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THE STUDY OF THE FACTORS AFFECTING THE PASSAGE OF URBAN PUBLIC TRANSPORT

P.A. Tonapetyan[1], K.A. Grigoryan[2], M.T. Hayrapetyan[2]
[1]*Armenian National Agrarian University*
[2]*Shushi University of Technology*

The number of means of passenger transport is constantly increasing in the cities as a result of which road network has become overloaded to such an extent that there are problems with the management of public transport routes connected with the sharp increae of private transport, the increase of traffic of route transport and traffic management at bus stops which do not meet the current situation.

It is suggested to determine the service time of passengers according to the routes and means of public transport in public transport stops in the conditions of high intensity and heavy traffic of urban passenger transport using the coefficients of possible rejection of service and variation applications.

Key words: road network, heaviness, traffic, intensity, parking space, passage.

Introduction

The number of means of passenger transport is constantly increasing in cities and the road network remains almost unchanged. Currently, the heaviness of the city road network has reached such a level that there are problems with the management of public transport. These problems are caused by a number of reasons, for instance, the number of private transport routes and the intensity of public traffic have sharply increased. As a result there are problems with the management of road traffic at bus stops which do not meet the current situation. The stops themselves cause traffic jams.

The following measures are necessary for solving the studied problem:

- Concentration of routes in a more number of streets, i.e. reduction of the route coefficient,
- Increasing the passage of the transport stops.

The first of these measures is related to the length of the route network and can be planned for long term perspective. The second measure, although leading to limited efficiency, /i.e. high passage/, can be used in not all areas of the route network in a short period of time and soon give results.

The analyses of domestic and foreign literature have shown that the management of the public transport route has not been extensively studied in the current intensity of the city. In the last 30 years no calculations of stop passages have been made and implemented in the project. A number of parameters concerning parking space passages and projects were not taken into account in the instructions of the local specialists which principally are very important in the case of heavy traffic flows.

Conflict setting and research results

The foreign theory and experience are of great interest in the design of urban passenger transport stops in the current situation, particularly the methodology of estimating the passage of the stops recommended by US scientists [1]. Some basic facts about the activity of stops are decribed in details here. These data are very easy to compare with the experimental data obtained as a result of studies conducted in the conditions of our republic.

To determine the passage of stops the model given in [1] has been chosen:

$$B_s = N_{eb} \cdot B_{bb} = N_{eb} \cdot \frac{3600 \cdot \left(\frac{g}{c}\right)}{t_c + \left(\frac{g}{c}\right) \cdot t_d + Z_a \cdot C_v \cdot t_d}, \quad (1)$$

where B_s is the passage of stop, unit/h, N_{eb} is the efficient number of places in the stops, B_{bb}-is the passage of one place in the stop, unit/h, g - is the duration of green light by seconds, C – is the duration of regulatory cycle, seconds, t_c- is the time of leaving the parking place, seconds, t_d - is the passenger service time in the parking place , seconds, Z_a –is the coefficient of possibility of overcroudedness of stops, C_v- is the coefficient of variability of passenger service time in stops.

It is worth mentioning that a great number of parameters are taken into account by the observed calculation methodology. Such parameters as Z_a – the coefficient of the possibility of overcroudedness, t_c- is the time of leaving the stop, the time of passenger service and the duration of green light and the relation of regulatory cycle to controlled crossings are of special interest. These data can be admitted as a result of direct observations. We should also mention here that as a resut of our studies we noted distribution of passenger service time at stops in t_d- parking space which is the result of variability of exploited driving stuff and traffic management.

The time of leaving the stop is considered to be the time from the starting moment of bus leaving to the time of its entry into the general traffic flow (Fig. 1). It consists of the time from the beginning of the movement, the time spent at the stop, the time it takes to get the passengers off, the time to get the passengers on and the time to get into the general traffic flow.

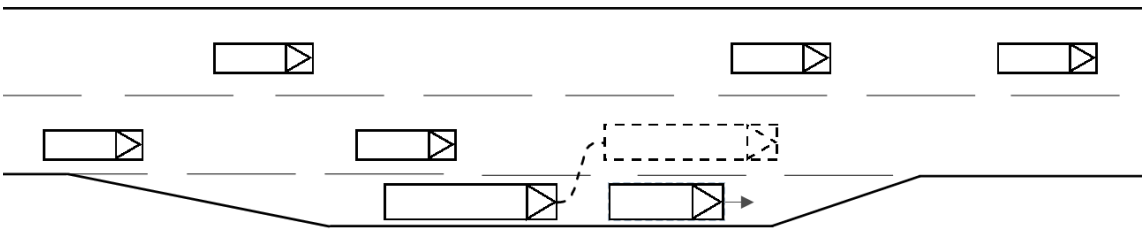

Fig. 1 The formation of the time for leaving the stop time

In this methodology only one factor is observed: the intensity of the total flow in the right edge zone which affects the freeing time of the stop. Such acceptance is correct in the case of using such moving staff with similar or technical characteristics. However, passenger transportation is carried out by various means of transport, according to the types, brands, number of gates and so on in our cities.

