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Review Paper on Potentiality and Pace Analysis of Urban Road

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ABSTRACT

This paper studied about the literature review on Potentiality and Pace Analysis of Urban Road. Efficient transportation is extremely necessary for the speedy economic process of a rustic and road transportation is that the solely mode that's complete in itself. The urban transportation framework is that the back bone of the economic activities altogether urban communities all over throughout the planet, and consequently sustains living of the individuals living in them. Traditional urban transportation facility involves railways, waterways and roads. Among these, the large extent includes of roads. Most coming up with and analysis efforts have targeted on the road system. In essence, road transit is that the major player within the economic activities of most urban centers. In recent times, several cities have seen an outsized increase in road traffic and transport demand that has consequently, cause decrease in capability and inefficient performance of traffic systems. Because the road development has not matched the transport demand, the country is facing a haul of severe traffic jam leading to sizable amount of accidents, delays and frustration on the roads.

1. Introduction

Within the past, it absolutely was thought that so as to resolve the attenuated capability downside it absolutely was merely to produce extra road area. This was the most strategy applied within the U.S.A at the wake of 1960's and 1970's. A lesson learnt from this strategy is that increasing capability of road alone is ineffective as a result of it induces travel growth that negates the advantages of route enlargement. Moreover, there's complexness in therefore doing for one reason that the majority cities square measure already settled areas; thence it's tough to hold out any substantial enlargement works.

In apply, it's neither socially nor economically acceptable to balance provide and demand entirely by increasing road capability. though the enlargement of road infrastructure isn't completely dominated out because the demand is also expected to still grow by time, the immediate, most relevant and acceptable strategy to mitigate capability issues and increase potency of the road network is thru traffic management applications. the foremost recent approach that has gained prominence in traffic management operations is that the introduction of Intelligent facility (ITS). Such technology helps in observance and managing traffic flow, cut back congestion, and supply alternate routes to travelers and will increase safety. These frameworks have created noteworthy accomplishment in important urban areas of the many created nations of America, Asia and Europe. for many cities of the developing countries, they need nevertheless to appreciate these edges, primarily thanks to economic and technological constraints. On the opposite hand the standard tools that are applied as traffic and demand management tools to extend the potency of the transport system embody and not restricted to: prioritization of road users (i.e. introduction of truck lanes, bicycle and pedestrian routes etc.), road markings and signs, social control devices (i.e. camera, police patrol, etc.), regulation of automobile parking space, congestion charges, traffic restraints (i.e. limiting entry to middle etc.), improvement of public transportation, etc. These tools or comparatively price effective and technologically cheap and applicable each in developing and developed countries.

However, very much like they will appear cheap, nonetheless they're not effectively enforced in most developing countries. The estimation and data of route capability area unit essential in designing, designing, and operation of transport facilities. As per HCM 2000 capability is outlined as "The most hourly rate at that area unit moderately expected to traverse some extent or an even phase of the route throughout a given period underneath condition of route, traffic and management conditions". capability is greatly influenced by the route, traffic and friction on the road. The route conditions embody geometric parameters like kind of facility, lane width, shoulder dimension, horizontal and vertical alignments etc. The traffic parameters embody dimensions of vehicles, kind of vehicle etc. aspect friction factors area unit outlined as all those activities happening by the edges of road and typically at intervals the road, that interfere with the traffic flow on traveled means.

2. Literature Review

General

Speed-flow study helps in determining capacity of the road. Capacity and traffic volume analysis is needed to plan, design and operation of roads, and provides the basis for determining the facilities, geometric parameters to be provided at any point in a road network with respect to composition and volume of traffic and to attain the level of service on the road that helps in easy maneuver to the road users. Capacity standards helps for evaluation of investments needed for the future road construction and improvements. Moreover speed flow analysis helps to determine traffic performance of road by evaluating present and future level of service.

