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Evaluation of Capacity and Level of Service of Roads

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ABSTRACT

The road networks of any city are its lifeline and the evaluation of their performance is very necessary for future traffic planning, design, operation and maintenance etc. Traffic flow in most cities of India is a mixed traffic characteristics and also the traffic congestion is the common problem in most major cities in India. The objective of the present study is to improve the performance operation of the urban road network by proposing the proper alternatives to enhance the traffic capacity. To achieve this objective, a complete methodology for analyzing the mixed traffic flow in 50m long stretch is selected and analyzed. Intersections are considered as the critical points of network and estimation of their performance is very necessary. The road networks are also considered as a lifeline for a city.The largest city in vidharbha is Nagpur, the second largest city is Amravati. Traffic congestion has become a major problem in many cities like Amravati. Amravati is 8th most populous metropolitan area in the state. Population of city was 7,45,000 in 2015. It has flyovers slowly coming up and enhancing the beauty of the city. The objective of study is to improve the performance operation of road. Traffic surveys are conducted to collect data on vehicular volume and speed selected road section. Traffic volume study is carried out and existing level of service is calculated. The data is analysed for peak hour traffic. Traffic surveys are conducted on working days during morning and evening peak hours. Manual technique is used for traffic surveys. Synchro software is used for analysis of road network. Synchro software is easy to use. It is optimization software & user can optimize the entire network. The results are useful for evaluation of capacity and level of service of road.

Keywords: Capacity, Highway Capacity Manual, level of service, saturation headway, spot speed, Traffic Volume study, Volume Count.

I. INTRODUCTION

E-commerce has become one of the vital parts of the modern life. Online payment is the supportive application for the payment of money for the products we buy. For the past years online security breach created a major problem and lots of money had been stolen. The proposed document deals by securing the payment through iris recognition [1]. This method also adds the method of using visual cryptography for securing the user credentials. This visual cryptography method was formerly invented by Moni Naor and Adi Shamir in 1994[6]. Scope of transportation system has developed very largely. This led to the increase in vehicular traffic especially in private transport network. Thus road space available is becoming insufficient to meet the growing demand of traffic and leading to congestion. The population of country is growing day by day. The intensity of the traffic and pedestrians crossing has increased significantly and there is no scope for increasing the road length and widening due to land acquisition problem especially at junctions in multiple directions. Recent rapid urban development in India has resulted in transport problems, such as traffic congestion, increasing delay and increase in traffic accidents in all the cities. Present study is carried on Amravati city. Amravati city faces the prospect of living with too many traffic signals. Since every signal has its own routine even on a 50-metre stretch, traffic stumbles every few seconds. If there were optimization of traffic signals and synchronization, then a volume of traffic can have uninterrupted flow on a particular stretch. Urban traffic problem is an important factor that affects the

development and restricts the economic construction of cities. In appropriate signal timing plans can cause not only discomfort (extra delay) to drivers but also increased emissions and fuel consumption. Thus, it is important to investigate the practice of signal optimization methodology to ensure that newly developed timing plans will improve the system performance. Signal timing optimization is most important method that can be improve intersection service level. Good intersection management is the key in improving for improving urban transportation efficiency. Research and experience has shown that retiming and optimizing traffic signals is one of the most effective tasks that can improve the traffic flow.

For a variety of reasons such as population, economic and auto ownership growth, increasing traffic demand can exceed the carrying capacity of the road during peak periods. As a consequence, traffic condition deteriorates and safety risk worsens. Capacity of a road is represented by the maximum rate at which vehicles can pass through a given point in an hour. Intersection capacity or volume-to -capacity ratio is one of the operational measures of effectiveness used in measuring LOS under prevailing operational conditions. Present study is carried out to determine peak hour traffic and also to determine capacity of road. Also it is carried out to determine level of service of road. The results are very useful for evaluation of traffic quality.

II. METHODS AND MATERIAL

The signalized intersection method involves five basic steps:

1. Collection of data.
2. Analysis of data.
3. Find out LOS by analytically and by using
4. SYNCHRO software.
5. Validation of data.

Selection of routes is done on the basis of congestion, Traffic volumes. Rajkamal and near intersections are flowing with maximum capacity in peak hours. Irwin junction to Rajkamal and Rajkamal square to Rajapeth Square these routes are selected for the study. These routes passes from the MSH-6 respectively so, these routes are designated as important routes as per Traffic department of Amaravati City.

III. RESULTS AND DISCUSSION

A. Capacity and Level of Service

Capacity at signalized intersections is based on the concept of saturation flow and defined as saturation flow rate. Intersection LOS is directly related to v/c ratio. Any v/c ratio greater than 1.0 is an indication of actual or potential breakdown. Volume capacity ratio (V/C) is one of the most used index to assess traffic status in cities, in which V is the total number of vehicles passing a point in one hour and C for the maximum number of cars that can pass a certain point at the reasonable traffic condition. Capacity is independent of the demand.

Highway capacity manual provides some procedure to determine level of service. It divides the quality of traffic into six levels ranging from level A to level F. Level A represents the best quality of traffic where the driver has the freedom to drive with free flow speed and level F represents the worst quality of traffic. Service A represents free-flow conditions. Only the geometric design features of the highway may limit the speed of the car. Comfort and convenience levels for road users are very high as vehicles have almost complete freedom to maneuver. Service B represents reasonable free-flow conditions. Service C delivers stable flow conditions. Service D is operating at high- density levels but stable flow still prevails. Service E represents the level at which the capacity of the highway has been reached. Service F describes a state of breakdown or forced flow with flows exceeding capacity. Capacity at signalized intersections is based on the concept of saturation flow and defined saturation flow rate. The flow ratio for a given lane group is defined as the ratio of the actual or projected demand flow rate for the lane group and the saturation flow rate. The flow ratio is given the symbol for lane group. Capacity at signalized I/S is based on the saturation flow and saturation flow rate.