Practical research has shown that the freeing of a stop is affected by both means of vehicles, their technical characteristics (coefficient of dynamics and sizes are different) and the problem of overtaking the vehicles ahead for which more time is spent.

To determine the time of freeing the stop we may use the following regressive equation more effectively [2,3,4].

$$t_c = B_0 + B_1 \cdot X_1 + B_2 \cdot X_2 + B_3 \cdot X_3 = 0.003 \cdot N + 0.056 \cdot Q + 6.53 \cdot i \,, \qquad (2)$$

where $B_{0,1,2,3}$ –are the coefficients of regressive equations, $X_{1,2,3}$ –are independent factors, N –is the intensity of general traffic flow in right egde, Q –is the namely passenger carriage of transport means, i –is a factor which considers the factor of overtaking.

In the chosen model (1) by saying the time of passenger service at stops we understand the period of time from the moment of opening the doors to closing the doors. The dimension of time spent mainly depends on the number of passengers getting on and off and, more precisely, the average time of one passenger getting on and off. Mathematically it may be shown like this:

$$t_d = P_a \cdot t_a + P_b \cdot t_b + t_{oc}, \qquad (3)$$

where P_a –is the number of passengers getting off the bus, per passenger, t_a –is the time spent on getting one passenger off, second, P_b –is the number of entering passengers, per passenger, t_b –is

the time spent on getting on one passenger, second, t_{oc} – is the time spent on opening and closing the doors, second.

Experimental data show that the time to open and close the doors of many buses coincides with the time to approach the stop or to free the stop which is unacceptable from the point of view of passenger safety. Therefore, the total time spent on passenger service may not include the time spent on opening and closing the doors.

It is suggested to understand the saying *service time of the passengers* as the time from the moment the bus stops at the bus stop to the time spent on freeing the stop.

It is accepted that the time spent on opening and closing the doors is already taken nto account. Particularly it turned out that the average time spent on opening doors comprised 1,95 seconds and 1,55 seconds correspondingly for special small class vehicles (public taxis) and the buses having hydraulic system, and on closing doors 1,35 and 1,93 seconds respectively. As different technical characteristics and various staff are used in the town public transport of RA, so the time of passenger service will also be different. There are also other factors which affect certain parameters such as number of doors and passenger bill.

Based on the above mentioned, it is necessary to take into account the cases when it turns out that all the seats are busy there while approaching the bus stop. Because different classes of vehicles have different dimensions of passenger service time at the bus stops depending on the dimension of the difference of route demand, the type of driving staff and other factors, the impact of passenger time variation is of great importance.

C_v variation coefficient of observed parameter may be defined as relation of deviation of passenger service time and average value:

$$C_v = \frac{S}{\bar{t_d}}, \tag{3}$$

where S–is the deviation of passenger service time and $\bar{t_d}$ – is average time of passenger service, seconds.

If the C_v coefficient of variation is equal to 0, then all the observed cases will have the same value. In case when C_v-is equal to 1, it means that approximately every third bus will have twice more time for passenger service than its average value is. The research carried out in the USA shows that the coefficient of time variation of passenger service fluctuates between 0,4 – 0,8 and in case of lack of studies we suggest to use 0,54 [1].

To increase the reliability of passenger service time at stops while calculating passage Z_a coefficient of possibility of rejecting service applications changes (Fig.2). The underlined part shows that the time of passenger service in some cases may exceed its average value:

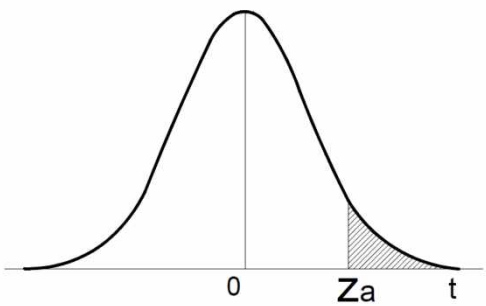

Fig. 2 Normal distribution

The coefficient of possibility of rejecting the passenger service applications at stops may be defined by the following expression:

$$Z_a = \frac{\Delta t_i}{S} = \frac{t_i - \overline{t_d}}{S}, \quad (4)$$

where t_i –is the random dimension of service time, seconds, Δt_i –is the deviation from average 2 $\overline{t_d}$ value, seconds and S –is the standard deviation.

