic through manual as well as videography technique. The level of service F is not going to observe anywhere since the analysis is carried out at the mid-block sections rather than at the intersections. The result obtained by HCS-2000 method were compared to the result obtained by HCM method.

Keywords: Level of Service, Volume, Avg. Spot Speed, Videography technique, Density, Flow

I. INTRODUCTION

Metropolitan cities in India are highly witnessing the population growth and consequently the increase in traffic volume in their transport corridors. For smooth running of the transportation system it is necessary to assess the Level Of Service of arterial roads, intersections, mid-block sections etc. on periodic basis. The Level of service is the range of operating conditions within the traffic stream. The Level of Service is a function of freedom to manoeuvre, speed, comfort and convenience, safety etc. The highway capacity manuals defines the level of service in six categories ranging from A to F with LOS A as best operating condition (Free-Flow) and LOS-F as worst operating condition (Forced-Flow). The level of service is inversely related to the congestion on road stretches. Inadequacy of supply side of the transportation system, uncontrolled growth of vehicular traffic, static and dynamic encroachment are some of the key parameters affecting the congestion on road sections.

The traffic in India is highly heterogeneous comprising of different types of vehicles (Auto rickshaws, bus, truck, bicycle, etc.) plying on the same facility. The lifeline of the country i.e. the highway (both state and national) runs along and across the different parts of country. The development of a particular country highly depends upon its interconnectivity and accessibility to the different parts of the country. Therefore, for a country to develop the first and foremost thing is the interlinking between the different modes of transport systems. In a developing country like India the vehicular growth over a period of time is of considerable amount.

The vehicular traffic growth on urban arterial roads, state highway, and national highways is witnessing a concern for transport planning engineers due to its uncontrolled growth resulting in increase in fuel cost, increase in journey time, additional fuel consumption consequently leading to the increase in air and noise pollution and deteriorating the environmental conditions. The Level of Service is used as a measure of effectiveness of highways arterial roads etc. The HCM-2000 defines the Level of Service as the range of operating conditions within a traffic stream i.e. freedom to maneuver, speed comfort convenience, safety and environmental compatibility. The six level of services are defined in Highway Capacity Manual ranging from A to F, with A as the best operating condition i.e. free flow and F as a worst operating condition i.e. forced flow or break-down flow.

II. PROCEDURE

A. Selection of Road Stretches

1) National Highway-7 Wardha road (NH-7)
2) National Highway-6 Amravati road (NH-6)
B. Traffic Field Study and Surveys

Traffic surveys are conducted to gather the data on classified vehicular volume and speed on the selected road sections of different highways passing through the metropolitan city. Inventory surveys are carried out for gathering the primary information regarding road surface characteristics, number of lanes, lane width etc. On the basis of inventory surveys, the detailed surveys are planned. The surveys are conducted on normal working days during morning and evening peak as well as off peak hours covering wide range of traffic conditions.

C. About the HCS-2000

The Highway Capacity Software (HCS-2000) implements the procedure defined in the Highway Capacity Manual (HCM-2000) for analyzing capacity and determining level of service (LOS) for signalized intersection, Signalized intersections, urban roads (Arterials), freeways, Multilane highways, Two lane highways Transit. HCS 2000 is the state of art windows application with a comprehensive help system and the highest level of professional technical support.

D. About the HCM-2000

The Highway Capacity Manual (HCM) provides transportation practitioners and researchers with a consistent system of techniques for the evaluation of the quality of service on highway and street facilities. The manual is the primary source document embodying research findings on capacity and quality of service and presenting methods for analyzing the operations of streets and highways and pedestrian and bicycle facilities. The Formula involved in calculation of LOS are:

1) Flow rate \( (V_p) \)

\[
V_p = \frac{V}{PHF \cdot \frac{1}{N} \cdot f_{HV} \cdot f_p}
\]  

Where,
- \( V_p \) = 15-min passenger-car equivalent flow rate (pc/h/ln)
- \( V \) = Hourly volume (veh/h),
- \( PHF \) = Peak-hour factor,
- \( N \) = Number of lanes,
- \( f_{HV} \) = Heavy-vehicle adjustment factor, and
- \( f_p \) = Driver population factor.