3. Problem and significance

The study entitled "POTENTIALITY AND PACE ANALYSIS OF URBAN ROAD" aims at collecting and analyzing the speed flow data of four lane urban road in Karnal city by considering effect of side friction and then comparing with the speed and flow recommended by IRC 106-1990. The study includes finding the composition of traffic, speed, capacity and level of service, amount of disturbance on the road in terms of side friction on the urban road.

Composition of traffic is useful in structural design of pavement, in geometric design and in computing roadway capacity. PCU factor values that suggested by IRC: 106-1990 helps in converting traffic volume of vehicles to PCU in simplified manner. The significance of Capacity and Level of Service is that they help in describing the operational conditions within traffic stream and enable for planning road improvements including future road widening decisions. They also help to know the extent of congestion on the road. Side friction affects the speed of traffic, capacity of road and measures to reduce the effect of side friction and prevent accidents.

Speed flow analysis for the traffic helps in evaluating performance of a road. The traffic flow moving on a road and its analysis is important for understanding the efficiency at which system works. The evaluation of capacity and level of service (LOS) of road helps to know the extent of congestion on the road. Knowing the traffic flow characteristics and the level of service one can easily determine whether a particular section of the road is handling traffic much above or below its design capacity. Traffic flow analysis and level of service evaluation is indicator to improve the transport facilities and is a valuable tool in the hands of transport planners.

In total, study under consideration will be helpful in planning, road improvements, traffic operations and regulations, control of existing facilities and to avoid traffic congestions etc.

4. Objectives of the study

The study under consideration aims at collecting the Speed flow data of four lane urban road in Karnal city by video recording technique. The data thus collected, to analyze the following objectives: -

(a) To determine the traffic composition
(b) To evaluate the speed distribution of traffic on the road
(c) To study the speed frequency curves for different type of vehicle on the road
(d) To develop the speed flow relationships on the urban road
(e) To evaluate the capacity, level of service and traffic performance of the road
(f) To evaluate the effect of side friction on capacity of urban rod

Idealized Speed--Flow Relationship

The idealized relationship between speed, volume and density is expressed in the three basic diagrams given in Fig.1, which are collectively known as the fundamental diagram of traffic flow.

It is seen that the speed density relationship is a straight line having maximum speed (free speed, Vf) when traffic is low and having zero speed when vehicles are jammed. Speed-volume relationship is a parabola having maximum volume (Qmax.) at a value of density equal to half that jamming density (Kj). The fundamental equation relating speed, volume and density is,

$$Q = KV \quad \text{(Eq. 1)}$$

Where, Q = volume
K = density or concentration
V = speed (space mean speed)

The maximum volume that can be accommodated on the road is considered to be the road capacity. From the idealized relationship, it is seen that the maximum volume occurs at half the free speed and half the jamming density, meaning thereby that:

$$Q_{max} = (Vf/2)\times(Kj/2) = (Vf\ Kj\ /4) \quad \text{(Eq. 2)}$$

Where, Qmax = capacity

Vf = free speed
Kj = jamming density

Design criteria for urban roads

Unlike rural roads, the hourly variation of traffic on urban roads has at least two distinct peaks i.e. during the morning and evening hours of the day. Further, traffic fluctuates more on urban roads than on rural roads. The urban peak hour traffic constitutes almost 8-10 per cent of the total daily traffic depending on various factors including the importance of the road in the network. During peak times, unidirectional traffic is also observed on several roads in .urban areas. These factors coupled with other urban characteristics make it necessary to design the urban roads on the basis of peak hour traffic rather than average daily traffic (ADT) as in the case of rural roads.

Design Service Volume (DSV)

From the point of smooth traffic flow, it is not advisable to design the width of road pavement for a traffic volume equal to its capacity which is available at the LOS 'E'. At this level, the speeds are considerably low (typically half the free speed) and freedom to maneuver within the traffic stream is extremely restricted. Besides, at this level, even a small increase in traffic volume would lead to forced flow situation and breakdown within the traffic stream.

