Assessment of Level of Service Concept in Urban Roads of Patna: A Review

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Abstract: In developing countries like India, traffic being highly heterogeneous; speed ranges of LOS categories of urban streets are not well defined (HCM2000). LOS is the key factor for analyzing traffic & geometrical characteristics of urban streets as it affects planning, design, operational aspects. LOS determination of urban roads is quite different from rural roads. This paper reviewed various parameters that will affect LOS of urban roads.

Index Terms **-** Level of Service, Urban Areas, Review Papers.

I. INTRODUCTION

Rising megacities and rapid growth of urbanization with millions of inhabitants causes severe challenge to developing country like India. As for the magnitude, in 1901, in Indian urban areas number of people residing there are nearly 25 million which constitutes about 10.84 % at that time of the total population. Since then, the population of urban areas has increased to 28 % of the total population in the next hundred years that is nearly 285 million. According to statistics provided by MORTH annual growth rate of motor vehicle population has been 10 % in the last decade in India. The basic problem is the increasing use of vehicles that cause traffic in megacities in India. Between the various categories of vehicles, the highest CAGR was recorded by cars, taxis and jeeps (11%) during the period 2002 to 2012 followed by two-wheelers (10.7%) which show increase in vehicles in urban areas. The rate of growth of amount of traffic in six megacities in India is equivalent to four times faster than the rate of population increase of those cities. Therefore, concept of level of service in urban areas has been introduced to solve the heterogeneous traffic problem in such developing country.

II. LEVEL OF SERVICE

The term ―Level of Service (L.O.S.) has been introduced by the Highway Capacity Manual (HCM) which represents the level of facility a user can derive from a road under various operating characteristics and traffic volumes. The Highway Capacity Manual (HCM 2000) designates six levels of service for each type of facility, from A to F, with LOS "A" representing the best operating conditions and LOS "F" the worst. Factors affecting LOS are traffic interruptions which include number of stops per km, speed and delay variations, driving comfort, speed and travel time consumed in travelling the entire stretch & Freedom to maneuver to maintain the desired operating speeds.

III. LOS IN URBAN AREAS

The L.O.S. for urban and suburban arterials can be related to the flow conditions, average overall travel speed, and load- factor at intersections, peak-hour factor, and service volume capacity ratio. LOS of urban roads is quite different from LOS of rural roads. According to (H.C.M,2000) L.O.S. is a quality measure describing operational conditions within a traffic stream, generally in terms of such service measures as speed and travel time, freedom to maneuver, traffic interruptions, and comfort and convenience. Basic service for the measurement of urban street is Travel speed. Inappropriate signal timing, poor progression and increasing traffic flow can degrade LOS. Signals with medium-to-high signal densities are more susceptible to these above-mentioned factors and thus poor LOS might be observed. Signals comprising heavily loaded intersections having longer urban streets can provide good LOS. The densities used to define LOS for basic freeway sections are explained in Table1:

Level of Service	Density Range (Pc/ Mi/ Ln)
A	0- 11
B	11- 18
C	19- 26
D	27- 35
E	35- 45
F	>45

Table1: Density based on various LOS (HCM 2000)

IV. REVIEW PAPER

K balaji reviewed variation in speed with lateral placement of different category of vehicles at different sections. Lane width of 25 cm each was divided and left rear wheel of vehicle was placed with the trap length of 30 m using a stop watch. This study shows that heavy vehicles, 3-wheelers & slow moving vehicles follow linear relation whereas 2 wheeler and car follow second degree polynomial. Vehicular speed increases as vehicle shifts towards center. As a whole polynomial relation was followed by vehicles [3]

Prasanta Kumar Bhuyan classified urban streets into four classes and correspondingly FFS were fixed. Average travel speed during peak and non-peak hours were analyzed by clustering and further LOS were categorized. It has been found that urban street speed ranges valid in Indian context were different from values mentioned in HCM (2000) because of the heterogeneous nature of traffic flow. It was found out that Average travel speed calculated for different LOS 'A' 'B' 'C' was comparatively higher as compared to HCM 2000. [4]

Dora Birago promoted Metro Mass Transit Limited (MMT) in Ghana by shifting the use of unsustainable modes such as mini-buses and taxis to the use of efficient systems such as high capacity buses which will reduce traffic congestion and road space will be used efficiently. But to achieve MMT LOS have to be improved by taking into account commuters desired LOS. Another way is to review its pricing system like fares. Therefore it would attract customers and will increase modal share. [5]

Dr. Satish Chandra evaluated capacity of two- lane road under mix-traffic conditions of over more than 40 sections of country on certain parameters such as gradient, lane width, shoulder width, traffic composition, directional split, slow moving vehicles, pavement surface conditions and further proposed Adjustment Factor was applied.[6]

