Effect of Autorickshaws and Buses on Mixed Traffic Flow - A Case Study of Shivamogga City

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Abstract:- **The mixed traffic which contains different kinds of vehicles with various static and dynamic vehicular characteristics resulting in traffic congestion in the recent years. This paper aimed at assessing the effect of autorickshaws and buses on the speed of mixed traffic flow. Shivamogga, a city in the state of Karnataka, India, is taken as a study area. The traffic volume and speed data are collected through traffic surveys and from secondary sources. The plots between speed-flow relationships are made for all the selected road stretches of shivamogga city. A regression model is then developed using multiple linear regression analysis technique and the percentage reduction in speed due to the presence of autorickshaws in the flow is arrived. The study helped to arrive at a conclusion that as the percentage of autorickshaws increases, the percentage speed reduction also increases and it can also be noted that the speed reduction is negligible up to 8 % of autorickshaws in the stream.**

Keywords: Regression model, speed-flow relationships, Mixed traffic flow.

1. INTRODUCTION

Intermediate public transport (IPT) is a sub-set of Public transport which are provided for short distance travel. In cities like shivamogga Intermediate public transport plays an important role. Auto rickshaws, buses are the forms of IPT popular in shivamogga. The people prefer autorickshaws since they provide door to door service, greater maneuverability in congested areas. These modes of transportation reduce gap between public transportation and demand of people. The modes like city buses are mostly preferred by low income groups since it provides service at a lower cost as compared to other modes.

The operating speed of vehicles for particular width of road depends on volume of traffic on that road. When volume of traffic reduces obstruction to movement is less hence speed is not affected but if the traffic volume increases it causes obstruction in movement hence speed also reduces. Greater the heterogeneity of vehicles greater is the number of obstructions in the traffic flow which leads to reduction in the speed of vehicles.

In the recent years proportion autorickshaws and buses in shivamogga is considerably increasing. These can create adverse traffic condition and reduce speed of fast moving vehicles. That's why effects of autorickshaws such as increment in accidents and decrement in capacity are more evident in intersections. Therefore it is essential to study the effect of auto rickshaws and buses in speed reduction.

1.1. Scope & Objectives of the study

Shivamogga, one of the Indian cities facing a rapid increase in the vehicular population. Lack of proper planning of road networks, design of intersections & traffic management in the city causing congestions & delays. The scope of the study includes assessing the effect of auto rickshaws and buses on traffic flow in the city. Following are the specific objectives of the study:

1. To assess the effect of autorickshaws and buses on speed of traffic flow in shivamogga.
2. To assess the autorickshaws and buses availability pattern.
3. To develop regression model relating percentage of autorickshaws on the road and change in speed of vehicles due to presence of autorickshaws and buses.

1.2. Methodology

Data regarding autorickshaw, buses, other vehicles, population, etc. have been collected through secondary sources like various government departments, their publications and relevant earlier study reports. An opportunity arose on 7th August and 10[th]September 2018 when the autorickshaws and buses went on strike respectively, to protest against increased fuel cost and demanding hike in hire rate. During this period, the study of traffic volume and speed in the absence of autorickshaws and buses were carried out for six selected road stretches of shivamogga city where traffic flow is more. Traffic flow details of these selected roads with autorickshaws and buses in flow were collected for other days. Traffic flow speed trends with and without autorickshaws and buses have been analyzed. A regression model has been developed by relating percentage of autorickshaws on road and change in speed of vehicles due to its presence.

2. STUDY AREA

Shivamogga city is one of the Indian cities located in the state of Karnataka. The city population in 2011 is 322,428. This city has an area of 27.30 sq mile. The main mode of intermediate public transportation in this city is autorickshaws. The main mass transit system in the city is bus.

