Scientific Journal of Silesian University of Technology. Series Transport
Zeszyty Naukowe Politechniki Śląskiej. Seria Transport

Volume 108 **2020**

p-ISSN: 0209-3324

e-ISSN: 2450-1549

DOI: https://doi.org/10.20858/sjsutst.2020.108.10

Journal homepage: http://sjsutst.polsl.pl

Article citation information:
Kurganov, V., Gryaznov, M., Davydov, K., Polyakova, L. Increased efficiency and reliability of maintanance of mass passenger flow with the regular route network of city transport. *Scientific Journal of Silesian University of Technology. Series Transport*. 2020, **108**, 107-119. ISSN: 0209-3324. DOI: https://doi.org/10.20858/sjsutst.2020.108.10.

Valery KURGANOV[1], Mikhail GRYAZNOV[2], Kirill DAVYDOV[3], Liliya POLYAKOVA[4]

INCREASED EFFICIENCY AND RELIABILITY OF MAINTANANCE OF MASS PASSENGER FLOW WITH THE REGULAR ROUTE NETWORK OF CITY TRANSPORT

Summary. This study is aimed at improving the methods of carriage of passengers by urban transport to improve its reliability and efficiency. It can be achieved by forming back-up bus routes within the existing regular route network for servicing mass passenger-flows. This study theoretically substantiates the impact of back-up bus routes in the current regular route network on the reliability and efficiency of the transport process. Mathematical models of reservation of regular route network and the assessment of the reliability of passenger transport using different reservation schemes are suggested. Methodological recommendations on the formation of passenger traffic on back-up bus routes and cost reduction on its maintenance, by managing the route speed depending on the loading of the city road network, have been developed. Technical and economic evaluation was conducted to the developed methodological toolkit.

Keywords: urban transport, route network, bus transportation, reliability of transport process, efficiency of transportation, back-up bus routes

[1] Tver State University, Tver, Russia. Email: glavreds@tvcom.ru
[2] Nosov Magnitogorsk State Technical University, Magnitogorsk, Russia. Email: gm-autolab@mail.ru
[3] LLC «Avtodorkomplekt». Magnitogorsk, Russia. Email: davyd_mazda@mail.ru
[4] Nosov Magnitogorsk State Technical University, Magnitogorsk, Russia. Email: lilitmgn@mail.ru

1. INTRODUCTION

Passenger traffic is the movement of passengers in the direction of the routes of the regular route network of urban transport. The sign of mass passenger flows or the flows with a great concentration of passengers is the presence of large centres of their attraction in the city. Such a centre can be an industrial zone, which houses several large enterprises, residential areas, trade and entertainment complexes, and sports and leisure facilities popular with the citizens. An example of a large centre of passenger traffic attraction is the city’s core enterprise, located in the urban area, which is a workplace for the majority of the city's residents.

The presence of mass passenger flows in the city determines the pendulum principle of their formation on several directions of the regular route network at certain periods of the day, depending on the time of operation of these centres of attraction. Priority in the maintenance of mass passenger traffic significantly reduces the efficiency of the regular route network of urban transport. Consequently, the population loses interest in urban transport as a reliable and affordable means of transportation. Consequently, the city's residents choose personal transport for their trips, which causes a decrease in the volume of traffic on the regular route network and loss of commercial appeal of urban transport for business.

Modern scientific literature proposes some ways of improving the efficiency of passenger traffic in cities, mostly at the expense of addressing sustainable urban transport [1, 2], increasing the level of informatisation of transport processes [3, 4, 5], surveys on the population's preferences in the choice of urban transport [6, 7], the formation of urban transport network [8, 9], the analysis of road transport companies operation [10, 11]. Despite the existence of a theoretical framework, the proposed method of improving the efficiency of passenger transport, including bus transport, does not entirely consider the aspects of ensuring the reliability of the transport process.

The problem of ensuring reliable transport processes and systems is studied by contemporary researchers, the examples of these researches are the following works [12, 13, 14]. Reducing the cost of transport work, without prejudice to the volume and reliability of transport is achieved by reducing the number of structural elements in the transportation process. Within the current regular route network, this effect is achieved through a reservation, which involves the formation of backup channels for the delivery of passengers to compensate for the losses of productivity of the basic mode of urban transport, caused by a decline in passenger traffic or congestion.

Currently, the impact of backup delivery channels on the reliability and efficiency of transport process has not been investigated. Moreover, the existing methods for coordinating regular transport routes do not consider the additional costs, associated with the formation of standby delivery channels within the existing regular route network, as well as the consequences of their malfunctioning. In this respect, the subject of our study is relevant.

2. METHOD OF RESEARCH AND VERIFICATION

Theoretical studies were based on the analysis of scientific literature, regulatory and technical documentation, legal framework, the concepts of the theory of reliability of technical and transport systems, and the systemic analysis of transport processes. The analysis of scientific, regulatory and technical and legal literature has allowed determining the depth of the problem of improving the efficiency and reliability of passenger transport in cities, as well as to define the purpose of this study.

