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The Project of Organizing Non-Stop Traffic at T-Intersections (Tyumen Case Study)

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ABSTRACT

The constant growth in the number of cars and trucks in single industry towns is forcing road design engineers to find ways convenient for all road users and pedestrians to move at intersections. Fulfilling such conditions is a difficult task but it can be solved, especially if there are many T-shaped intersections along the entire length of the road. Most often they are located along the line of railways, heating mains, river or lake banks, parks, etc. Since there are no adjacent roads, it is possible to ensure continuous movement of cars, but only in one direction.

The objective of this work is to substantiate the project aimed at ensuring unhindered traffic at T-intersections of vehicles following 50 let VLKSM street in the city of Tyumen.

To achieve this objective, the method of observation and recording, as well as the analysis of operation of optical devices that regulate passage of cars at intersections were used. With newly designed travel mode, there is no infringement of rights in relation to other motorists and pedestrians since the traffic light mode for the rest of segments keeps the same counting in seconds. A system of safe pedestrian crossing is envisaged along with an improvement in the environmental component of the whole city.

For initial adaptation of motorists to new conditions, it is proposed to use a side green vertical arrow attached to the traffic light and signal columns that delimit traffic lanes for a «slow merge» into the flow of those leaving the secondary road. An undeniable advantage of this type of design is the minimum cost of reconstruction of intersections. Based on author's own observations, it can be argued that this project increases traffic of vehicles moving from the central part of the city to the eastern part by 1,5–1,8 times.

Keywords: *transport, T-shaped intersection, traffic lights, road marking, traffic organisation.*

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INTRODUCTION

The number of vehicles sold and registered in Russia is growing steadily from year to year. Basically, this increase occurs in regional centres and large cities of the country. Both passenger cars and trucks are registered by individuals and organisations. Unfortunately, transport interchanges, overpasses, roads in most cities of the Russian Federation do not have time to cope with the constantly growing number of vehicles [1]. Even after construction of new interchanges, which were supposed to increase traffic capacity, motorists still often experience difficulties when driving through this or that intersection. Sometimes inauguration of new interchange is expected for years due to calculation errors during construction, lack of funding, etc. And all this aggravates the situation even more. Obviously, an option is needed that would combine minimum cost estimate, minimum construction or reconstruction time at road segments, and will ensure a safe crossing for pedestrians, but under all these conditions, road capacity for vehicles would increase [2].

For the most part, the transport infrastructure of the city of Tyumen is a balanced traffic of vehicle and pedestrian flows. The markings have been applied, delimiting traffic lanes, traffic light switching has been correctly adjusted, there are smooth road surfaces, new pedestrian crossings and those under construction, etc. Despite the well-developed concept of traffic flows, the city still suffers problems with congestion at intersections, mainly in city's central parts. Based on the experience of other cities [3–6; 10; 15], these problems, as a rule, are proposed to be solved by increasing the number and expansion of carriageways, additional construction of second-level roads (above the main road), using reverse traffic, regulated depending on the growing traffic flows at different times of the day.

But what if the carriageway is expanded to its maximum limit, and the construction of second-level roads and reverse traffic is not possible due to the fences on the carriageway? The answer to this question is that it is necessary to develop such a traffic project that will increase road traffic capacity with the minimum amount of road works and estimated costs.

The *objective* of this article is to create a typical project for T-shaped intersections, with the possibility of increasing car traffic in one of the directions. The objective is studied using the case of one of the central streets of the city of Tyumen.

As research *method*, the study of automatic operation of traffic light control and of the number of vehicles moving at T-shaped intersections from the central part of the city to the eastern part is applied.