Approach Capacity (C)/ Lane capacity

The maximum rate at which vehicles can pass through the intersection under prevailing conditions. It is also the ratio of time during which vehicles may enter the intersection.

Saturation flow times the proportion of effective green.

$C = s \times g/c$

Where,

C is the capacity of lane in vehicle per hour
s is the saturation flow rate in vehicle per hour per lane
c is the cycle time in seconds

B. **Synchro 8**

Synchro is software for signal optimization and developed by trafficware. Optimization can be applied to cycle lengths,splits,offsets.

Synchro is a complete software package for modeling, optimizing, managing and simulating traffic systems. Synchro is a software suite that includes Synchro, a macroscopic analysis and optimization program; SimTraffic, a powerful, easy-to-use traffic simulation software application; 3D Viewer, a three-dimensional view of SimTraffic simulations; SimTraffic CI, an application that interacts with a controller interface device connected to a controller to simulate the operation of the controller with simulated traffic.

C. Volume to Capacity ratio:

The ratio of flow rate to capacity (v/c), often called the volume to capacity ratio, is given the symbol X in intersection analysis.

$$X_i = (\frac{v}{c})_i = \frac{v_i}{s_i(\frac{g_i}{C})} = \frac{v_i c}{s_i g_i}$$

where, X_i = (v/c)i = ratio for lane group i, v_i = actual or projected demand flow rate for lane group i (veh/h), s_i = saturation flow rate for lane group i (veh/h), g_i = effective green time for lane group i (s) and C = cycle length

For Irwin Square

Morning peak hour volume=1050.28

C= 565 vehicle per hour

Volume to Capacity ratio = 1050.28/565

= 1.85

Level of service of road is F.
It is found that after traffic signal optimization (Intersection split, Cycle length, phase setting and offset optimization) tested for the pretimed control signal system, Level of Service is significantly improved.

D**. Figures and Tables**

TABLE I
The comparison LOS before and after the optimization For Irwin Square

Intersection			**Irwin Square**			
Direction	EB		WB		SB	
Condition	Before	After	Before	After	Before	After
Level Of Service	F	F	F	D	D	D

TABLE III
The comparison LOS before and after the optimization For Rajkamal Square

Intersection			**Rajkamal Square**					
Direction	EB		WB		NB		SB	
Condition	Before	After	Before	After	Before	After	Before	After
Level Of Service	C	A	F	F	F	F	F	F

TABLE IIIII
The comparison LOS before and after the optimization For Rajapeth Square

Intersection			**Rajapeth Square**					
Direction	WB		NB		SB		SEB	
Condition	Before	After	Before	After	Before	After	Before	After
Level Of Service	E	D	F	E	F	F	D	B

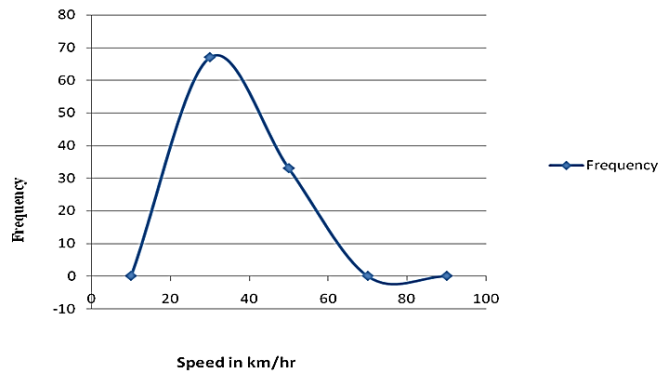

Figure 1: Speed vs Frequency For Irwin Square

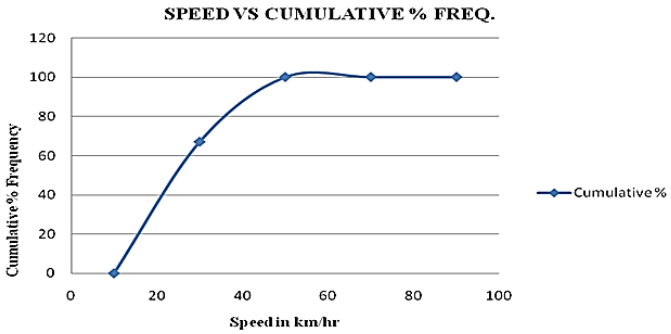

Figure 2 : Speed vs Cum. % Freq. For Irwin Square

IV. CONCLUSION

The following conclusions are obtained from the present traffic conditions Signalized intersections typically form the capacity bottlenecks in urban road networks. Signal timing plans are developed in order to segregate potentially conflicting movements at a signalized intersection. The method on Signal Timing Optimization of an intersection will overcome this problem. The study clearly emphasizes the need for estimation of PCU values based on actual field studies at the signalised intersections for their analysis and performance. Signal optimization is an effective techniques for intersection service level and make it more efficient it can reduced control delay, number of vehicle stops at the intersection and increase the Level of Service of intersection which can further improve in the Level of service of the arterial and/or sub arterials. Results shows that where the intersection is junction point of arterial road and sub arterial road or one road with maximum traffic flows as compared to another there is actuated signal control system can work effectively in such case phase sequence can be arranged such that it can skip phases wherever the low traffic at intersection can increase level of service. Transportation user perception was affected by many factors including roadway geometry, traffic flow, road user behaviour, and other traffic facilities.To achieve optimal efficiency and maximize vehicular throughput at the signalized intersection, traffic flow must be sustained at or near saturation flow rate on each approach.

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