The study of the main concepts of the theory of reliability of technical and transport systems, as well as the system analysis of transport processes, allowed us to justify the impact of reserve regular bus routes on the reliability and efficiency of passenger transport.

Pilot studies were carried out in laboratory and road conditions using economic-mathematical modelling, the methods of probability theory and mathematical statistics, computer modelling, the feasibility study, the analysis of passenger flows, and the field data. Through these research methods, the authors obtained the mathematical models of reservation of the regular route network and the assessment of the reliability of passenger transport using different reservation schemes. The adequacy of the proposed mathematical models has also been assessed. Moreover, via computer-aided simulation, we have established the dependence of traffic flow on its density, as well as the dependence of the technical speed of the bus on the additional roads on the density of the flow of vehicles.

The raw data for computer-aided simulation were obtained by the *in situ* observations of the traffic flows on urban highways, as well as by direct counting of passenger traffic correspondence on regular routes of urban transport.

The feasibility study made it possible to justify the value of the practical implementation of the proposed tools and materials.

The reliability of the obtained results is confirmed by the validity of accepted assumptions in the development of mathematical models, by the coincidence of the results of our theoretical and experimental research with the data of well-known academic works of other authors.

3. MODELLING

The justification for the impact of the reserve bus routes in the current regular route network on the reliability and efficiency of the transport process requires the analysis and understanding of these concepts. According to the theory of reliability, a reservation is a way of improving the reliability of processes and systems by the inclusion of backup elements during the development or operational phases. The reservation scheme of a regular route network, which determines the operational costs and reliability of the transport process, is a way of connecting its core and duplicating (reserve) structural elements and their connections, called delivery channels. The operational costs and the reliability of the transport process, determine its efficiency; first, as a measure of total costs; second, as the indicator of the number of failures in the transport process and the cost of their elimination.

The analysis of the concepts under consideration makes it possible to determine their hierarchy of relationship as represented by the Euler diagram (Fig. 1).

The reservation scheme of a regular route network depends on the mode of resource consumption (Tab. 1).

The back-up regular bus routes are characterised by the following features: the coincidence of the part of the length and the synchronisation of traffic schedules with the main routes of urban transport; the arranging of drop-off/pick-up of passengers in any place not prohibited by traffic regulations; the ability to control the route speed by redirecting the flow of route vehicles on additional roads of the city road network during its loading.

We believe that the choice of the reservation scheme of a regular route network should be based on mathematical modelling.

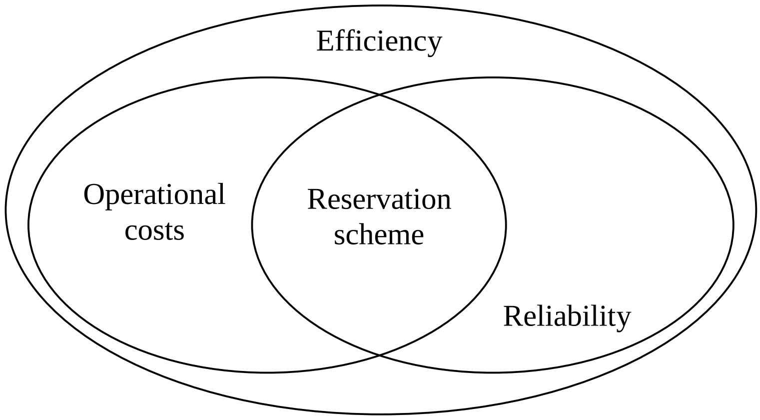

Fig. 1. Euler Diagram illustrating the hierarchy and relationship of the concepts under consideration

Tab. 1

Reservation regimes for the regular urban transport route network

Features	Resource consumption scheme	
	Regular	Resource-efficient
Reservation principle	Build-up of rolling stock on the line in the absence of back-up bus routes	The organisation of back-up bus routes
Reservation regimes	Schemes with a series-parallel arrangement of elements	Majority replacement schemes

The target function of the model is to minimise the total cost (C_{total}), which is defined as the amount of cost spent on building transport infrastructure to organise the bus traffic on reserve routes ($C_{bilding}$), operating costs for transportation (C) and the cost of eliminating failures when operating on contingency routes ($C_{failure}$):

$$C_{total} = C_{bilding} + C + C_{failure} = \frac{D \cdot C_I}{365 \cdot K} + \\ + \frac{E_{wages} + E_{contribution} + E_{fuel} + E_{oil\ servise} + E_{tires} + E_{repair} + E_{shock\ absorption} + E_{other\ costs}}{S} + \\ + \frac{F_\Sigma \cdot T \cdot Q_D \cdot D \cdot Q(t) \cdot (1 + 0,01 \cdot \gamma)^{\frac{D}{365}}}{100} \to \min, \quad (1)$$

where D – the length of the period under review [days]; C_I – the overall cost of infrastructure, necessary to organise the movement of buses on back-up routes, [rub.]; K - the useful life of infrastructure for depreciation groups [years]; к – the number of depreciation groups under consideration; E_{wages}, $E_{contribution}$, E_{fuel}, $E_{oil\ servise}$, E_{tires}, E_{repair}, $E_{shock\ absorption}$, $E_{other\ costs}$ – the expenses, respectively, for the wages of drivers and conductors, extrabudgetary contributions, fuel costs, oil service, wear of tires, shock absorption, other costs in the amount of indirect costs for the vehicle fleet, [rub./km]; S – bus mileage for the period, [km]; F^Σ – the total amount of fines or compensations for violations in the transport process through the fault of the carrier, [% from the traffic fare]; T – traffic fare and baggage charges, [rub.];

Q_D – passenger flow for the period, [person]; *Q(t)* – transportation reliability; γ – annual interest rate on capital, [%].

