Evaluation Of The Introduction Of Public Transport Movement Priority On The Regulated Crossroad

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Abstract – In this paper various methods of prioritization of public transport movement were considered, and the influence of prioritization on delays in the private transport movement in the adjacent streets was investigated. An estimation of the introduction of prioritization on a specific example has been carried out.

Keywords: traffic delay, traffic light control, public transport, methods of prioritization.

I. Introduction

Currently one can observe an increase in the number of both private (PrT) and public (PT) transport in the city streets. It leads to the increase in traffic intensity, and as a result to delays and traffic jams in the street-road network (SRN). Taking into account that most of the population moves by public transport, cities are now trying to prioritize PT movement in every possible way. However, it is not always appropriate, and often causes damage to other road users [1].

II. Methods of giving priority to public transport

There are several methods of prioritization of PT movement, however, some of them are irrelevant under different conditions. For isolated crossroads, all methods are divided into three groups, namely[2]:

1) Priority in space;
2) Priority in time;
3) Spatio-temporal priority.

Such division into groups is, to some extent, conditional, since the implementation of priority in space can not but affect the change in parameters of traffic lights control on a crossroad, which is its time aspect of functioning. However, to determine the advantages and disadvantages of prioritization it was convenient to classify them.

Ensuring of the full priority of PT travel on a regulated crossroad, that is, a travel without stopping, is best achieved by the introducing separate lanes of motion and activating the desired traffic signal at a certain moment.

However, to use one of the methods of PT movement prioritization as an optimal for all crossroads is inappropriate, since each of crossroads has different road and transport conditions that require a separate approach for each road section.

For example, for the appropriate setting of separate lanes, there should be a high intensity of PT motion in this SRN section [3]. Also, in order to call the desired signal of the traffic light, it is necessary to take into account the influence that occurs on PT movement in adjoining streets, if it should create delays and traffic jams [4].

That is why it is expedient to use a combination of several methods from different groups of the proposed classification.

III. Object of research

This problem was considered at the example of the crossroad of Chuprynky and Horbachevskoho streets in the city of Lviv.

The existing motion scheme and the cyclogram of the traffic lights in the absence of a tram at this crossroads is presented below.

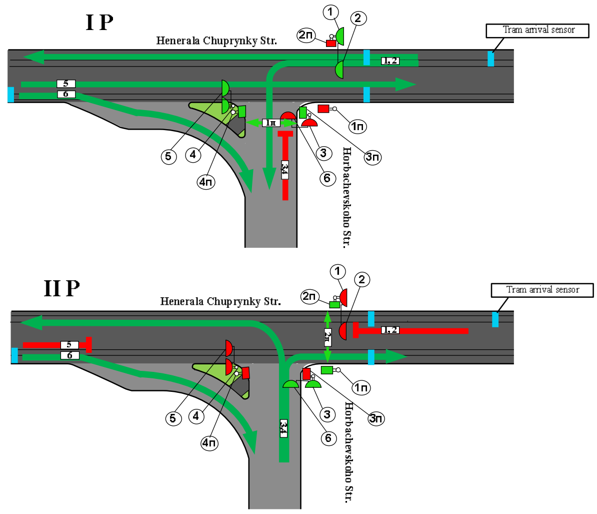

Fig. 1. Phase pathway at the crossroads of Chuprynky-Horbachevskoho Streets

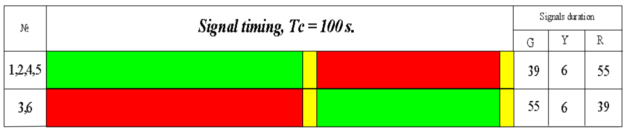

Fig.2. Cyclogram of traffic lights at the crossroads of Chuprynky-Horbachevskoho Streets

When a tram is comeing near the crossroad (what is fixed by the sensors), the green signal of the traffic lights № 1,2,4,5 is automatically turned on and therefore the red signal of the traffic lights №3,6, which lasts longer than the standard one and varies depending on whether or not a tram has passes the crossroad. The previous time of the green signal of traffic lights № 3,6, which also varies depending on the time of a tram entrance to the crossroad is not taken into account. After the modified cycle, the traffic lights return to the usual regime, while not compensating the delay in moving along Horbachevskoho street.

Horbachevskoho street is blocked because the traffic lights "can not cope" with such a number of cars. This phenomenon can be estimated by a parameter – saturation coefficient, determined by the formula:

$$W_{(t)} = \frac{N_c}{N_{cr}} \text{ ,} \qquad (1)$$

where:

– $N_{ni\partial}$ is the number of the cars that came to the traffic lights,

– N_{np} is the number of the cars that crossed the stop line at the green light.

At $W_{(t)} > 1$ a queue is formed. The dependence of saturation change on the duration of traffic signals is depicted on the graph.

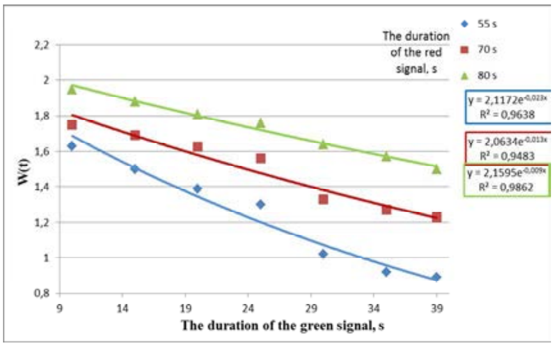

Fig.3. The dependence of the saturation coeficient on the duration of the traffic light signals

In this graph, it can be noticed that at an increase in the duration of the red signal till 70 s, the saturation coefficient is greater than 1, even at the green signal duration of 39 s. We revealed also other dependencies, which show the need to increase the duration of the green signal of traffic lights after the tram passing, for traffic flow in Horbachevskoho street, to normalize the queue and reduce the saturation factor for the improvement of the comfort in passing this crossroad.

Conclusion

There are several variants to solve this problem:

1) Proportional method.

Using this method, the duration of the green signal of traffic lights, closest to the tram passage, is supplemented by the number of seconds for which the tram completely crosses the crossroad, and it is determined proportionally how much seconds must be added to the duration of the green signal on the adjacent street to compensate the delay and level the queue that was formed. So, the green light for the tram is not automatically turned on and it does not create such a large delay in PT movement in adjacent streets, but the passage of the crossroad at the nearest green signal of the traffic lights is guaranteed.

2) Correction after Webster formula

By this method, you can try to correct the motion by changing the duration of the intermediate signal. However, this will entail a change in the duration of the cycle, which is not a desirable consequence.

3) Analytical method

This method suggest to determine the desired duration of the green signal of the traffic lights by, for example, the method of interpolation according to the exponential law of the above mentioned data. At interpolation the time of the green signal, at which $W_{(t)} \leq 1$, is determined.

There are two variants of the establishment of the traffic lights cycle, namely, the automatic activation of the green signal for the tram or the rigid cycle.

Which of the proposed methods is the best may be determined by research and simulation modeling of various options.

Therefore, the further direction of research should be the determination of the ways of movement optimization, the choice of the method of prioritization of PT movement so that it does not create discomfort for the movement of PrT.

References

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