Shivamogga city also being a administrative headquarter of shivamogga district has various type of Public & private establishments. Most of them are located within the CBD

area. Five road sections in the shivamogga city are selected for the study based on the criteria of high traffic volume. They are Shivamurthy circle, Mahaveer circle, Gopi circle, Amir Ahmed circle, Sagar road. Shivamurthy circle is one of the major road in shivamogga, which has many commercial building and popular medical care centers of the city. Mahaveer circle section has some educational institutes and some important government buildings like District court and Deputy Commissioner Office. Gopicircle is one of the main commercial roads in shivamogga city and also has main cinema theatre of the city. Sagara road is one of major roads in the city for public transport system and also includes government buildings such as police station. Amir Ahmed road has some religious holy places and a city center mall, in addition to that its an old part of city which includes city market which is densely populated most of the time in a day.

3. DATA COLLECTION

The data utilized in this study is collected by the following surveys:

1) Traffic volume survey.
2) Traffic speed survey.

3.1. Traffic volume survey

The traffic flow on the day of strike i.e., 7th August 2018 (without autorickshaw was obtained from the videography data from the SP office and also manual count of traffic was taken for 6 hours on another strike day on 10th September 2018 for both direction of selected road stretches. The volume count of all the vehicles except autorickshaw and buses has been taken. The traffic volume count on normal day has also been made by considering all types of vehicles. The traffic counts are represented in terms of equivalent passenger car unit.

1.2. Traffic speed survey

The speed studies are conducted during the peak hours and non-peak hours, for two situations with and without auto rickshaws and buses in traffic streams. For preparing the speed flow diagram the space mean speed is required. The mean speeds of selected sample of vehicles are obtained by using Rader gun. The sample of vehicles selected randomly making sure that it includes all type of vehicles. Hourly mean speed is the average speed of the flow and the same has been calculated. It was observed that the speed varies from 15 to 45 kmph for the selected road stretches of shivamogga city.

4. TRAFFIC FLOW COMPOSITION ON SELECTED ROUTES

The observations from the volume study made for the selected road stretches are as follows:

a) Light fast moving vehicle constitute the major portion of the total traffic.
b) Out of total traffic two wheelers are comparatively more.
c) Cycle and other non-motorized vehicles are very less.

d) Heavy vehicles constitute less than 10% of total traffic.
e) Autorickshaws and bus population is about 1/4th of the total traffic.

5. SPEED-FLOW RELATIONSHIPS FOR SELECTED ROUTES

The speed study data collected for peak and non peak hours for the selected road stretches are analysed. Speed-Flow curves are made with the help of the collected data. The speed-flow diagrams are shown in Fig 1 to 5 for Motorized vehicles. The Plots of speed of the stream in kmph vs. Hourly traffic flow (PCU/hr) are prepared from the collected data for both with and without autorickshaws.
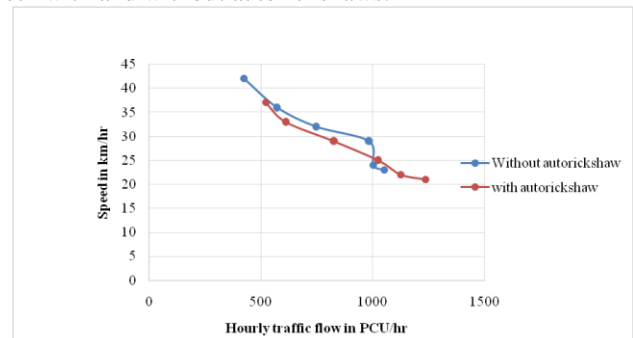

Fig.1. Speed-flow relationship for Ameer Ahmed circle to Gopi circle
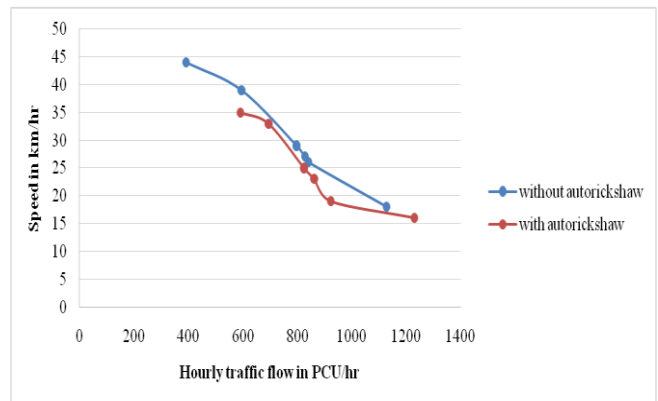