The system of restrictions enforces compliance with the quality of transport services of the urban population in terms of conformity with the transport interval, as well as the performance of contractual obligations on the volume of traffic, the cost and the number of buses on back-up routes:

$$\begin{cases} I \le I_s \\ \dfrac{C_{total}}{Q_D} \le \dfrac{T}{(1+0,01\cdot R)} \\ A \ge \sum\limits_{i=1}^{h} A_{hi} + \sum\limits_{j=1}^{l-h} A_{(l-h)j} \end{cases} \qquad (2)$$

where I, I_s – the suggested and specified interval of movement, [min.]; R – transportation profitability, [%]; A – the number of vehicles required to service a passenger flow, [pcs.]; A_h – the number of vehicles on major routes, [pcs.]; $A_{l\text{-}h}$ – the number of buses on back-up routes, [pcs.]; h – the number of main routes, [pcs.]; $(l - h)$ – the number of back-up routes, [pcs.]; l – the amount of basic and reserve routes, [pcs.].

The failure probability in the transport process *Q(t)* is determined by the reliability of passenger transport. When there are no back-up routes, the regular route network has a consistent parallel structure. We believe that evaluation of reliability for the carriage of passengers if there are contingency routes in the regular route network, should be based on the calculation of the reliability of the majority replacement schemes (Fig. 2) based on the rule of total probability of compatible events.

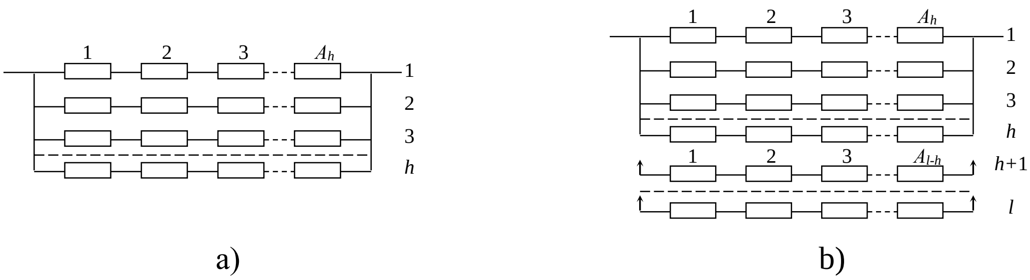

Fig. 2. The structure of a regular route network in the aspect of ensuring the reliability of passenger transport: (a) without back-up routes; (b) with back-up routes

Thus, we offer to assess the reliability of passenger transport using a mathematical model:

- a regular route network without contingency routes:

$$P(t) = 1 - Q(t) = 1 - (1 - P_i^{A_h})^h, \qquad (3)$$

where P_i – the probability of a fail-free operation of a bus on the main route.

- a regular route network with contingency routes:

$$P(t) = 1 - Q(t) = 1 - \left[(1-(1-P)^{A_h}) + (\sum_{j=1}^{l-h} P_j^{A_{l-h}} \cdot (1-P_j^{A_{l-h}})) \cdot (1-P)^{A_h} \right], \quad (4)$$

where P_j – the probability of a fail-free operation of a bus on the back-up route.

Positive results of verification of the proposed model of quantitative evaluation of the reliability of passenger transport based on Fisher's criterion prove its appropriateness.

4. PASSENGER FLOW FORMATION ALGORITHM ON BACK-UP BUS ROUTES

The formation of ridership on back-up bus routes is based on the analysis of the compatibility of existing urban transport route network with the needs of the population in their labour movements. Passenger traffic is not mastered by the main regular routes, after its detail on the periods of the day, can be potentially mastered on back-up routes.

Reducing the cost of servicing the passenger traffic on contingency bus routes is achieved by maintaining a specified interval of traffic with fewer buses. This is achieved by increasing the average traffic speed resulting in the direction of buses on additional roads during road loading.

The procedures are implemented according to the algorithm (Fig. 3).

In the first stage of the proposed algorithm, analysis of the compliance of the urban transport route network to the needs of the population in their labour movements is carried out. Based on the results of the performed analysis, on the second stage, is determined the passenger flow, which is not mastered by the main regular routes. Its detail is defined on the periods of the day and the trace of the back-up bus routes is conducted within the framework of the current route network. The third stage provides the mode of resource-saving passenger services on back-up routes by controlling the route speed of buses. The result of the algorithm is the development of the passenger schedule for the bus traffic on back-up routes.

