

A REVIEW ON EFFECT OF VARIATION IN CATEGORIES OF VEHICLES ON URBAN ARTERIAL ROAD CAPACITY

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ABSTRACT: Highway traffic flow phenomena involve several complex and stochastic variables with high interdependencies. In this study the variations in roadway, traffic and environmental factors influence the traffic flow quality significantly. Capacity analysis of road sections under different traffic and geometric conditions need to quantify the vehicles of widely varying characteristics to a common and universally acceptable unit.

Key words: Passenger car unit (PCU), Passenger Car Equivalent (PCE), slow moving vehicles (SMV), Indian Road congress (IRC), Arterial roads.

1. INTRODUCTION

1.1 General

India is a land of diversity in every aspect. Traffic in India is not an exception to this diverse behavior. India is a developing country with considerable share of slow moving motorized and non-motorized vehicles along with fast moving traffic observed in almost every region. The main function of an arterial road is to supply traffic from collector roads to arterial roads, and between urban centers at the highest level of service possible. The variations in roadway, traffic and environmental factors influence the traffic flow quality significantly.

Arterials in metropolitan cities are expected to provide flexibility to the high volume of traffic. A realistic understanding of traffic flow behavior for such essential urban roads is necessary for traffic operation planning and management for ensuring the desired level of service. The main function of an arterial road is to supply traffic from collector roads to arterial roads, and between urban centers at the highest level of service possible.

In India rapid urbanization and improved socio-economic status from past few decades has resulted in high vehicular growth. India is urbanizing at rapid pace with urban population rising much faster than its total population. Level of urbanization has increased from 17.29% in 1951 to 31.6% in 2011. India is competing with the fastest growing countries in the world. As reported in (National Transit- Oriented Development) NTOD policy (MOUD (Ministry of Urban Development) [2016]), the urban population in India, which is nearly 377 million, is poised to grow to 600 million by 2030.

The urban population of India contributes 65% of country's Gross Domestic Product (GDP), which is expected to grow to 75% as the Indian cities are growing at a rate faster than other cities in the world.

1.1.1 Indian Roads Congress (IRC)

The central govt. established the Indian Roads Congress. In IRC 106-1990 some guidelines are considered by the traffic engineering committee. The guidelines contained in IRC 106 are applicable for mid-block sections of urban roads and will also apply roads in suburban areas.

Scope of project

- Traffic characteristics.
- Traffic studies and analysis.
- Geometric design.
- Traffic operation, regulation and control.
- Road safety aspects.

2. LITERATURE REVIEW

(Nkaro 2004) : Proper utilization of such huge investments necessitates systematic planning for need-based development. Such need-based developments include determination of the required capacity expansion, provision of additional road infrastructure, improvement of existing roads, prioritization of different development phases and forecasting of which is possible upon collection of traffic data. The concept of forecasting the future use of the road network in terms of traffic loading and flow to adopt suitable road traffic methodologies for conducting road traffic surveys, which are both technically and scientifically sound, and operationally convenient to execute under the country's prevailing conditions. This includes the use of both manual and automatic traffic counters, together with computer analysis of the collected traffic data.

(Joshi et al. 2011): Arterials in metropolitan cities are expected to provide mobility to high volume of traffic. Realistic understanding of traffic flow behavior for such vital urban roads is essential for traffic operation planning and management for ensuring desired level of service. Metropolitan cities in India carry variety of vehicles with varied static and dynamic characteristics with predominance of two wheelers. The interaction in the midblock section between different types of vehicles

significantly varies with the flow rate and therefore has varied effect on the equivalency of vehicle and the service volume.

(Patel and Joshi 2012): The study demonstrates the field traffic surveys are carried out to capture the classified volume and speed data through manual as well as video graphic technique. Multi regime speed – flow relation is developed based on time, data extracted from the field survey. Unobserved data is simulated by artificial neural network model. Thresholds of level of service based on volume to capacity ratio established by cluster analysis approach. The result are very useful for evaluation of traffic quality for access controlled urban arterials in mixed traffic condition.

(Varmora, K. and Gundalia 2013): Day by day the traffic of an urban streets increases rapidly .Due to the increase in traffic the problems related to this also become more and more complex . Most of the Indian cities are having heterogeneous traffic which make the use of same road. The area selected for this study was two lane/three lane urban road. Urban as well as rural road networks serve the heterogeneous traffic having a wide range of type of vehicles, characteristics (static as well as dynamic) of vehicles, variation in behavior of drivers. Also there is wide variation in the income of urban people which directly affect ownership of different types of vehicles (i.e., Cars, two wheelers, cycles etc.).