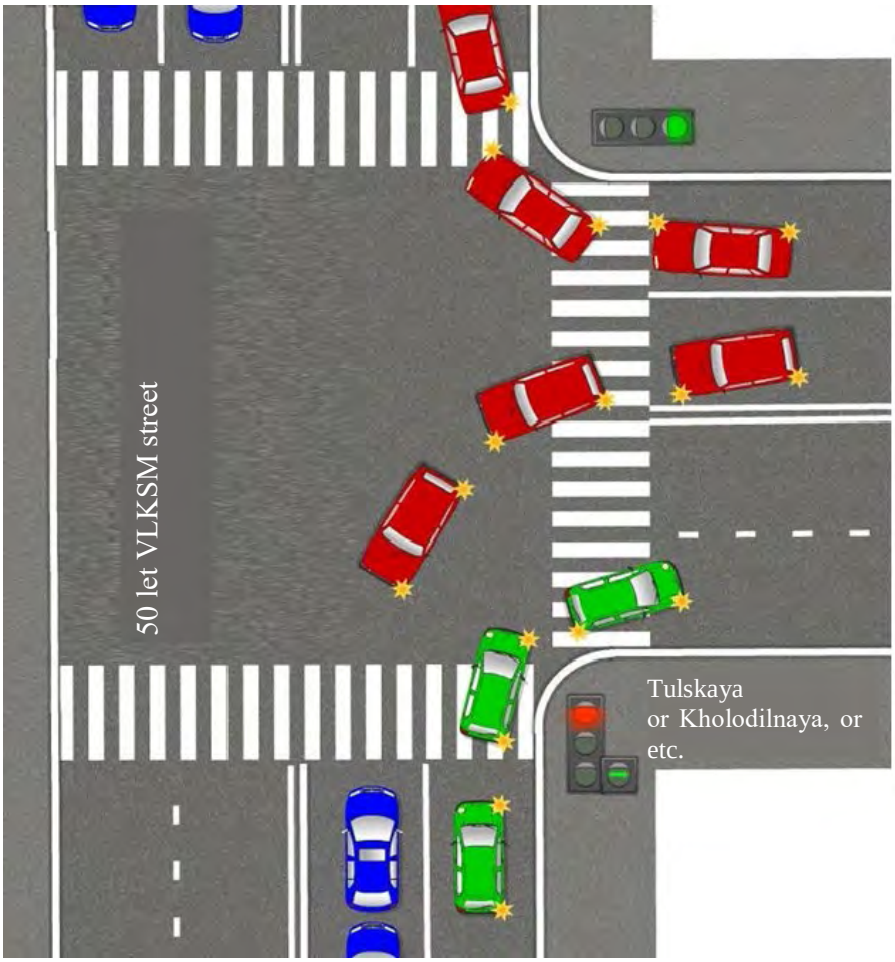
RESULTS

Input Conditions

It is proposed to consider the example of 50 let VLKSM street, coming from Zapolnaya street and ending at the intersection with Montazhnikov street. The fact is remarkable that this street connects the city centre with its eastern part. It is in the eastern part of the city that new residential neighbourhoods are being actively built, and universities, shopping centres, recreation areas, etc. are concentrated in the central part. Hence, the emphasis is put on this road-and-street section.

50 let VLKSM street in Tyumen is a duplicate of another central street, Respubliki street, therefore, increasing traffic capacity in this area is extremely important for the entire city. The traffic congestion at the 50 let VLKSM street is sometimes even more than that of its backup since vehicles with a permitted maximum weight of more than 3,5 tons are prohibited from moving along Respubliki street in its central part. When carrying out work on recording time of traffic light operation (in the direction from the centre to the eastern part of the city) on weekdays from 7:30 to 19:00, it was found that the green traffic light was on at all T-sections for the period from 50 to 60 seconds. During this period, 45–50 units of vehicles pass in the forward direction, the rest stop in front of the prohibiting traffic light. The red signal lights up from 35 to 40 seconds, and during this time 2 to 6 more cars join the standing cars, approaching from the secondary road.

Most of the intersections on this section of the road are T-shaped, as shown in Pic. 1. With minor amendments, the intersection of 50 let VLKSM street with Maksim Gorkiy, Kholodilnaya and Permyakova streets can also be attributed as being T-shaped. Their difference is that, moving from west to east, there is an additional lane for turning left or making a U-turn. Also, at these intersections there are turns to the right (crossing Maksim Gorkiy street), where the car service is located, and to the gas station (crossing Kholodilnaya and Permyakova streets). Based on the observations of movement of vehicles at these intersections, it can be noted



Pic. 1. Scheme of T-shaped intersection at the street 50 let VLKSM (compiled by the author).

that the number of vehicles leaving them on 50 let VLKSM street is so small that it is possible to remove the traffic light near a car service, gas stations and make an exit as «from the adjacent territory when it is allowed to turn only to the right».