James Oliver Ensley evaluated roadway efficiency to priotize importance of roadway project in the state by using (TRIMS) i.e. Tennessee Roadway Information System which is a database for input data provided by the Tennessee Department of Transportation. Comparative study was conducted on two lane highways which show that best LOS was provided by Class III. Another Comparative study was conducted between 256 segments and (EVE) Evaluation of Roadway Efficiency database results; out of which 42 segments showed LOS of D, E, or F. Further these will be analyzed to resolve any issued that may lead to poor LOS. It improves Decision-making abilities when updated with HCM (2010). [7]

Hamedy Faheem(et.al) Investigation was done on rural multilane highways. Empirical data for four lane divided highways was collected from the sites of Cairo- Aswan agriculture. Firstly analysis is done on Impact of lane position (Median lane) (Shoulder lane) (Average travel speed), Further relation between ATS and different traffic characteristics was figured out which include (density, percentage of heavy vehicles, and lane position variables). In the end effect of lane position and traffic headway characteristics has been discussed. [8]

Ebin Nirmal, Joseph (et.al) studied various parameters to improve the performance of urban roads by enhancing the traffic capacity. To achieve the desired result a 50m stretch was analyzed. Traffic surveys, speed, volume and LOS were calculated. Synchro software was used for road analysis. Signal time optimization method was used to overcome the problem on intersections and helps in reduced control delay, number of vehicle stops and increase the LOS of intersection which further improves LOS of arterial/non- arterial roads. [10]

Jack Klodzinski reviewed Delay at two main toll plaza's in Orilando, Florida. For better precision to capture the delay the 85th percentile of the cumulative individual vehicular delays was found. Service time was examined to determine discomfort and inconvenience felt by driver at Toll plaza. Volume to capacity ratio and density was neglected because a toll plaza has wide range of operating conditions and densities. Thus LOS was calculated by the use of field data and simulated data. [11]

Bhargab Maitra, P. K. Sikdar(et,al) aims at developing congestion models and the effect of roadway width on congestion levels and service volumes. Level of Congestion and its relation with casual influences of traffic movement was then analyzed. Further overall congestion of different vehicle types and their mitigation were being analyzed 10 LOS had been proposed out of which 9 was in stable zone (A-E) and 1 was in unstable (F) [12]

A. Mehar (et.al) reviewed sections of four lanes and six lanes and flow data was collected to determine capacity and speed distribution on two highways under mixed traffic conditions. VISSIM (traffic simulation model) was used to generate traffic flow and speed data that was difficult to obtain from field observation, further calibrated VISSIM was used to determine PCU of different vehicles found on interurban highways and which varies with traffic volume and proportional share of the vehicle in the traffic

stream. Analysis was done on multi-lane interurban highways which showed the effect of congestion level (v/c ratio) on PCU of different type of vehicles. [13]

Smruti Sourava Mohapatra studied GPS and clustering analysis to classify urban streets and LOS where GPS and GIS were used to collect speed and inventory data respectively. This study presented FFS,function and geometric characteristics of street segments. FFs were found using four different clustering algorithms and were entirely different from each other. Study revealed that usage of GPS gave high precise speed data in short duration of time. In comparison to HCM (2000) speed ranges for LOS (A-F) expressed in percentage of FFS were found to be 8-10% less. [15]

Ashish Kumar Patnaik clustered Adaboost,Genetic Programming, Maximum Likelihood Method and Expectation Maximization Method to calculate speed data and to classify various road segment and speed ranges of LOS. Firstly clustering is done to determine FFS then Average travel speed is calculated on peak and non-peak hours. Five parameters were used namely, Homogeneity- Separation Index, Mirkin Index, Rand Index, Adjusted Rand Index, Huburt Index. Major reason for lower value of FFs is Heterogeneous traffic, varying geometry and environmental characteristics. In HCM(2000), the FFS ranges are (90-70)km/hr, (70-55)km/hr,(55-50)km/hr,(55-40)km/hr for urban street class I,II,III,IV Respectively. Further by genetic programming the data speed ranges were (67-90) km/hr,(57- 67)km/hr,(45-57)km/hr,(25-45)km/hr, which is comparatively lower than speed shown in HCM(2000).[16]

V. CONCLUSION

Study reviewed that LOS of Urban Roads is totally different from LOS of Rural Roads. Free flow speed is observed in mid-block sections of urban street, based on which urban street class is determined. LOS determination on the basis of Average travel speed. V/C ratio affects LOS of the street.Urban streets should have minimum LOS of "C". Worst LOS comes during non-peak hours. Urban streets contain mixed traffic. Minimum of 3km street should be taken into account for LOS analysis. Capacity of the street depends upon signal timing, geometry characteristics and composition of traffic on that particular segment.

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