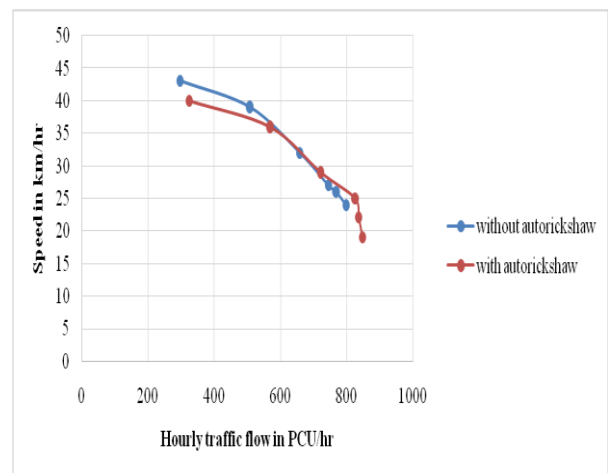Fig.2: Speed-flow relationship for usha nurshing home to shivamurthy circle

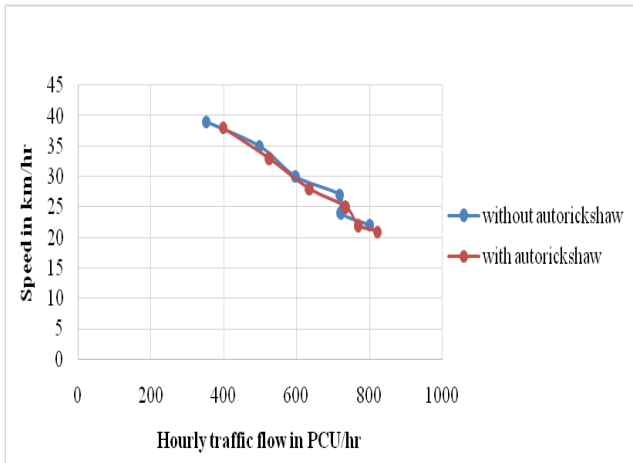Fig.3: Speed-flow relationship for mahaveer circle to gopi circle.

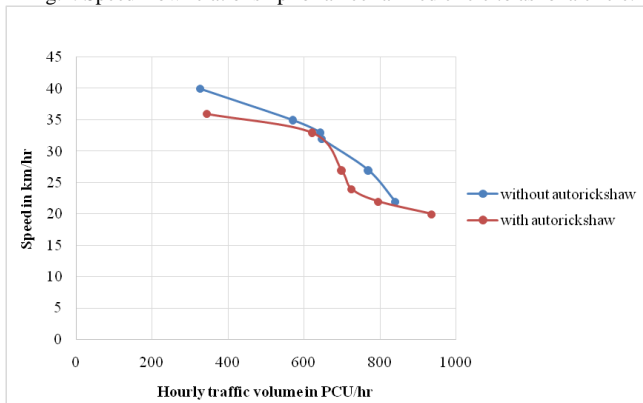Fig.4: Speed-flow relationship for ameer ahmed circle to ashoka circle.

Fig.5: Speed-flow relationship for shivamogga bus station to sagar road

Such plots are made for the five selected roads. The plots of motorized conditions show that the stream speed with autorickshaws is less than that without autorickshaws for all the stretches. Thus it can be said that the speed of fast moving vehicles get reduced with the presence of autorickshaws.

6. DEVELOPMENT OF REGRESSION MODEL

Multiple linear regression analysis has been extensively used in traffic engineering problems and has been found to be more suitable for the present study.

Speed-flow relationships for the five selected roads show that for the same hourly traffic flow in PCU/hr, speed with and without autorickshaws are different. Speeds of

vehicles corresponding to certain PCU values with known percentage of autorikshaws are calculated from the plots. Then the speed of the stream without autorickshaws was found from the same curve for the same PCU value, as above. The two speeds, with and without autorickshaws, for the same PCU values were considered for comparision. So in the present study the data has been statistically analyzed to study the impact of autorikshaws in traffic flow.