The conformity assessment of the major urban transport routes to the needs of the population in their labour movements is made by the coefficient:

$$\varphi = \frac{Q_{comf.}}{n}, \quad (5)$$

where $Q_{comf.}$ – the number of people who have passed through the checkpoints of the enterprises, and whose waiting time of the vehicle at the stops of the regular route network does not exceed the time of comfortable waiting, person/24 hours; n – the total number of transactions of entrances and exits through the checkpoints per day.

The waiting time for the passengers of the vehicle at the stop (t) is determined on the basis of the survey of the passenger flows. The time of comfortable waiting ($t_{comf.}$) is set by the survey of the citizens' public opinion conducted by the specialists of the municipality. The value (φ) is smaller than 1,0 and shows the inconsistency of the urban transport network with the needs of the population in their labour movements and the importance to organise the back-up bus routes. The resource-saving mode of passenger traffic on back-up routes is achieved by the direction of buses on additional roads of the city road network during the periods of its loading. This allows for avoiding the need to increase the number of buses for maintaining a predetermined traffic interval by increasing the route speed.

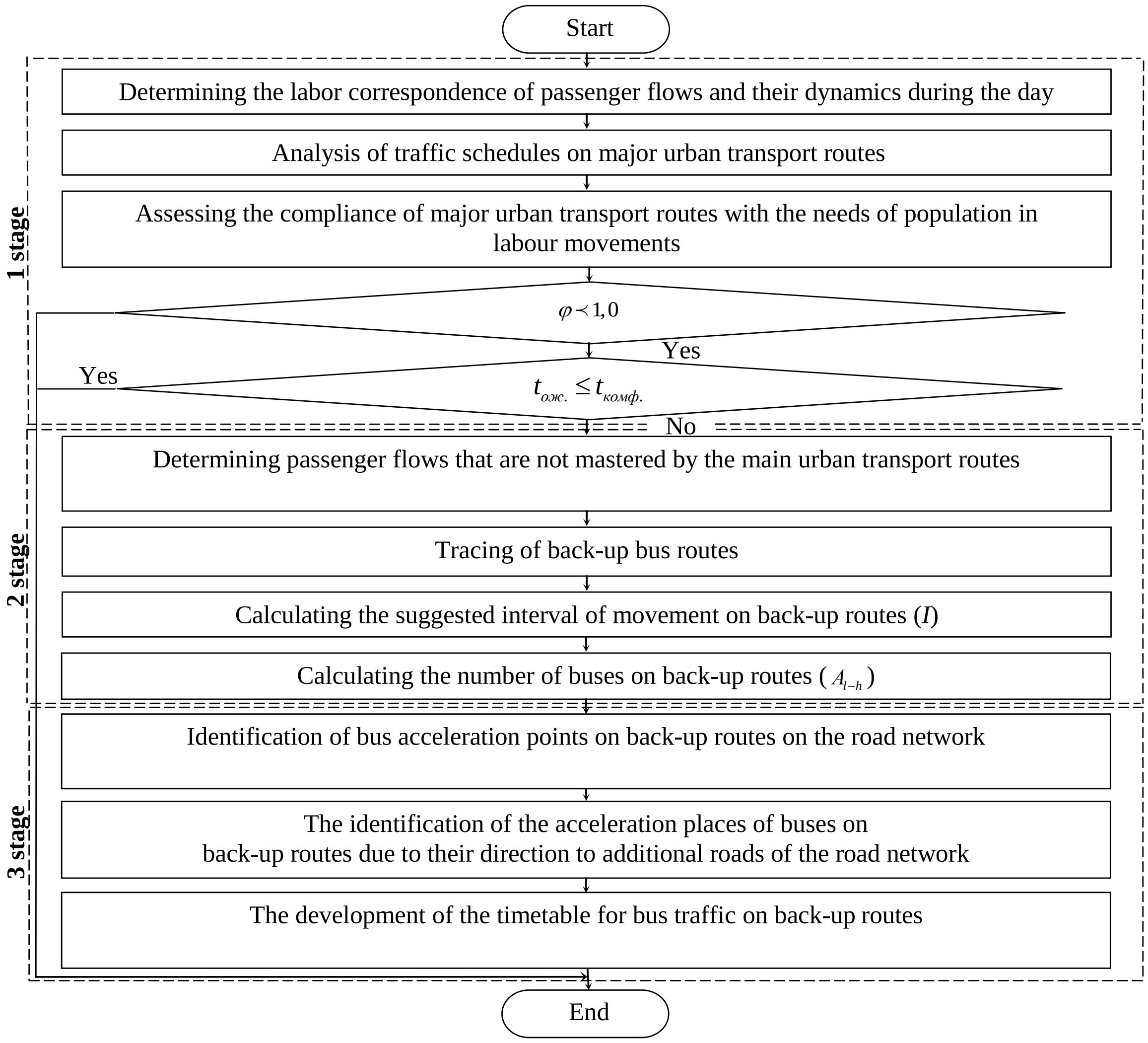

Fig. 3. Passenger flow formation algorithm on back-up bus routes

The speed of the traffic flow, considering the traffic density, is determined by the dependence obtained by mathematical modelling of the three situations that characterise the congestion of the road network when the vehicle overcomes the congestion at the signal-controlled intersection at one, two or three cycles of traffic lights, respectively (Fig. 4).

