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PREFERENCE FOR PUBLIC TRANSPORT VEHICLES IN SELECTED AREA OF PÚCHOV

Stanislav Kubaľák, Ambróz Hájnik, Veronika Harantová
University of Žilina, Faculty of Operation and Economics of Transport and Communications, Slovakia

Abstract

The paper deals with ensuring the preference for public transport vehicles in the selected area of Púchov.The main aim of the paper is to analyze the current traffic situation within the selected area in the cadastral area of Púchov, near the "Nástupište, MŠK (Makyta)" bus stop, focusing on the delay of public transport vehicles due to the large number of bus lines arriving and departing from the stop, and emerging delays of these vehicles at entry and exit. Moreover, the partial aims of the paper are to evaluate traffic surveys, to design alternative solutions to the new organization of transport, and to select the optimal option which will predict the most significant time savings of public passenger vehicles. The necessary basis of the paper was the elaboration of several traffic surveys. The application of preferential tools enables to improve the throughput and fluency of problematic sections, to eliminate large delays achieved in the most stressed sections, to improve conditions for passengers, to increase attractiveness for public transport, also to observe timetables, reduce road accidents and driving safety, and ultimately reducing financial costs.

Keywords: preference, public transport, traffic survey, delay time

1 Introduction

In most large cities today, efforts are being made to make urban public transport (UPT) systems more efficient, in particular by removing the negative effects of individual bus transport (IBT) by gradually introducing elements of urban transport preference. To mitigate these impacts, dedicated lanes for public transport vehicles are being built in individual cities, streets are being unified or IBTs are being banned from entering central areas of cities. One of the effective measures to reduce public transport delays is to introduce a preference at light-controlled intersections, which cause large time losses for public transport [3, 6]. Movement of public passenger transport buses (PPT) in the street area, resp. over the local road, networks re generally quite complex. Preferential measure for buses On the infrastructure side, PPTs are a basic tool for minimizing the negative effects of individual road transport as a tool for ensuring the functions, quality, and attractiveness of bus transport as a reliable part of the integrated transport system. Maximizing the effects of PPT preference is only achievable with the effective and consistent application of preferential measures [4].

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2 Public transport in the monitored area

The current organization of transport in the assessed area is ensured using three uncontrolled intersections, two of which are used for entry and exit of public passenger transport (PPT) vehicles directly to/from the Makyta stop, and the third intersection is situated in the direction of the city center on the road I/49. At present, the entry and exit of vehicles to the Makyta stop re provided from two directions (Fig. 1). The yellow arrows in fig. 1 show the directions from which public transport vehicles enter the stop. The red arrows show the directions in which the vehicles leave the stop and join the street on 1. Mája. The assessed area includes 22 routes of suburban bus lines and 8 routes of public transport lines.

Figure 1 Map showing the distribution of individual inputs (left panel), Current organization of transport in the assessed area with indication of the direction of public passenger transport lines (right panel) [own study]

3 Traffic survey and analysis

Several traffic surveys were carried out in the assessed area since we wanted to approach the current situation in the assessed area during the simulations of individual models and we also wanted the model to be as accurate as possible. The performed traffic surveys were:

- directional traffic survey at the intersection of 1. Mája and Športovcov street,
- survey of the delay of public transport and regular bus service vehicles at the Makyta bus stop (MŠK platform) in the town of Púchov,
- processing of timetables,
- measurement of selected parameters= Detector = SIERZEGA SRA 5.4.1.

4 Proposal for a new transport organization through alternative solutions

The main goal of the changes in the organization of transport is to achieve an increase in the smoothness and safety of passage of all road users in the assessed area. However, in many cases, the proposal to change the organization of transport is not beneficial for all road users, including public passenger transport vehicles (PPT). For this reason, these calculation procedures can be replaced by the virtual reality of the modeled transport network - the transport model [8].

It was the use of the transport model that assessed the effects of several variants of the change in the organization of transport on public passenger transport vehicles in a defined area near the central urban zone of the town of Púchov. When modeling the traffic flow, we create real situations of a certain traffic problem. The proposal of changes in the organization of transport in the assessed area was made using the transport model Aimsun [7].

4.1 Assessment of the traffic situation using a traffic model

The transport model was developed in the transport - modeling software of the Spanish company TSS (Transport Simulation Systems) Aimsun. For each simulated variant, 36 simulations were performed (taking into account the standard deviation generated by the traffic model, corresponds to the accuracy of the results at 99 % confidence level with a confidence interval of 6). From the number of simulations, average values were calculated for the monitored indicators. The results were monitored and evaluated for public passenger transport vehicles and individual transport vehicles specifically with measurements on buses, to determine the variant that will achieve the best results in a given comparison of average values [7].
In order to better orient ourselves in the simulation model, I am using the function „Subpaths" divided the intersection into individual entrances and exits. (Fig. 2). The given division is clearer when evaluating the individual characteristics of traffic flow for the current state and the proposed solutions.

