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Transportation Research Procedia 17 (2016) 468 – 477

Transportation Research Procedia

www.elsevier.com/locate/procedia

11th Transportation Planning and Implementation Methodologies for Developing Countries, TPMDC 2014, 10-12 December 2014, Mumbai, India

Traffic Flow Characteristics for Multilane Highways in India

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Abstract

The traffic composition on multilane highways in India comprises of a wide range of vehicles in terms of their type, size, engine power, manoeuvring ability, etc. This mix of vehicles with different operating capabilities results in a broad range of speed. Slow moving or non-motorized vehicles occupy the lower ranges of speed spectrum whereas the new technology cars dominate the higher ranges. To understand the real traffic behaviour, it requires quantification of some of the basic traffic flow characteristics such as Speed, Flow, Density and Occupancy through which the capacity can be derived. The radical changes in road network and vehicle technology have resulted in variations in speed-flow characteristics and subsequently road user costs. The problems arise out of three major aspects associated with several types of vehicles in the traffic mix i.e. speed and acceleration capabilities of vehicles, their manoeuvres and lateral clearance requirements within the right of way. The main objective of the present study is to estimate the basic traffic flow parameters for six lane divided traffic stream under study and to evolve speed-flow relationships for six lane divided carriageways for different vehicle types. In the present study, linear models have been developed for speed-flow equations for different vehicles on each lane of selected road sections of six-lane divided carriageway.

Peer-review under responsibility of the Department of Civil Engineering, Indian Institute of Technology Bombay

*Keywords:*Traffic, Speed-Flow, Sixlane highway, Pasenger Car Unit

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Peer-review under responsibility of the Department of Civil Engineering, Indian Institute of Technology Bombay
doi:10.1016/j.trpro.2016.11.092

1. Introduction

Out of various major parameters contributing in developing effective Pavement Management System (PMS), traffic is the controlling parameter. Consequently the traffic flow analysis on multilane highways is essential. Traffic engineers analyze and evaluate plan improvements in traffic facilities based upon traffic flow parameters and upon their knowledge of normal ranges of behavior. These parameters are the traffic engineer's measure of reality and they constitute the language by which traffic flows are described and understood. The fundamental characteristics of traffic flow are flow, speed and density. Unless these basic characteristics are known or estimated in the planning, design, and operation of a highway, the traffic engineer has meager knowledge of the traffic system of interest.

2. Past Development

Banks, J.H. (1989) speed flow concentration relationships in freeway traffic are verified. Regression analysis was used in the study of speed flow relationships under free flow conditions. Hall Fred L. and Hall Lisa M. (1990) investigated the speed flow relationships, downstream of a queue and within the queue to identify capacity flows and the effects of formation of an upsteam queue on speed and flow. Chin H.C. and May A. D. (1991) examined speed and flow characteristics of a free way section (California state highway 24) at Caldecott tunnel and compared with the speed flow curves in the Highway Capacity Manual (HCM) for freeways and those in the new procedure for the multilane highways. Brilon W. and Martin Ponzlet (1996) presented the studies of speed flow relationships for German autobahns and the consequences of differing speed flow relations for the maximum flow. Hurdle V.F., Mark I. Merlo and Doug Robertson (2000) made an attempt to examine the relationship between speed and flow for entire roadway, the linear functions were not adequate, but cubic functions performed reasonably well. Roux J. and Bester C J (2002) tested the relevance of overseas models to South African conditions, a number of these models have been investigated with data obtained from South African freeways. The subject of the study was speed flow relationships in uncongested conditions. Simple polynomial functions were fitted to the individual lane speed flow data. Raghvachari S., and Badrinath, K.M. (1983) studied mixed stream parameters using a real density concept in Hyderabad City and they developed the following relationships for speed and flow:

$$u = 6903516\text{-}659q \qquad R^2 = 0.3463 \qquad (1)$$

$$q = 2578 + 4.106 \times 10^{-5}k \qquad R^2 = 0.37 \qquad (2)$$

$$\log(u) = 2.91726 - 0.37269k - 0.51472p \qquad (3)$$

where,

u = speed of vehicle type (km/hr)
k = aerial density,
p = percentage of slow moving vehicles.

Kumar, V.M. and Rao, S.K. (1998) studied Speed - Density - Flow relationships on a few stretches of NH-5 and NH-6 which is two lane highway. It is observed that at low volumes of traffic, the average speeds of vehicles were in the order of 43 to 47 kmph and with the increase of traffic volumes, speeds were observed to decrease correspondingly. In PCUs/hour, the observed highest flows were approximately in the range of 1200 PCU/hr to 2000 PCU/hr. Chandra, S. (2004) developed the capacity estimation procedure for two lane roads under mixed traffic conditions. Data collected at more than 40 sections of two lane roads in different parts of the country were analyzed. The capacity of a two lane road under mixed traffic conditions is given by following equation:

$$C_a = c_b f_g f_w f_{ds} f_{smv} f_s f_{ui} \qquad (4)$$

Where,

C_a =Actual capacity under prevailing roadway and traffic conditions

c_b= Basic capacity (3100 pcu/h)

$f_g f_w f_{ds} f_{smv} f_s$ and f_{ui} are the adjustment factors for gradient, lane width, directional split, slow moving vehicles, shoulder conditions and unevenness index. These adjustment factors for different road conditions is work out.

Dey P.P., Chandra S., and Gangopadhyay S. (2007) studied the PCU values under different volume capacity ratios and varying proportions of vehicles on two lane roads. Speed data are obtained from a simulation program, and the effect of traffic mix and volume capacity ratio on PCU of a vehicle is explained.