We propose to determine the technical speed of the buses on the additional road network, when it is loaded with the traffic flow of route vehicles, in accordance with the dependency given in Fig. 5.

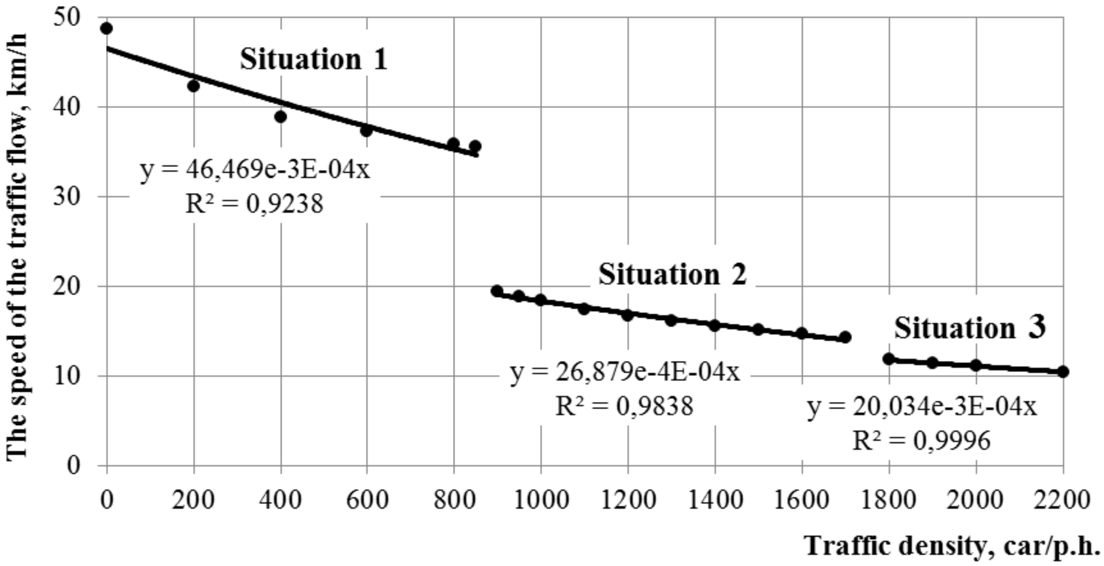

Fig. 4. Dependence of speed of the traffic flow from the density of the flow of vehicles

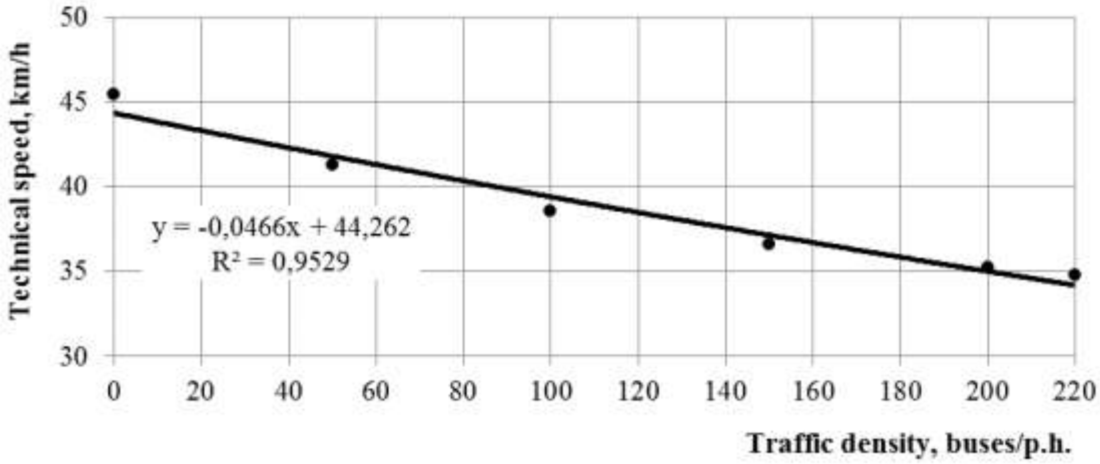

Fig. 5. Dependence of technical speed of the bus on additional roads from the density of the flow of route vehicles

Furthermore, the planning decisions of the city road network depend on route speed, the availability of additional roads on the road, which duplicate the main highways. The planning decisions of the road network are individual for each town area. The direction of buses to additional roads, duplicating the main transport routes, allows accelerating the traffic flow significantly. On the example of Magnitogorsk, we have established that the through speed, when implementing such opportunities, increases on average by 4 km/h (Fig. 6).

Thus, increasing the route speed, by directing buses on contingency routes to additional roads of the municipal road network during its loading makes it possible to reduce costs of ridership maintenance.