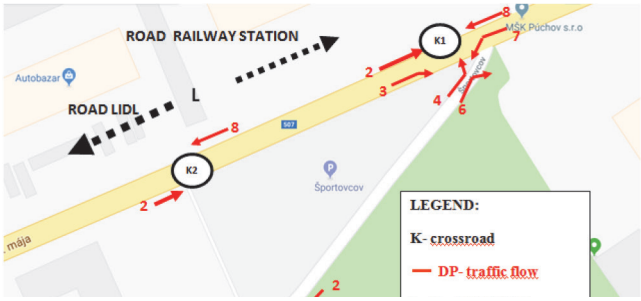

Figure 2 Division of individual entrances and exits [own study]

The current traffic situation was assessed in the transport model and several proposals were made to change the organization of traffic. The monitored indicators were evaluated separately for each means of transport. The results were evaluated for public passenger transport vehicles and buses. The following variants were simulated in the transport model (the current organization of transport in the area under consideration):

- Proposal 1: Design of light control at the intersection of streets on 1. Mája – Športovcov (entrance A),
- Proposal 2: Design of light control at the intersection of on streets Športovcov – 1. Mája (entrance B),
- Proposal 3: Reserved lane for public passenger transport vehicles at the intersection of streets on 1. Mája - Športovcov,
- Proposal 4: Change of transport organization of street on Športovcov - entrance to the Makyta stop.

5 Analysis of the obtained results and selection of the optimal variant

As already mentioned, 36 simulations were performed for each variant, from which the average values for individual monitored indicators were subsequently calculated, the monitored indicators include: waiting time, number of stops, total travel time, standing time, average speed, section speed and number of stops. These indicators were monitored separately for public passenger transport vehicles on the routes of public passenger transport lines passing through the assessed area. These parameters were also monitored for individual bus transport vehicles, with an evaluation compiled for the whole area under assessment, as shown in Tables 1 and 2.

Table 1 Overall comparison of public passenger transport lines with the current situation [own study]

Proposal	Line	Direction	Delay time [s]	Number of stops [st./veh.]	Total travel time [s]
current situation	Line1	Regular bus service from Lidl - directly	2,38	1	243,36
proposal 1			2,38	1	243,67
Proposal 2			2,33	1	243,36
proposal 3			2,31	1	244,09
proposal 4			1,96	1	243,76
current situation	Line2	Regular bus service from the railway station - directly	4,95	0,25	120,8
proposal 1			4,95	0,25	120,8
Proposal 2			4,72	0,24	120,13
proposal 3			5,19	0,26	123,55
proposal 4			4,23	0,2	120,3
current situation	Line 3	Public transport from the railway station - Makyta - back	25,34	2,19	118,27
Proposal 1			17,08	1,78	113,1
Proposal 2			25,13	2,17	117,93
proposal 3			25,95	2,25	118,89
proposal 4			26,52	2,39	114,54
current situation	Line 4	Regular bus service from Lidl via Makyta	10,6	1,42	123,88
proposal 1			11,38	1,47	124,81
Proposal 2			10,53	1,39	123,98
Proposal 3			10,06	1,42	123,45
proposal 4			11,27	1,36	119,88
current situation	Line 5	regular bus service from the station via Makyta	25,44	1,78	126,54
Proposal 1			24,87	1,72	118,02
Proposal 2			11,73	1,17	113,5
proposal 3			25,79	1,78	127,93
proposal 4			26,66	1,89	126,21

Based on the overall comparison of individual results (Tab.1), the most appropriate proposal, in terms of achieving the lowest value of the residence time for public passenger transport (PPT) vehicles at the entrances to intersections, can be considered proposal 2. The proposal changed the organization of transport construction of traffic lights inclusion (TLI) proposed at the intersection of streets on 1. Mája - Športovcov, which was to contribute in particular to reducing the waiting time of vehicles turning left from the main road of the street Športovcov. The waiting time was found to be 15.11 sec. The comparison of the results achieved on the individual assessed lines shows that in the case of all lines in the case of proposal 2 an improvement of the values of the assessed parameters compared to the current state was found. The second-lowest delay time was found in the case of proposal no. 1, for which a value of 17.37 sec. was found. The results of the performed simulations show that proposal 3 and proposal 4 do not affect the movement of PPT vehicles within the assessed area. In both cases, the values of the assessed parameters were compared with the current state, or worse.

The reserved lane itself (proposal 3) was not located in a place where there would be significant delays in PPT vehicles. The benefit of such a lane would rather be manifested at the entrance to the intersection, where PPT vehicles have to wait in a row of stationary vehicles in front of the intersection (controlled or uncontrolled), and thus there is a delay. In such a case, a reserved lane would allow the segregation of PPT vehicles from other road users and would contribute to shortening the delay time and thus the travel time itself. The same conclusion can be drawn in the case of a change in the organization of transport by redefining the main road at the entrance to the stop Makyta from Športovcov street (proposal 4). The intensity of vehicles on a given street is not so high as to significantly affect the departure of vehicles from the stop.

