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REVIEW PAPER ON EXPERIMENTAL STUDIES ON THE APPLICATION OF INDUSTRIAL WASTE AND BY-PRODUCTS FOR CONSTRUCTION OF HIGHWAY

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ABSTRACT

The estimation of roadway capacity is essential in planning, designing, and operation of highway facilities. Capacity and speed of road suffers a loss due to various factors such as geometric parameters, environmental parameters, city size factors, side friction factors etc. The environmental parameters include rainy conditions, fog, temperatures etc. The effect of friction factors can cause jam conditions in urban stretches, so need to be investigated and some regression equations need to be established between capacity and friction factor to know impact of friction factors. Better characteristics (geometrics, environmental etc.)of road may lead to higher capacity and higher speed at a certain flow.

The thesis aims at, to develop the speed flow relationship for the four lane urban road and to find out effect of friction factor on capacity and speed of road. Friction factor includes major effects such as pedestrian movements, parking & stopping vehicles, exit/entry vehicles into traffic stream, unmotorized vehicles etc. At high side friction value there is significant difference between actual speed and those without friction i.e. very low friction from side. These capacity values are compared with IRC: 106-1990. At low side friction value, capacity and speed does not affect much but at high side friction losses in capacity and speed are high. Therefore, the optimum dosage of steel fibers was determined to be 3 %.

Keywords: geometric parameters, unmotorized vehicle, friction loses, steel fibre

1. INTRODUCTION

Efficient transportation is very important for the rapid economic growth of a country and road transportation is the only mode that is complete in itself. The urban transportation framework is the backbone of the economic activities in all urban communities everywhere throughout the world, and consequently sustains livelihood of the people living in them. Normal urban transportation facility involves railways, waterways and roads. Among these, the huge extent comprises of roads. Most planning and research efforts have focused on the road system. In essence, road transportation system is the major player in the economic activities of most urban centers. In recent times, many cities have seen a large increase in road traffic and transport demand, which has consequently, lead to decrease in capacity and inefficient performance of traffic systems.

As the road development has not matched the transport demand, the country is facing a problem of severe traffic congestion resulting in large number of accidents, delays and frustration on the roads. In the past, it was thought that in order to resolve the decreased capacity problem it was simply to provide additional road space. This was the main strategy applied in the U.S.A at the wake of 1960's and 1970's.

A lesson learnt from this strategy is that increasing capacity of road alone is ineffective because it induces travel growth that negates the benefits of highway expansion. Moreover, there is complexity in so doing for one reason that most cities are already built-up areas; hence it is difficult to carry out any substantial expansion works. In practice, it is neither socially nor economically acceptable to balance supply and demand solely by increasing road capacity Although the expansion of road infrastructure is not absolutely ruled out as the demand may be expected to continue to grow by time, the immediate, most relevant and acceptable strategy to mitigate capacity problems and increase efficiency of the road network is through traffic management applications. The most recent approach that has gained prominence in traffic management operations is the introduction of Intelligent Transportation System (ITS). Such technology helps in monitoring and managing traffic flow, reduce congestion, and provide alternate routes to travelers and increases safety. These frameworks have made noteworthy accomplishment in significant urban areas of many created nations of America, Asia and Europe. For most cities of the developing countries, they have yet to realize these benefits, primarily due to economic and technological constraints.

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2. LITERATURE REVIEW

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.

CAPACITY OF URBAN ROADS IN PLAIN AREAS

Capacity provides the basis for determining the number of traffic lanes to be provided for different road section regarding volume, composition and other parameters of traffic. IRC has developed the guideline on the capacity of urban roads. These guidelines are based on experience in developed countries and limited studies carried out in India. IRC 106:1990 provides "Guidelines for Capacity of Urban Roads in Plain Areas". These guidelines are applicable for the mid block sections of urban roads but these are not directly applicable for the urban expressways.

Capacity

Capacity is defined as "maximum hourly rate at which persons or vehicles are reasonably expected to traverse a point or a uniform segment of a roadway during a given time period under conditions of roadway, traffic and control conditions". The roadway conditions consist of geometric parameters such as type of facility, lane width, shoulder width, horizontal and vertical alignments, curves etc. Friction on the road also affects the speed and capacity of vehicles.

Speed

Speed is the rate of motion of individual vehicles of the traffic stream. It can be measured in meters per second or generally as kilometers per hour. Two types of speed measurements are commonly used in the traffic flow analysis i.e.

i) Space mean speed

ii) Time mean speed

For the purpose of study space mean speed is preferred over time mean speed. Space mean speed is the mean speed of vehicles in a traffic stream at any instant of time over a certain length (space) of road. In other words, this is average speed based of vehicles to traverse a known segment of roadway based on the average time. Time mean speed is the mean speed of vehicles observed at a point on the road over a period of time. It is the mean spot speed. Space mean speed is slightly less than the time mean speed.

Density

Density (or concentration) is the number of vehicles' occupying a unit length of road at an instant of time. The unit length is generally one kilometer. Density is expressed in relation to the width of the road (i.e. per lane or per two lanes etc.). When vehicles are in a jammed condition, the density is at maximum. It is then termed as the jam density.

Functional classification of urban roads

Besides the Expressways, urban roads can be classified into the following four main categories:

(i) Arterial (ii) Sub-arterial

(iii) Collector Street (iv) Local Street

Equivalency Factors

Urban roads are having characteristics of mixed traffic conditions. resulting in complex interaction between various kinds of vehicles. To cater this, we need to express the capacity of urban roads in terms of a common unit. The unit generally employed is the 'Passenger Car Unit, (PCU), and each vehicle type is converted into equivalent PCUs based on their relative interference value. The equivalent PCUs of different vehicle categories do not remain constant under all circumstances. Rather, these are a function of the physical dimensions and operational speeds of respective vehicle classes. In urban situations, the speed differential amongst different vehicle classes is generally low, and as such the PCU factors are predominantly a function of the physical dimensions of the various vehicles.

REVIEW OF CLASSICAL SPEED-FLOW RELATIONSHIP AND FACTORS AFFACTING

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

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these formulas:

(a) For free flow speed

FV = (FVO+FVW) x FFVSF x FFVCS

Where,

FV = free flow speed (km/hour)

FVO = basic free flow speed (km/hour)

FVW = road width factor (km/hour)

FFVSF = adjustment factor for land use and side friction.

FFVCS = city size factor

(b) For capacity

C=Co x FCW x FCSF × FCCS

Where,

C = capacity (pcu/hour)

Co = basic capacity (pcu/hour)

FCW = road width factor.

FCSF = side friction factor

FCCS = city size factor

Yagar and Vanar (1983) list the factors affecting capacity and speed-low 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 2.5m 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.

3. CONCLUSIONS

In this section, this part summarizes the conclusions reached based on the findings of the experimental investigations, followed by the conclusions reached based on the findings of the analytical studies.

1. The change of the CBR value in relation to the percent of WFS employed in the mixture is non-linear in general.
2. There is an ideal percent of WFS for both the stabilizing elements utilized in this study, such as cement and lime, that results in a greater CBR value of the combination.
3. Adding 10% red mud to the combination reduced the CBR value for virtually all of the WFS percent adjustments studied.
4. It was discovered that using WFS at 70% of the time resulted in increased strength (CBR value)
5. The usage of 5.5% red mud at the optimal WFS resulted in a higher CBR value.

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