Comparing the Methods of Passenger Car Unit Estimation

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The equivalency factors for different types of vehicles are often required in carrying out highway capacity calculations. Any bias in these values will lead to bias in capacity estimation for highway facility. The PCU values derived from different methods documented in literature have been compared in this paper. It is concluded that none of these methods gives realistic PCU values when applied to mixed traffic conditions.

Keywords : Highway capacity; Passenger car units; Equivalency factors; Mixed traffic

INTRODUCTION

The unrestricted mixing of various classes of vehicles along a road creates many problems to the traffic engineers and planners. One type of vehicle in the traffic stream cannot be considered equivalent to any other type as there is large difference in their vehicular and flow characteristics. The aggregate flow of all types of vehicles presents a peculiar behaviour of traffic stream. The space of the carriageway is shared by vehicles depending upon their size, speed, headway and lateral gap maintained by them. The vehicles which are less efficient cause operational difficulties to other vehicles. The degree of influence depends on net composition of traffic stream. On rural highways the proportion of commercial vehicles and buses is large as compared to passenger cars.

The non-uniformity in the static and dynamic characteristics of the vehicles is normally taken into account by converting all vehicles in terms of a common unit. The most accepted one such unit is passenger car unit (PCU). The foremost drawback of PCU concept is the ambiguity in its definition which makes everyone to determine PCU value in a different manner. As such, many methods are available in the literature to determine PCU value of a vehicle type. In the present study, PCU values have been calculated using five different methods documented in the literature and resulting PCUs have been compared.

DATA COLLECTION

Data collection in the field was mainly done by video filming a section of National Highway (NH-8), 2 km from Anand-Chikhodara intersection, at Vaghasi village (Gujarat). The site is easily approachable from Anand city and is a clearly defined two-lane highway with 2.5 m wide shoulders on either side. A trap of 25 m length was made on the highway and traffic data was recorded for about 3 h during peak flow. To decide the busiest hours of the day, classified volume counts for both the directions were made from 8.00 a.m. to 5.00 p.m. on a typical weekday and the peak flow was found to exist between 9.00 a.m. to 12.00 noon. The recorded film was replayed on a large screen TV monitor in the laboratory and data on classified volume count, speed and time headway for different types of vehicles were extracted.

Walker's Method

Walker's method is based on the number of overtakings that would be performed per kilometre length of highway if each vehicle continued at its normal speed. It can be shown that

\[ N = \sum_{i=1}^{n} \sum_{j=1}^{m} x_i y_j \left( \frac{1}{S_{ij}} - \frac{1}{S_{i}} \right) \]  

(2)

where \( N \) is sum of overtakings in terms of vehicles travelling at speed \( S_1 \) that will overtake \( x \) vehicles per hour travelling at speed \( S_2 \) within one km of highway when the number of vehicles travelling at speed \( S_1 \) is \( y \) vehicles/h; \( m \), the number of faster vehicles at selected speed groupings; and \( n \), number of slower vehicles at selected speed groupings.

The passenger car unit is then calculated as the ratio of the number of overtakings when a traffic has one slow moving vehicle per hour to the number of overtakings when there are passenger cars of equal volume. Thus, if \( N_1 \) and \( N_2 \) are the desired number of overtakings in a stream of 100 passenger cars per hour and 99 passenger cars + 1 truck, then PCU of the truck is given by

\[ PCU = \frac{N_1}{N_2} \]