Consequently

$$S = C_v \cdot \overline{t_d}, \quad (5)$$

Deviation is $\Delta t_i = t_i - \overline{t_d}$, $\Delta t_i = S \cdot Z_a = C_v \cdot \overline{t_d} \cdot Z_a$

According to [1], the possibility of rejecting the applications of stop service in central parts of the town (business-centres, public crowded places etc) is about 7,5 to 15%. Such data is obtained in case of communication speed and high stop passages in central parts of towns. The possible heaviness of stop in the edges of road network comprises 2,5%.

In case of the lack of studies we suggest to accept the average time of passenger service as 26,5 s and the coefficient of variation as 0,54.

Conclusions

1. It is necessary to distinguish between the service time of passengers by routes and vehicle classes which can be determined with the help of the variation coefficient in the high intensity of urban public transport, heavy traffic and the variety of routes. According to experimental data, the value of this coefficient varies from 0,4 to 0,8. It is recommended to use the value of 0,54 in case of lack of studies.
2. In case of normal distribution of time of passenger service (Z_a) coefficient of possibility of rejecting the sevice applications may be used. The value of this coefficient is guaranteed from 7,5 to 15% in central parts of towns (business centres, public crowded places etc).

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ՔԱՂԱՔԱՅԻՆ ՈՒՂԵՎՈՐԱՏԱՐ ՏՐԱՆՍՊՈՐՏԻ ԿԱՆԳԱՌՆԵՐԻ ԹՈՂՈՒՆԱԿՈՒԹՅԱՆ ՎՐԱ ԱԶԴՈՂ ԳՈՐԾՈՆՆԵՐԻ ՈՒՍՈՒՄՆԱՍԻՐՈՒԹՅՈՒՆ

Պ.Ա. Տոնապետյան[1], Ք.Ա. Գրիգորյան[2], Մ.Թ. Հայրապետյան[2]
[1]Հայաստանի ազգային ագրարային համալսարան
[2]Շուշիի տեխնոլոգիական համալսարան

Քաղաքներում անընդհատ աճում են ուղևորատար ավտոտրանսպորտային միջոցների քանակը, արդյունքում ճանապարհափողոցային ցանցի բեռնվածքը հասել է այն մակարդակի, որ առաջացել են հասարակական օգտագործման ուղևորատար տրանսպորտի երթևեկության կազմակերպման խնդիրներ, կապված մասնավոր ուղևորատար տրանսպորտի երթուղիների քանակի կտրուկ աճի, երթուղային տրանսպորտի երթևեկության ինտենսիվության մեծացման, ինչպես նաև քաղաքային ուղևորատար տրանսպորտի կանգառներում երթևեկության կազմակերպման հետ, որոնք չեն բավարարում ստեղծված իրավիճակներին:

Առաջարկվում է քաղաքային ուղևորատար տրանսպորտի բարձր ինտենսիվության, խիտ հոսքերի և երթուղիների բազմազանության պայմաններում, քաղաքային ուղևորատար տրանսպորտի կանգառներում ուղևորների սպասարկման ժամանակը որոշել ըստ երթուղիների և տրանսպորտային միջոցների դասերի, օգտվելով վարիացիայի և սպասարկման հայտերի մերժման հավանականության գործակիցներից:

Բանալի բառեր. ճանապարհափողոցային ցանց, բեռնվածք, երթևեկություն, ինտենսիվություն, կանգառ, թողունակություն:

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ИССЛЕДОВАНИЕ ФАКТОРОВ, ВЛИЯЮЩИХ НА ПРОПУСКНУЮ СПОСОБНОСТЬ ОСТАНОВОК ГОРОДСКОГО ПАССАЖИРСКОГО ТРАНСПОРТА

П.А. Тонапетян[1], К.А. Григорян[2], М.Т. Айрапетян[2]
[1] Национальный аграрный университет Армении
[2] Шушинский технологический университет

Количество пассажирских транспортных средств в городах непрерывно увеличивается, в результате чего нагрузка на дорожно-уличную сеть достигла такого уровня, что возникли проблемы с организацией движения общественного пассажирского транспорта, связанные с резким увеличением количества маршрутов частного пассажирского транспорта, увеличением интенсивности движения маршрутного транспорта, а также с организацией движения на остановках городского пассажирского транспорта, которые не удовлетворяют создавшейся ситуации.

В условиях высокой интенсивности городского пассажирского транспорта, плотного потока и разнообразия маршрутов, рекомендуется определять время обслуживания

пассажиров на городских автобусных остановках в соответствии с маршрутами и классами транспортных средств, используя коэффициенты вероятности вариации и отказа сервисных заявок.

Ключевые слова: дорожно-уличная сеть, нагрузка, движение, интенсивность, остановка, пропускная способность.

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