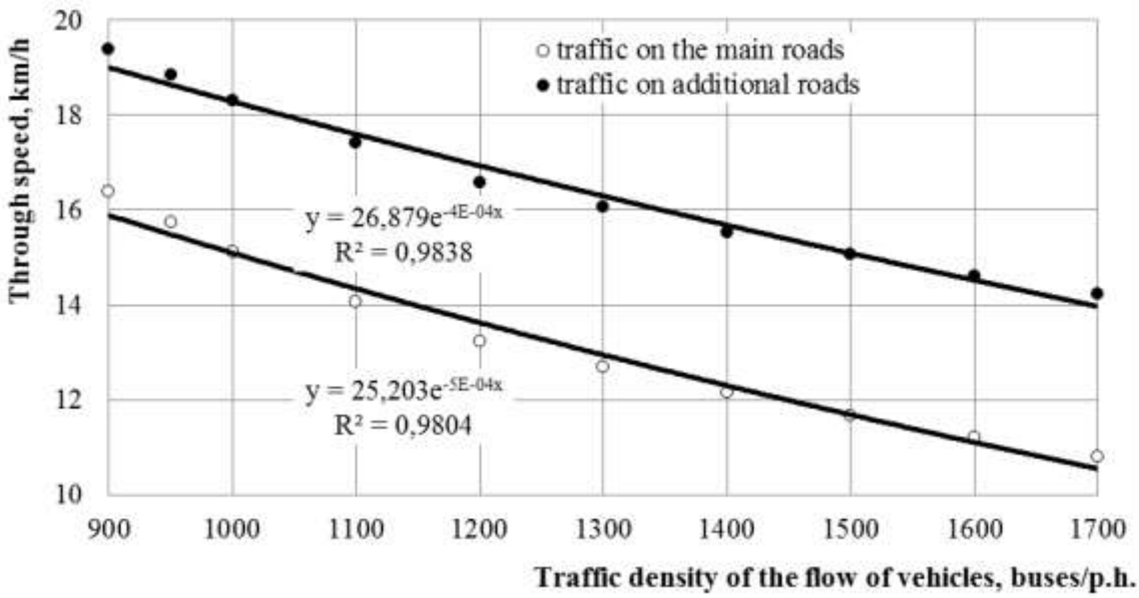

Fig. 6. Modification of the average through the speed of buses when they are directed to the additional road network (on the example of Magnitogorsk)

5. TECHNICAL AND ECONOMIC ASSESSMENT OF THE FINDINGS

The technical and economic assessment of the findings was carried out on the example of public transport routes in Magnitogorsk. The route network of Magnitogorsk is characterised by the presence of departure lines to the industrial site of the Magnitogorsk Iron and Steel Works (MMK), located on the left-bank part of the city. The workflow of MMK units determines the pendulum principle of ridership formation: heading to the east in the morning and to the west in the evening.

Checkpoints of MMK are the places of generation and reducing of mass ridership; that is the reason regular routes of urban transport run along the transport arteries, skirting the boundaries of the industrial site, which cause the coincidence of long-distance sections for majority of the regular routes.

The results were used to form a backup delivery channel for MMK workers on the regular bus route No 33. The larger part of the route is the same as route No 3 (Fig. 7), which is the main route in our calculations.

Conformity assessment of the reserved route No 3 to the needs of the population in their labour movements is made by f-le (5).

The calculations consider the present traffic schedule, as well as the need to move the employee on foot between the checkpoint or residence and the nearest stop. The results of the evaluation are shown in Tab. 2.

Passenger flow, in which the waiting time for the vehicle at the stop exceeds 15 minutes (t_{comf}), accepted in the calculations, is not transported by the main route. The presence of a common section of the route makes it possible to service this passenger flow by the reserve regular bus route No 33.

Knowing the time of the workers' passage through the checkpoints No 1, 2, 10, 16, the detailisation of the potential passenger flow on the reserve route on the periods of the day is done.