Adoption of a higher level of service like A or B, although enabling near free flow conditions would mean lower design service volumes necessitating higher number of traffic lanes to carry a specified traffic volume with implicit higher facility cost. As a compromise solution, it is recommended that normally LOS 'C' be adopted for design of urban roads. At this level, volume of traffic will be around 0.70 times the maximum capacity and this is taken as the "design services volume" for the purpose of adopting design values. On the other hand LOS B can be provided if the cost required is available with us.

The DSV that should be considered for design / improvement of a road facility should he the expected volume at the end of the design life. This can be computed by projecting the present volume at an appropriate traffic growth rate which should be established after study of past trends and potential for future growth of the traffic.

5. Side Friction

Activities that lead to disturbance of movement of traffic on the road come under side friction activities. All the activities are grouped together to get the degree of disturbance/ side friction on the road which is written in short as "FRIC". Activities that give rise to side friction were observed in Karnal City. However, their intensity and type depends much on locations such as central area, urban and suburban. Generally these activities were classified as follows:-

- **Activities happening within the travelled way:**
  - (a) Public mini-buses parking and un-parking to load and unload passengers
  - (b) Non-motorized vehicles especially bullock carts and three-wheelers bicycles
  - (c) Parked broken- down vehicles
  - (d) Road unworthy vehicles and slow moving vehicles such as tractors
  - (e) Animals crossing the travelled way i.e. dogs, cows etc.
- **Activities happening on shoulders**
  - (a) Vehicles parking and un-parking especially public mini-buses and taxies
  - (b) Parked broken-down vehicles
  - (c) Pedestrians, bicycles and non-motorized vehicles using the shoulders
- **Activities happening on the roadsides which essentially generate friction events to shoulders and the travelled way:**
  - (a) Accessibility junctions and driveways to roadside premises such as shops, residences, schools, garages, petrol stations, etc
  - (b) Trading activities including food stalls, kiosks, vendors, etc.

Mainly four frictional items were judged that are generally important to create side friction at most sites. They were:

(1) Pedestrian movements (pedestrian/hour per 200 meters)

(2) Parking and stopping cars, mini-buses etc. on the roadway (Vehicle/hour per 200 meters). There is no specific bus stop along the road. Therefore, the bus can stop anywhere.

(3) Merging Diverging vehicles (vehicle/hour per 200 meters)

(4) Unmotorized vehicles (vehicle per hour per 200 meters)

To determine the side friction value, calculation method, which is shown in Table 2.4 below, has been employed.

Table 1- Side friction class according to side friction value

Sr. no.	Side friction class	Side friction value
1	Very low	<100
2	Low	100-299
3	Medium	300-499
4	High	500-899
5	Very high	>900

6. Review of classical speed-flow relationship and factors affecting

Since 1930s, perhaps beginning with the pioneering works of Greenshields (1935) an immense amount of literature has been produced on the relationships between the speed, flow and density of traffic and the factors affecting these relationships.

Bang and Heshen (2000) developed capacity guidelines for road links and Intersections for Henan and Hebei provinces in China. The side friction class will be used to determine the speed and capacity reductions, i.e. by using these formulas:

Yagar and Vanar (1983) list the factors affecting capacity and speed-flow relationships for two-lane highways under three headings, as follows;

(i.) Geometric factors: grades, bendiness, lane width, lateral clearance

(ii) Traffic factors: vehicle mix, abutting land use etc.

(iii) Weather-surface factors: darkness, pavement roughness and the winter season alone (without adverse weather) all decreased speed.

Chandra and Kumar (2003) investigated the impact of lane width on capacity of two-lane roads in India. They investigated the impact of lane width on capacity of two-lane roads in India. They found that the capacity of two-lane roads in PCU/h increases with total width of the carriageway, and the relationship between the two follows a second-degree curve. The relationship can provide a capacity estimate for two-lane roads with a carriageway width ranging from 5.5 to 8.8 m.