2) Heavy-Vehicle Adjustment Factor \( (f_{HV}) \)

\[
f_{HV} = \frac{1}{1 + P_T(E_T - 1) + P_R(E_R - 1)}
\]  

Where,
- \( E_T \) and \( E_R \) = passenger-car equivalents for trucks and buses and for recreational vehicles (RVs), respectively;
- \( P_T \) and \( P_R \) = proportion of trucks and buses, and RVs, respectively, in the traffic stream; and
- \( f_{HV} \) = adjustment factor for heavy vehicles.

3) Free Flow Speed \( (FFS) \)

\[
FFS = BFFS \cdot f_{LW} \cdot f_{LC} \cdot f_M \cdot f_A
\]  

Where,
- \( FFS \) = free flow speed (km/h),
- \( BFFS \) = base free flow speed (km/h),
- \( f_{LW} \) = Adjustment for lane width (km/h),
- \( f_{LC} \) = Adjustment for right shoulder clearance (km/h),
- \( f_N \) = Adjustment for number of lanes (km/h),
- \( f_{ID} \) = Adjustment for interchange density (km/h).

4) Density \( (D) \)

\[
D = \frac{V_p}{S}
\]  

Where,
\( D = \text{Density (pc/km/ln)}, \)
\( V_p = \text{Flow rate (pc/h/ln)}, \)
\( S = \text{Average passenger car speed (km/h)}. \)

III. LITERATURE SURVEY

Kayitha Ravinder, S Velmurugan and S Gangopadhyay (2013) in their work they study the nationwide characteristics of road traffic and to bring out a manual for determining the roadway capacity and Level of Service. By the method to Estimate the roadway Capacity by Direct empirical approaches and Indirect empirical approaches. The developed manual can serve as a handy tool for the practicing engineers and planners to Decision-making tool for road development and management, Comparison of alternative road infrastructures in terms of LOS, etc.

Chetan R Patel and Dr. G.J.Joshi (2012) work on an urban arterial road of Surat city was studied to get its capacity and los. Various data was collected like Volume of vehicles; speed of vehicles data was collected by manual as well as video graphic method. Similarly, volume and speed of vehicles at different time was noted and graphed accordingly. The established LOS threshold based on the capacity and volume will be appropriate in examining traffic quality. Further the established capacity and LOS criteria will be useful for the long and short-term transport infrastructure planning by the local government.

Steffen Axer and Bernhard Friedrich (2014) in their study Level of service estimation is done based on the Floating car data collected from the past. Four stage method was used, Digital road network and traffic message channel system study. Algorithm was used for study area connected to less traffic channel and low floating car routes. Analysis of speeds of vehicles. This data was collected from the past and analyzed. Based on all the above three stages, LOS of the study route was estimated. The developed fourth stage concept could be applied successfully for the road network and the surrounding area. The realized methodology allows road authorities a representative, driving speeds related estimation of LOS for large road networks based on FCD.

Johan Olstam and Andreas Tapani (2011) carried out to present a survey of the current traffic simulation guidelines and to give an overview of how contributions from these guidelines will be utilized in the development of the traffic simulation part. Input data collection, construction of the simulation model, model verification, model calibration, model validation, alternative analysis, and documentation are done. Increasing traffic volumes leading to high degrees of saturation and the introduction of ITS have brought a need for traffic analysis tools that are capable of representing traffic dynamics and the performance of new technologies under various traffic conditions.

IV. CONCLUSION

The Level of Service varies with both average spot speed and volume exponentially. Using the HCS-2000 software assesses the Level of Service for various National highway midblock sections. The Level of Service is a function of Speed and volume, the decrease in speed as a consequence of increase in traffic volume will lead to the deterioration of Level of Service.

REFERENCES


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