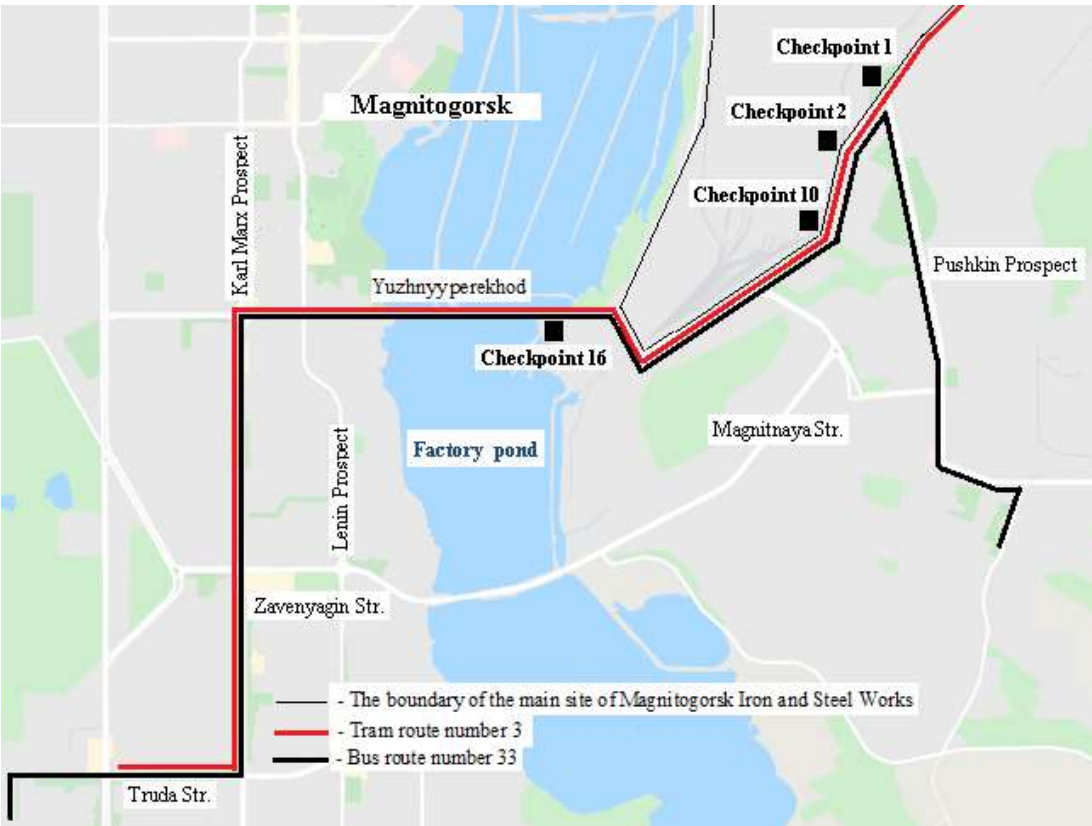

Fig. 5. The location of MMK's checkpoints on the general section of the highway of routes under consideration

Tab. 2

Conformity assessment results of the main route No 3 to the needs of the population in their labour movements

Station	No check point	Potential ridership, person/a day					
		total	Waiting time is less than 15 min.	Waiting time is more than 15 min.	Another route is more convenient	The desired route is missing	φ
Kirova	10	1591	303	118	614	556	0,19
Kirova 70	2	4143	995	261	1917	970	0,24
Komsomol'skaya ploshchad'	1	12415	1837	1061	3979	5538	0,15
Lugovaya	3	2991	518	165	1241	1067	0,17
pos. Bruskovyj	13	631	112	51	239	229	0,18
Prokatmontazh	9	1000	173	69	453	305	0,17
TEC	16	446	69	13	222	142	0,15
						On average:	0,18

The accumulation level of potential passengers at the nearest point to the checkpoints stops allows to set the interval of bus traffic on the back-up bus route (I_s), and the route speed allows to calculate the time of turnover and the required number of buses (A_{l-h}).

The analysis of congestion of the road network's sections during the day, through which the track of the back-up bus route No 33 runs, allowed determining the critical section along Karl Marx Prospect (Starevarov Str. and Truda Str.), where at peak hours of the day, from 15:00 to 18:00, the average traffic speed reduces to 11 km/h, thus, leads to congestion at intersections and increases the delivery time of passengers by fixed routes.

We suggest redistributing route vehicles on this section of the road network to the additional road parallel to Karl Marx Prospect during this period. Given these dependencies (Fig. 6), we have established that the proposed redistribution would increase the route speed of buses to 18 km/h. This would ensure the predetermined interval with fewer buses during the loading of the road network and avoid the need to increase the number of buses on the line.

Having calculated the total cost of the infrastructure required to organise the movement of buses (C_I), using the proposed mathematical model, we have selected the optimal reservation scheme based on the minimum cost of total costs (C_{total})), for which the passenger information schedule of traffic is being developed.

Based on the calculations, we have proved that it is inappropriate to use the reservation scheme to improve the efficiency and reliability of the labour movements of the population of Magnitogorsk, which involves increasing the number of rolling stock on route No 3. It has been established that the formation of a contingency delivery channel based on the regular bus route No 33 will provide an additional volume of transport equal to 178,000 passengers per year, by submitting buses to the stops of the route during periods of lack of vehicles on the main route. The direction of the buses of contingency route on the additional road during the loading periods of the road network will increase their route speed by 7 km/h.

Using the proposed results will reduce the cost of transporting one passenger by 7%, increasing its reliability by 1,14 times and the service of additional ridership without increasing the costs of urban transport.

6. CONCLUSIONS

Based on the studies carried out, we propose to solve the urgent scientific and practical problem of improving the methods of transporting passengers by urban transport to enhance its reliability and efficiency, by forming contingency bus routes within the existing regular route network to service mass ridership.

The main findings and results of this study are as follows:

1. We have proposed a mathematical model of a regular route network reservation, the target function of which is to reduce the amount of costs for the formation of transport infrastructure for the organisation of bus traffic on the back-up routes, operating costs for transportation, and the costs of eliminating malfunctions at work. The system of restrictions provides for compliance with the interval of traffic, as well as contractual obligations on the volume of traffic, their cost and the number of buses on contingency routes.
2. The offered mathematical model of assessing the reliability of passenger traffic on regular bus routes taking into account the scheme of reservation of the regular route network, is built on:

- for reservation schemes with a consistent location of elements - it is based on the production of probabilities of fail-free operation of buses on the route,
- for majoritarian reservation regimes with substitution - it is based on the use of the formula of overall probability of joint events.