Percentage reduction in speed due to the presence of autorickshaws in traffic flow is considered as dependent variable. The percentage of autorickshaws in the flow, corresponding to the above points is considered to be the independent variable.

The speed reduction model for the Shivamogga city is as shown in Fig 11. The figure depicts the variation of the percentage of speed reduction, with respect to the percentage of autorickshaws in the flow. From the model it is clear that for 4 to 8 percent of autorickshaws present in the stream the percentage of speed reduction becomes negligible. If the percentage of autorickshaws in the traffic stream increases above this value, the speed reduction at starts to increase. The data used to develop this model is given in table 1. From the figure it is clear that as the percentage of autorickshaws in the total traffic mix increases, the percentage speed reduction also increases. It can also be noted that the reduction in speed will be negligible for 8 % of autorickshaws in the stream.
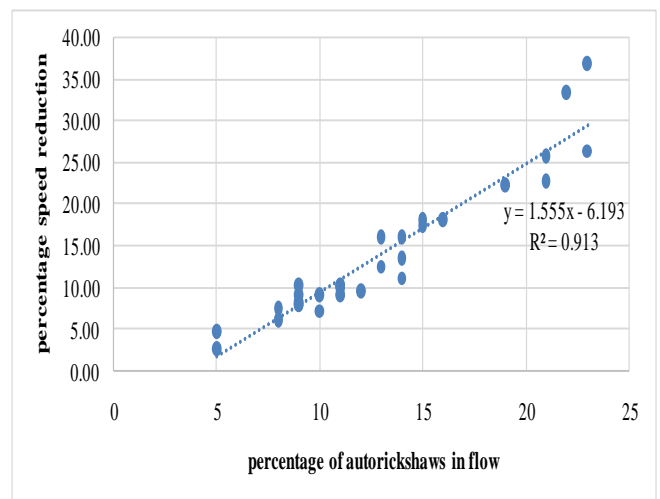

Fig.11.Percent speed reduction vs percentage of autorickshaw in traffic flow for shivamogga city

Table.1. DATA FOR MODEL DEVELOPMENT

PCU/hour corresponding to the points in the speed flow curve with known value of percentage of autorickshaws	Percent of Autorickshaw in flow	Speed with autorickshaw (from speed flow graph)	Speed without autorickshaw For same PCU value	Percentage speed reduction
522	14	37	42	13.51
611	10	33	36	9.09
825	9	29	32	10.34
1023	14	25	29	16.00
1125	9	22	24	9.09
1235	12	21	23	9.52
592	21	35	44	25.71
695	15	33	39	18.18
825	13	25	29	16.00
862	15	23	27	17.39
923	23	19	26	36.84
1230	13	16	18	12.50
325	8	40	43	7.50
568	9	36	39	8.33
721	11	29	32	10.34
825	9	25	27	8.00
836	16	22	26	18.18
847	23	19	24	26.32
400	5	38	39	2.63
525	8	33	25	6.06
635	10	28	30	7.17
735	9	25	27	8.00
769	11	22	24	9.09
822	5	21	22	4.76
344	14	36	40	11.11
621	8	33	35	6.06
699	19	27	33	22.22
725	22	24	32	33.33
796	21	22	27	22.73
936	11	20	22	10.00

7. CONCLUSIONS.

1. Volume study reveals that auto rickshaws constitute one-fourth of the total vehicles on traffic flow in the selected stretches.
2. Moderate variation were observed in the total number of vehicle, when the traffic volume studies for both situations with and without buses and auto rickshaws were conducted on the six selected stretches. It is also seen that in absence of buses and auto rickshaws, other light fast vehicles like two wheelers, cars, jeeps, etc. increased in number, to a certain extent.

3. Speed-flow relationships for selected stretches reveal that there is reduction in speed of the stream due to presence of buses and auto rickshaws. These also show that for same value of PCU, speed with and without buses and autorickshaws is different
4. An attempt has been made to develop a speed reduction model the percentage speed reduction due to presence of autorickshaws is very less for 4-8 percent of this mode in traffic stream.

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