(Karuppanagounder Krishnamurthy and Venkatachalam 2014): The variations in roadway, traffic and environmental factors influence the traffic flow quality significantly. Capacity analysis of road sections under different traffic and geometric conditions need to quantify the vehicles of widely varying characteristics to a common and universally acceptable unit. The knowledge of traffic volume is an important basic input required for accurate estimation of road capacity. Expressing traffic volume as the number of vehicles passing a given section of road or traffic lane per unit time will be inappropriate when several types of vehicles with widely varying static and dynamic characteristics are comprised in the traffic.

(Patel and Joshi 2015): Traffic in the Indian condition is highly heterogeneous in nature and because of the wide ranges of static and dynamic characteristic it is worth to express all the vehicles in the traffic stream in terms of equivalent passenger cars. The vehicle equivalent factor is most likely to vary as the flow rate and speed of the stream which changes from time to time. This is more relevant in urban areas where hourly variations of flow rate are quite significant. Under such circumstances, it is desirable to derive the vehicle equivalent factors which take care of the fluctuations in stream speed and also the speed of the individual vehicles for the urban roadway.

(Dhamaniya and Chandra 2017): The study demonstrates the influence of operating speed on capacity

of a midblock section of urban road. The variation is explained on the basis of city size and driving behavior, which would influence the free flow speed on the road.. An urban arterial in India is a general term denoting an urban street primarily for through traffic, usually on a continuous route. The arterials are generally divided highways with full or partial access. Due to long distances between the intersections and larger speed differential amongst vehicles, platoons get dispersed in the mid portion between the intersections and the midblock section typically operates similar to a suburban section but with mixed traffic of urban characteristics.

(McAndrews et al. 2017): Arterials are types of roads designed to carry high volumes of motorized traffic. They are an integral part of transportation systems worldwide and exposure to them is ubiquitous, especially in urban areas. Arterials provide access to diverse commercial and cultural resources, which can positively influence community health by supporting social cohesion as well as economic and cultural opportunities.

(Yousf 2018): A good percentage of the total number of trips commencing in most of the urban areas of our country is shared by walking and using slow moving vehicles .There is a mixed traffic condition in India consisting of the motorized vehicles like buses, trucks, cars etc. and non-motorized vehicles or slow moving vehicles like cycles, cycle rickshaws and so on. The proportion of the slow moving vehicles is quite significant in most of the urban areas of India and play a very substantial role in meeting the travel demands of an area. When the number of slow moving vehicles increases in a traffic stream, they considerably affect the flow characteristics of that traffic stream like the traffic density, traffic capacity and flow speed.

(Arkatkar 2018): In India rapid urbanization and improved socio-economic status from past few decades has resulted in high vehicular growth. The knowledge of traffic flow characteristics is a very important basic input required for planning, analysis, and operation of roadway systems. . In order to estimate the traffic volume or capacity of roadway sections under heterogeneous traffic conditions, it is necessary to study the interaction between the moving vehicles over a wide range of roadway and traffic conditions.

(Gautam and Jain 2018): Arterials in metropolitan cities are expected to provide flexibility to the high volume of traffic. A realistic understanding of traffic flow behaviour for such essential urban roads is necessary for traffic operation planning and management for ensuring the desired level of service. An arterial road is a high-capacity urban road. The main function of an arterial road is to supply traffic from collector roads to arterial roads, and between urban centers at the highest level of service possible. The relationships among traffic flow characteristics (flow (q), speed (v), and density (k)) are

typically represented graphically and referred to as fundamental diagram. The results are very applicable for estimation of traffic quality for access controlled urban arterials in mixed traffic flow.

(Gulivindala and Mehar 2018): Urban roads in India operate under highly mixed traffic conditions. The traffic conditions some time become more chaotic when side friction plays on these roads. The side friction on a road also acts as bottleneck where the flow of the traffic stream found to be reduced with severity. The any roadway in city turns into congested state as side friction increases due to reduction in capacity. The capacity of roadway is used as an important parameter to measure congestion and level of service (HCM, 2010). Frequent pedestrian movements occur on the side of the roads especially at shopping malls, market areas etc.

(Ankitgupta, SatyajitMondal and Kriti Mahajan 2019): India is a developing country with considerable share of slow moving motorized and non-motorized vehicles along with fast moving traffic observed in almost every region. The effect of Slow Moving Vehicles on mixed traffic flow characteristics of urban arterials and their capacity has been analyzed. Here a mixed composition of traffic with varying speeds is observed including two wheeler motorized and non-motorized vehicles, slow moving cycle rickshaws, autos as preferred public transport facilities due to urban street networks and fast moving small and big cars, light commercial vehicles, buses and heavy vehicles all are observed without any dedicated lanes to follow unlike road infrastructure facilities of developed countries.