3. The value of ridership on back-up bus routes is determined by the analysis of the compliance of the existing urban transport route network with the needs of the population for their labour movements. The ridership, being not mastered by the main regular routes, after its detail on the periods of the day, can be potentially mastered on back-up routes.
4. Reduced costs of servicing ridership on contingency bus routes are achieved by maintaining the predetermined interval of traffic by fewer buses. It is achieved by increasing the route speed of traffic as a result of the direction of buses on additional roads during its loading.
5. We have proved the feasibility of the proposed results established on the example of public transport routes in Magnitogorsk. The formation of a back-up delivery channel based on a regular bus route will provide an additional volume of transportation by submitting buses to stops during the periods of lack of transportation on the main route. This will reduce the cost of transporting of one passenger by 7%, increase its reliability by 1.14 times and acquire the additional passenger flow without increasing the cost of urban transport.

References

1. Grishaeva Y.M., O.Y. Matantseva, I.V. Spirin, M.I. Savosina, Z.N. Tkacheva, D.V. Nasin. 2018. „Sustainable development of transportation in the cities of Russia: experience and priorities”. *South of Russia: Ecology, Development* 13(4): 24-46. ISSN: 2413-0958 DOI: https://doi.org/10.18470/1992-1098-2018-4-24-46.
2. Beim M., M. Haag. 2010. „Freiburg's way to sustainability: the role of integrated urban and transport planning”. *Real Corp 2010: Cities for Everyone, Liveable, Healthy, Prosperous – Proceedings, Competence Centre of Urban and Regional* Planning: 285-294.. 18-20 May 2010, Vienna, Austria. ISBN: 978-39502139-8-0.
3. Nemtinov V., Y. Nemtinova, A. Borisenko, V. Mokrozub. 2017. „Information support of decision making in urban passenger transport management”. *Transport Problems* 12(4). DOI: 10.20858/tp.2017.12.4.8.
4. Lu J., L. Cao. 2003. „Congestion evaluation from traffic flow information based on fuzzy logic”. *Proceedings IEEE Intelligent Transportation Systems* 1: 50-53. DOI: https://doi.org/10.1109/ITSC.2003.1251919.
5. Schneider W. 2005. „Mobile phones as a basis for traffic state information”. *Proceedings IEEE Intelligent Transportation Systems*: 782-784. DOI: https://doi.org/10.1109/ITSC.2005.1520148.
6. Barcik R., L. Bylinko. 2018. „Transportation demand management as a tool of transport policy”. *Transport Problems* 13(2). DOI: 10.20858/tp.2018.13.2.12.
7. Börjesson M., M. Bliemer, R. Batley, J. Bates, J. Bliemer, M. Borjesson, T. Worsley. 2019. „New appraisal values of travel time saving and reliability in Great Britain”. *Transportation* 46: 583-621. DOI: https://doi.org/10.1007/s11116-017-9798-7.
8. Gavu E.K. 2010. „Network based indicators for prioritising the location of a new urban connection: case study Istanbul, Turkey”. *MSC thesis.* International Institute for Geo-information Science and Earth Observation, Enschede, the Netherlands.

9. Raju N., A. Chepuri, S. Arkatkar, G. Joshi. 2020. „A Simulation Study for Improving the Traffic Flow Efficiency of an Intersection Coupled with BRT". European Transport \ Trasporti Europei. Issue 75. Paper n 1. ISSN: 1825-3997.
10. Bokor Zoltan, Rita Markovits-Somogyi. 2015. „Improved cost management at small and medium sized road transport companies: case Hungary". *Promet - Traffic & Transportation* 27(5): 417-428. DOI: https://doi.org/10.7307/ptt.v27i5.1719.
11. Baykasoglu A., V. Kaplanoglu. 2008. „Application of activity-based costing to a land transportation company: a case study". *International Journal of Production Economics* 116(2): 308-324. DOI:10.1016/j. ijpe.2008.08.049.
12. Lukinskiy V., V. Lukinskiy, R. Churilov. 2014. „Problems of the supply chain reliability evaluation". *Transport and Telecommunication* 15(2): 120-129. DOI: https://www.doi.org/10.2478/ttj-2014-0011.
13. Taghizadeh H., E. Hagezi. 2012. „The investigation of supply chain's reliability measure: a case study". *Journal of Industrial Engineering International*: 8-22. DOI: https://doi.org/10.1186/2251-712X-8-22.
14. Vojtov V., N. Berezchnaja, A. Kravcov, T. Volkova. 2018. „Evaluation of the reliability of transport service of logistics chains". *International Journal of Engineering & Technology* 7(4.3): 270-274. DOI: https://doi.org/10.14419/ijet.v7i4.3.19802.

Received 20.02.2020; accepted in revised form 17.06.2020