Bang et al. (1995) under the consultancy of Swedish National Road Consulting AB, SweRoad identified significant effects of geometric factors (i.e. carriageway width, shoulder width, median), traffic and environmental factors (directional split, city size) and side friction factors (i.e. pedestrians, non-motorized vehicles, public transport vehicles) on speed-flow relationships on Indonesian urban/suburban road links and these were included in Indonesian HCM (1997).

Gibreel et al. (1999) studied the relationship between geometric design consistency and highway capacity based on a three-dimensional analysis, considering combinations of vertical and horizontal curves. They have compared the actual service flow rate as determined based on the observed traffic flow data, and the theoretical flow rate as calculated based on highway capacity analysis. The results show that the actual service flow rate is always smaller than the theoretical service flow rate with a ratio of actual to theoretical ranging from 0.74 to 0.98.

Reddy et al. (2008) studied the effect of on-street parked vehicle on traffic mobility in urban area and found that parking facility with a width of 2.5 m and a length of 30 to 40 m, would reduce speed by 10 to 12% in case of motor cycles, autos and cars, and 12 to 15% in case of heavy vehicles.

Dhamaniya and Chandra (2014) studied the influence of undesignated pedestrian crossings on midblock capacity of urban roads in India. They estimated the capacity by plotting fundamental diagrams at the sections and then comparing it with the capacity of a section without any side friction. They developed a mathematical relation between pedestrian cross flow and reduction in capacity. They found no influence on

capacity when pedestrian cross-flow is less than 200 peds/hr. The capacity however reduces by 30 percent when pedestrian cross-flow is increased to 1360 peds/hr

Chiguma (2007) adopted an empirical method to determine the effect of side friction factors such as pedestrians walking along or crossing the roadway, bicycles, non-motorized vehicles, parked and stopped vehicles on traffic performance on urban roads in Dar-es-salaam, Tanzania. He then combined the individual friction factors into a single unit of measure called "FRIC". The results showed that side frictions can have considerable effect on speed and capacity under high side friction values.

Koshy and Arasan (2005) developed a microscopic simulation model to analyze the influence of bus stops on heterogeneous traffic flow with great attention to reduction in traffic stream speed. They validated the model using traffic data collected at curbside bus stops and bays. The results of the simulation model at curbside stop and bus bay on a 7.5 m wide road, show reduction of average speed with increasing flow at various times.

There are several studies identified to have attempted to incorporate and quantify the effects of different frictional elements on road networks of urban areas. Among these, the most comprehensive was the one conducted in the course of implementing the Indonesian Highway Capacity Manual (IHCM) and reported by Bang et al. (1995). It identified significant effects of geometric factors (i.e. carriageway width, shoulder width, median), traffic and environmental factors (directional split, city size) and side friction factors (i.e. pedestrians, non-motorized vehicles, public transport vehicles) on speed-flow relationships on Indonesian urban/suburban road links. Road links was only part of the large study that involved all other facilities namely; intersections, roundabouts and weaving sections. This project was conducted as an empirical study where three principal items were measured, these were speed, traffic flow and traffic composition. Other data that were recorded are side friction, geometric and traffic control conditions. Analysis was performed using vehicles as flow units and later was changed to passenger car flow units (PCUs). It was found that most of the sites reflected speed-flow relationship that fitted the Greenshields theoretical model, which is a linear relationship of speed-density data. After establishing these relationships for each site, the study analyzed how they are influenced by the various factors mentioned above (geometric, traffic, environmental and side friction). It was found that the following factors had the greatest influence (in the Indonesian case)

Aronsson and Bang (2005) in Sweden conducted another study, which showed possible relevance to the definition and measurement of side friction. This Swedish study was aimed at analyzing factors that influence speed on urban streets and later develop speed prediction models to be used by planners and traffic engineers for selection and evaluation of alternative street designs and traffic management measures. The scope of this reference is however limited to the study of factors that influence an individual driver's choice of speed on different types of urban streets. Analysis of the field data was performed by the application of regression analysis, which showed the following results.