Design Proposals

To implement the design solution for development of unhindered traffic along the 50 let VLKSM street in one of the directions, it is proposed to do the following:

• To install signs allowing only left turn from the left lane and right turn from the right lane only at all the T-shaped intersections entering the 50 let VLKSM street.

• To keep the same mode for traffic from east to west, namely for vehicles driving in the extreme right lane to install signs allowing going straight and to the right, for those moving in the left lane there will be sign allowing going only straight forward.

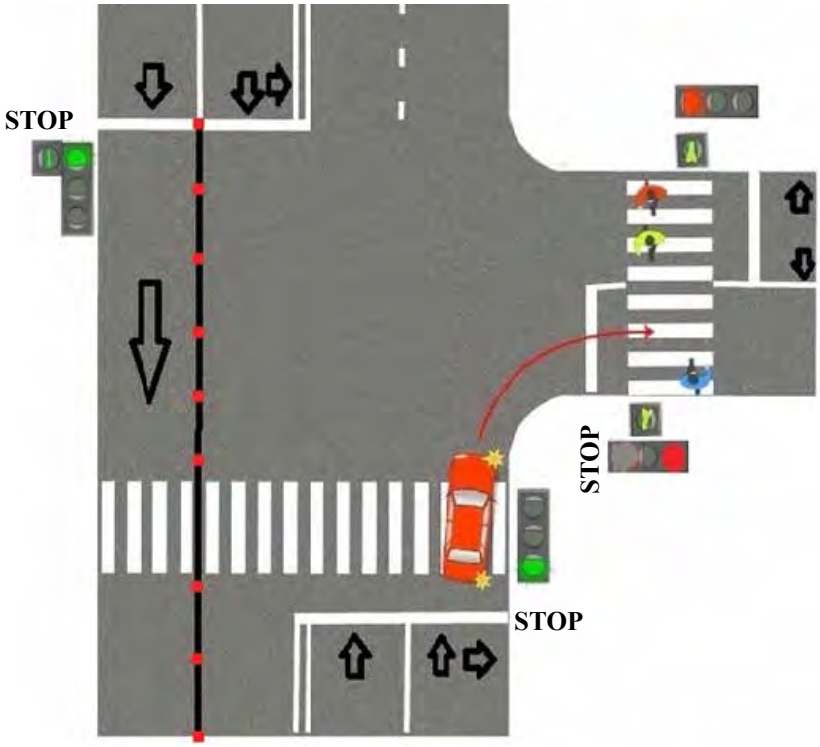
• When driving from west to east of the city in the extreme left lane, it is possible to make a left turn and a U-turn, and the extreme right lane can be intended for driving straight, except for right turns (e.g., to car services and gas stations), if there are any.

• To carry out markings for a pedestrian crossing across the 50 let VLKSM street on only one side of the intersection.

• To equip the installed traffic lights with special buttons for manual switching on for pedestrian crossings, after a certain time interval, and it is proposed to leave the same time for passing and waiting for vehicles.

An approximate design option will look as shown in Pic. 2.

For initial introduction of this project, so that motorists can develop a habit, it is possible to install additional signs [12] before entering the intersection and to separate the far right lane, for example, with signal identification posts (Pic. 3).



Pic. 2. An approximate typical design of a T-shaped intersection for unimpeded movement in one of the directions (compiled by the author).

Pic. 3. Signal identification posts.

CONCLUSIONS

When implementing the project of a T-shaped intersection along its entire length of 50 let VLKSM street at the intersection with secondary roads, it is possible:

• To ensure unimpeded movement from the city centre to its eastern part, thereby increasing average speed of movement of vehicles, including freight vehicles with a maximum permissible weight of over 3,5 tons.

• Not to infringe on other road users in delaying traffic lights.

• To stay in the limits of minimum cost estimate for reconstruction.

• To avoid global construction works.

• To increase car traffic by 1,5–1,8 times.

• To create convenient schemes for operation of pedestrian crossings.

• To organise safe conditions for pedestrian crossings.

• To reduce downtime of vehicles at intersections, which will entail a decrease in emission of harmful gases and improve the environmental situation.

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Editor's note. Even though the research is of applied and local nature and does not pretend to generalise the conclusions, it seems that precisely because of its specific focus, its results can be of interest and might be useful due to the similarity of the problems experienced in many cities with comparable traffic congestion.