Table 2 Overall comparison of proposals for buses [own study]

Comparison	Delay time [s/km]	Stop time [s/km]	Number of stops [st./veh./km]	Speed [km/h]	Harmonic speed [km/h]	Total travel time [s]
current situation	18,91	10,23	1,03	25,15	21,41	0,20
proposal 1	17,37	8,59	0,99	25,37	21,79	0,20
proposal 2	15,11	6,97	0,93	25,40	21,87	0,20
proposal 3	18,96	10,45	0,93	25,16	21,46	0,20
proposal 4	18,64	10,16	1,03	25,48	21,69	0,20

A comparison of the individual proposals shows that the application of proposal 2 should achieve the highest time savings for public passenger transport (PPT) vehicles. This fact is influenced by the fact that at the intersection in question the number of vehicles turning left from the main road gradually increases (due to increasing the attractiveness of this area), while for this intersection no separate lane is built on the main road, as stated in the description of the current state. This affects not only the movement of PPT vehicles but also the movement of other vehicles in the superior current. The equipment of the traffic lights inclusion (TLI) junction will allow vehicles to turn left to leave the junction more quickly and thus also contribute to the shortening of delay times for PPT vehicles. To avoid these negative effects, it is necessary to consider the equipment of TLI exits and the preference of PPT vehicles, as based on the results of individual simulations in proposal No. 2.

6 Application of the selected optimal variant

Based on the comparison and evaluation of the obtained results, the optimal variant is proposal 2 = Design of light control at the intersection of on streets Športovcov – 1. Mája (entrance B). In this part of the article, we will present the application of the selected variant in the selected part of the town of Púchov. Figure 3 shows a view of the routing of public passenger transport (PPT) lines and the designation of the place where we propose a change in the organization of transport. Figure 4 shows there commendation proposal 2, where there would be a change in the organization of transport at the intersection of the street of Športovcov – 1. Mája. In the above, the equipment of the intersection is considered by a light signaling device.

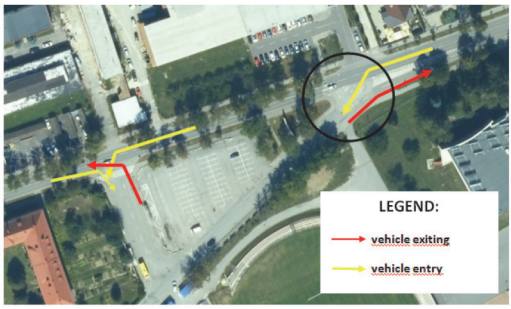

Figure 3 Map with the proposal of design 2 together with the indication of the direction of public passenger transport lines [own study]

Figure 4 Recommended proposal to change the organization of transport (left panel), the changed state model in Aimsun (right panel) [own study]

The proposal considers that the traffic lights inclusion (TLI) will not manage traffic at the intersection at all times, it will be used only if a call is detected from a detector located at the entrance to the intersection in the direction away from the city center. Therefore, if a public passenger transport (PPT) vehicle arrives at the intersection, which wants to cross the intersection by turning left onto Športovcov street, by crossing the detector it will cause a signal change (it will cause a red signal) in all collision directions. This change will ensure that the vehicle passes smoothly through the intersection without stopping. If no challenge is detected on the detector, the intersection is not controlled by the TLI, but vehicles pass through the intersection as if they were at an uncontrolled intersection (as at present).

In case the traffic at the intersection in question would be controlled by traffic lights throughout the day (via the established signaling plan), the preference of PPT vehicles can be ensured by detectors located at individual entrances (since PPT vehicles pass through the intersection from all entrances). In such a case, however, it is necessary to ensure dynamic control of the intersection and we propose the following principle of operation, which is shown in Figure 5. [1, 5].

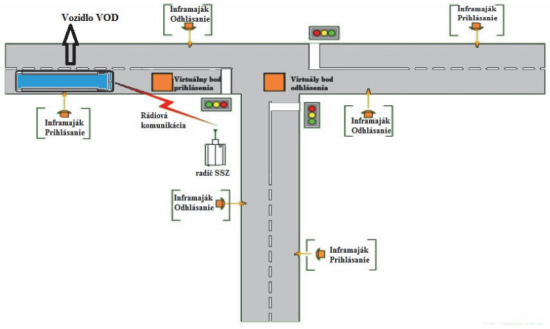

Figure 5 Principle of active preference of public passenger transport vehicles [own study]

7 Conclusion

The article aimed to analyze the current traffic situation within a selected area in the cadastral area of Púchov, near the stop „Nástupište, MŠK (Makyta)“ with a focus on delays of public transport vehicles due to entry and exit. The partial goal of the article was to evaluate traffic surveys, propose alternative solutions of the new transport organization and select the optimal variant, which will be expected to significantly save public passenger transport vehicles, while such a proposal can be considered in terms of simulations 2, as mentioned above in the text. In conclusion, we can note that the application of preferential instruments (measures) allows to improve the passability and smoothness of problem sections, eliminate large delays achieved in the busiest sections, improve driving conditions for passengers, increase attractiveness for public transport [2, 3].

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