The study indicated that arterial roads have comparatively higher operating speed facilities than suburban and urban streets. It is indicated that parameters such as; road function, area, roadside parking and separated bicycle lanes were predominantly influential to the operating speed of the streets in Sweden, while side friction and lane parameters were found to be less influential in comparison.

Another study that addressed a general urban traffic problem related to side friction was that of Black et al. (1988). This study includes a project, which collected land use data on main roads in the Sydney area. The main purpose was to identify incompatibilities between land use and traffic to help formulate land use/transport policies. The study showed that the number of pedestrians, parking manoeuvres, bus stops and access drives had an effect of lowering average vehicle speeds on roads where both through movement and access (frontage) activities are present.

Munawar (2011) in Indonesia conducted another study, Speed and Capacity for Urban Roads by considering the effect of side friction factors on the speed and capacity of urban roads. The side friction factors that included were no. of pedestrians, parking and stopping vehicles, merging and diverging vehicles and non-motorized vehicles. All the friction factors combined to find out side friction value and there effects were known on speed for low and high value of side friction separately.

7. Conclusions

In the present paper traffic volume, speed and friction factor is studied on an urban stretch in the Karnal city. The selected stretch is four lane divided road with 2×7.5 m carriageway, 1m median and 1m shoulder on each side. The following main conclusions were drawn from the study-

(i) Traffic study was carried out in the three stretches of 2 hours each i.e. 08:00 AM to 10:00 AM, 12:00PM to 02:00 PM and 08:00 PM to 10:00 PM.

(ii) From the traffic volume data it is observed that maximum hourly traffic on the road is 2460 vehicles/ 3132 PCU (12:30 PM to 01:30 PM) and the minimum traffic is 356 vehicles/467 PCU (09:00 PM to 10:00 PM).

(iii) From the traffic composition it is observed that maximum contribution is of two wheelers with 38% followed by Autos having 29%, cars/jeeps 25% and others 8%.

(iv) The traffic in terms of PCUs maximum contribution is of autos with 45% followed by two wheelers 22%, cars/jeeps 19% and others 14%.

(v) The fast moving vehicle on the road is 98% and 2% vehicle on the road is slow moving vehicle or human drawn vehicles. The fast moving vehicle on the road in terms of PCU is almost 99% and the slow moving vehicle on the road is almost 1%

(vi) From the speed flow results it is observed that 98th percentile speed is found to be 52 kmph which is less than the present recommendation of IRC which is 60 kmph. The 85th percentile speed for the road is found to be 39kmph which indicated the upper safe limit for the vehicles moving on the road. The 15th percentile speed on the road is found to be 15kmph which defines the minimum speed to avoid congestion on the road.

(vii) The model speed for the road section is found to be

29kmph which shows that maximum vehicle on the road are travelling at this speed.

(viii) The FFS (free flow speed) on the road section is found to be 57.5kmph which is average speed for 100 vehicles which are moving at free speed during 9:00PM and 10:00PM.

(ix) The speed flow relationship have been developed for all vehicles an individually for each category of vehicle by providing coefficient of determination value (r2) for the road section. From the speed flow relationship of all categories of vehicles the capacity value estimated on the road was 3340 PCU/hr which is little less than the capacity recommendation of 3600 PCU/hr for 4 lane divided urban (arterial) road by IRC:106-1990.

(x) From the urban road capacity is found during design used in PCU/hr but it can be converted to PCU/day for the road by considering peak hour factor of 8% and it was estimated to be 45000 PCU/day.

(xi) It is observed that the four lane divided section of the road is presently operating at LOS 'D'. By 2018, its LOS will be reduced to 'E' and by 2019 the road will be operating under LOS 'F' i.e. traffic volume on the road will be exceeding the capacity of the road and the road will be operating under forced condition. Hence suitable remedial measures need be taken to improve the level of service.

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