(Gaur and Sachdeva 2020): Condition of shoulder and its width affects speed of vehicles, capacity of the road and safe vehicle operation on the road. Similarly, slow moving vehicles of the traffic stream affect the speed, capacity and vehicle operation on the road. It is found that capacity of a road reduces as the shoulder width reduces and its condition changes from good to poor. The slow moving vehicles in the traffic also reduce capacity of the road. Among various factors like carriageway width, traffic mix, speed of traffic, features of the road and other roadway and traffic conditions that affect the capacity of a road, shoulder condition and the proportion of slow moving vehicles in the traffic stream have also been found to affect the capacity of a road.

(Gao et al. 2020): Large vehicles impact the quality of traffic flow. To predict the impact of large-scale vehicles on the average speed of traffic flow, vehicle speeds under different vehicle mixing rates were collected through field observations. A laser roadside traffic survey instrumentality with automatic vehicle type identification functionality was used to collect cross section traffic flow data. The v/C ratio, large vehicle mixing rate, and average speed of traffic were calculated for each data set.

3. CONCLUSIONS

Based on the literature, the following conclusions were drawn:

1. The results from the study of mid-block sections show that the average stream speed is reduced significantly (to minimum of 10km/h), due to the presence of small percentages of slow moving vehicles in the traffic stream at all sites under study.
2. The study of slow moving traffic showed that due to the improper management or non-availability of right of way for slow moving vehicles in urban areas increases the traffic density which leads to congestion and many other traffic related problems.
3. Due to reduction in carriageway width, the traffic stream speed also encounters more congestion level along the length of link
4. As the Volume of Large size and slow moving vehicles increases, the traffic flow as well as the speed decrease
5. Operating speed on a road can change due to many reasons like road condition, side frictions, speed humps, etc. Drop in the operating speed will have influence on capacity of the road.
6. The access controlled arterial road can be the base for capacity calculation of the arterial road with existing traffic, control and roadway condition. The established speed flow relationship will be the ideal for the similar kind of roadway section.

REFERENCES

1. Arkatkar, S. S. (2018). "Traffic operations and capacity analysis in India." *Transportation Letters*, Taylor & Francis, 10(2), 65–67.
2. Dhamaniya, A., and Chandra, S. (2017). "Influence of Operating Speed on Capacity of Urban Arterial Midblock Sections." *International Journal of Civil Engineering*, Springer International Publishing, 15(7), 1053–1062.
3. Gao, C., Xu, J., Jia, X., Dong, Y., and Ru, H. (2020). "Influence of Large Vehicles on the Speed of Expressway Traffic Flow." *Advances in Civil Engineering*, 2020.
4. Gaur, P., and Sachdeva, S. N. (2020). "Effect of Shoulder and Slow Moving Vehicles on Capacity of a Road." *International Journal of Engineering Applied Sciences and Technology*, 04(10), 377–380.
5. Gautam, L., and Jain, K. (2018). "Study on Mixed Traffic Flow Behavior on Arterial Road." *International Journal of Engineering Research & Technology (IJERT)*, 6(11), 1–7.
6. Gulivindala, P., and Mehar, A. (2018). "Analysis of side friction on urban arterials." *Transport and*

- Telecommunication, 19(1), 21-30.
7. Joshi, G., Sinha, V., and Patel, J. (2011). "Heterogeneous Traffic Characterisation and Flow Behaviour Modeling for Metropolitan Arterial in India." *Journal of the Eastern Asia Society for Transportation Studies*, 9, 1684-1699.
 8. Kuo, C.-W., and Tang, M.-L. (2011). "Survey and empirical evaluation of nonhomogeneous arrival process models with taxi data." *Journal of Advanced Transportation*, 47(June 2010), 512-525.
 9. McAndrews, C., Pollack, K. M., Berrigan, D., Dannenberg, A. L., and Christopher, E. J. (2017). "Understanding and improving arterial roads to support public health and transportation goals." *American Journal of Public Health*, 107(8), 1278-1282.
 10. Nkaro, A. (2004). "Traffic Data Collection and Analysis." (99912-0-417-2), 1-54.
 11. Patel, C., and Joshi, G. (2015). "Equivalency Factor Using Optimization for Indian Mixed Traffic Condition." *International Journal for Traffic and Transport Engineering*, 5(2), 210-224.
 12. Patel, C. R., and Joshi, G. J. (2012). "Capacity and LOS for Urban Arterial Road in Indian Mixed Traffic Condition." *Procedia - Social and Behavioral Sciences*, 48, 527-534.
 13. Varmora, K. and Gundalia, P. J. (2013). "Effect of Traffic Composition and Road Width on Urban Traffic Stream Keywords : Heterogeneous Traffic ; Urban streets ; Speed ; Flow ; Traffic Stream ; Vehicle Composition." *Indian Journal of Research*, 2(4), 168-170.
 14. Yousf, A. (2018). "Pedestrian and Slow Moving Traffic Study in Urban Areas." *International Journal for Research in Applied Science and Engineering Technology*, 6(7), 626-631.