



10th International Scientific Conference Transbaltica 2017:
Transportation Science and Technology

Effect of Mixed Traffic on Capacity of Two-Lane Roads: Case Study on Indian Highways

Nabanita Roy, Rupali Roy, Hitesh Talukdar, Pritam Saha*

Indian Institute of Engineering Science and Technology, Shibpur, Howrah, West Bengal, India

Abstract

This paper focuses on effects of mixed traffic on capacity of two-lane roads. On the basis of field data collected on Indian highways, the present paper makes it clear that capacity reduces if the proportion of slower vehicles increases in the traffic stream. Since such vehicles are responsible for the formation of platoons, their increasing proportion in traffic would accordingly increase the equivalency factor of vehicles, thereby, resulting in variation in capacity. The present study therefore explicates the need of introducing the concept of dynamic passenger car unit and anticipates that this would alleviate the current implication on capacity standards of such roads under mixed traffic.

© 2017 The Authors. Published by Elsevier Ltd. This is an open access article under the CC BY-NC-ND license (<http://creativecommons.org/licenses/by-nc-nd/4.0/>).

Peer-review under responsibility of the organizing committee of the 10th International Scientific Conference Transbaltica 2017

Keywords: two-lane roads, mixed traffic, highway capacity, platooning, passenger car unit

1. Introduction

Traffic operations on two-lane highways differ from the divided carriageways substantially because of interaction between flows in two opposite directions. The frequent interaction between vehicles owing to restricted passing opportunities, both in the direction of flow and with the opposing traffic has significant impact on traffic

* Corresponding author.

E-mail address: saha.pritam@gmail.com

performance of such roads. The interaction is more acute if the prevailing traffic is mixed in character and speed differential is large due to the presence of slower vehicles including non-motorized one.

Typically, speed-flow curves on two-lane highways appear to have a concave shape; however, studies elucidate the need of further research particularly for the traffic conditions which prevails near and at capacity [1]. This is paramount on roads with mixed traffic since the equivalency factors of different vehicle types, commonly referred as passenger car equivalent; considerably change with traffic composition and flow. This is attributed to frequent formation of platoons which often compels a faster vehicles to move at the speed of slower impeding vehicles, like non-motorized and also, low performance motorized ones since they cause significant level of friction to the faster ones [2]. Eventually, such variation results in a considerable change of speed-flow characteristics and capacity as a consequence.

According to the Highway Capacity Manual [3, 4] the two-way capacity of two-lane roads is 3,200 pc/h and it is about 1700 pc/h for each direction. The capacity, however, significantly reduces in the event of heterogeneity in the traffic mix. Even changing static and dynamic characteristics of same category vehicles have major impact on it. A study on simulation of mixed traffic on such roads indicates a two-way capacity of about 2,860 pc/h even under all car situation with equal directional split [5]. This aggravates further if the proportion of slower vehicles increases in traffic composition. These facts along with the pressing need of developing capacity standards under mixed traffic have been the motives of present study. Thus, objective of the study was to evaluate heterogeneity effects of mixed traffic on capacity of two-lane highways. The study also aimed at investigating the factors that influence in capacity reduction.

2. Literature review

The speed-flow relationship is fundamental for capacity and level-of-service assessment of highways. Greenshield [6] developed a relationship for these parameters and subsequent to his study, significant efforts [7–9] have been made during past several decades while dealing with this issue. However, none of those studies considered the impact of mixed traffic, which is prevalent in most of the developing countries including India, while estimating capacity [7]. Accordingly, it became apparent to develop highway capacity norms for such highways [8]. Further, dynamic characteristics of vehicles have undergone considerable changes over past ten years resulting in higher speeds of those vehicles [9] and change in speed-flow characteristics as a consequence. A study on Finnish road reported a capacity of about 2500 veh/h for two-lane roads with 50/50 directional split [10]. Effect of roadway width and also, traffic composition on capacity was found to be significant for such roads [11]. Thus, a study made an attempt to develop speed-flow equations for different vehicle types on the basis of both, traditional and microscopic simulation models [12].

There have been a number of researchers who investigated the speed characteristics of traffic on roads where large variation in speed is observed. A study observed that percentile speeds are affected by traffic volume, type of vehicles, accessibility, speed limit, existence of an extra lane, and grade [13]. Free-speed characteristics of different vehicles were also observed to change considerably on Indian highways [14, 15].

Historically, Highway Capacity Manual [3] was the first document to define capacity and quality of traffic flow. However, capacity is a probabilistic measure and varies with the roadway and traffic conditions. Further, the latest edition of the manual [4] points to the fact that free-flow speed can be best approximated at low flow when traffic interaction is insignificant. Besides, a number of methods have been suggested over the past decades to eradicate the difficulty in assessing free-speed [16–20]. Couple of experiences on speeds of highway traffic indicates that car following interaction diminishes beyond a headway threshold of 6 s and vehicles travel at their free-flow speed [21] and 85th percentile speed does not vary beyond a critical headway value of 5 s [22]. Also, several studies investigated appropriate mathematical model to describe observed speed data and majority of them confirmed that speed data usually follow a normal distribution [23–26].

Most of the above cited studies were conducted under homogeneous traffic conditions and insignificant efforts have been made in investigating the impact of heterogeneity under mixed traffic, particularly where speed differential is large. This is more acute on two-lane roads wherein frequent formation of platoons results in a considerable change of equivalency factors of different vehicle types, thereby, a change in speed-flow characteristics

Download English Version:

<https://daneshyari.com/en/article/5027853>

Download Persian Version:

<https://daneshyari.com/article/5027853>

[Daneshyari.com](https://daneshyari.com)