Improving the transport infrastructure on the federal highway

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Abstract. Rostov-on-Don is located in the central part of Russia. It is a major transport hub. Paths from many regions of Russia intersect here. A route to the southern cities of the country passes through the metropolis, which is especially popular in the summer. Since 2022, the flow of freight and passenger transport from the annexed territories of Russia has increased significantly. The city of Rostov-on-Don plays an important role in the supply of goods, provision of services, as well as the supply of construction materials for the restoration of settlements in the annexed territories. In the Rostov region, great attention is paid to repairing roads to the Lugansk and Donetsk people's republics. High-quality roads and transport links play an important role in the development of new territories in Russia and influence the development of the modern economy. The main entrance/exit to the city is the A-280 highway “Rostov-on-Don - Taganrog - border with the DPR”, which has federal status. The route starts from Rostov-on-Don, namely from the roundabout intersection of Malinovskoye Street and Taganrog Highway, which is located within the city. The purpose of the study is to improve transport infrastructure to improve road safety at this intersection.

1 Introduction

Rostov-on-Don is located in the central part of Russia and is a major transport hub. Paths from many regions of Russia intersect here. A route to the southern cities of the country passes through the metropolis, which is especially popular in the summer. In the Rostov region and Rostov-on-Don, the problem of improving transport infrastructure is urgent [1].

Since 2022, the flow of freight and passenger transport from the annexed territories of Russia has increased significantly. The proximity of Rostov-on-Don to the border of the Donetsk people's Republic makes it an attractive place for many residents of the republic who are looking for better conditions for work, education and life in general. In addition, the metropolis has a railway station, which helps attract a large number of people from the surrounding areas. The city of Rostov-on-Don plays an important role in the supply of goods, provision of services, as well as in the supply of construction materials for the restoration of

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settlements in the annexed territories [2]. In the Rostov region, great attention is paid to repairing roads to the Lugansk and Donetsk people's republics. Since the beginning of 2023, work on 40 sections has been completed on the Don within the framework of the national project “Safe Quality Roads”. High-quality roads and transport links play an important role in the development of new territories in Russia and influence the development of the modern economy [3]. Despite the increased attention to this issue, there are still sections of roads that require reorganization due to increased traffic.

The main entry/exit to the city is the A-280 highway “Rostov-on-Don - Taganrog - border with the DPR,” which has federal status [4]. It is called “Novorossiya” and includes the routes Rostov-on-Don - Mariupol - Melitopol - Simferopol. The route starts from Rostov-on-Don, namely from the roundabout intersection of Malinovskoye Street and Taganrog Highway, which is located within the city.

2 Materials and methods

Malinovskogo Street and Taganrog Highway are one of the main routes into the city for nonresident transport, and also connect large residential areas with the city center. There is no traffic light regulation at the roundabout intersection of these streets. Regardless of the time of day, you can observe congestion in the transport network. The reasons for congestion can be any, but the main one is insufficient road capacity. The situation is especially aggravated in bad weather. Traffic accidents often occur here. One of the reasons for accidents is the difficulty of passing the roundabout for heavy vehicles. Vehicle collisions are common. Since the roundabout is unregulated, drivers often do not follow the order of passage and try to rush through. As a result, road accidents can occur.

The purpose of the study is to improve transport infrastructure to improve road safety at the intersection of Malinovskoye Street and Taganrog Highway. To do this, the following tasks are solved: 1. the intensity of vehicle traffic is determined; 2. the composition of the traffic flow has been studied; 3. conflict points of transport flows have been identified; 4. measures were proposed to reorganize a section of the road network.

The intensity of traffic was studied using the method of continuous observation. The counting was carried out on weekdays, twice a day at “peak” time intervals at least 3 times: 8.00 - 9.00 and 17.00 - 18.00. Based on the observation results, a cartogram of traffic flows and a histogram of traffic intensity were constructed. During the day on weekdays there is a continuous flow of vehicles. The greatest intensity can be noted in the morning hours in the direction of the city center along the Taganrog Highway, and in the evening hours in the direction of leaving the city.

An important indicator characterizing the ratio of vehicles of various types is the composition of the traffic flow. This indicator has a significant impact on all traffic parameters [5].

Figure 1 shows the percentage of traffic flow at the roundabout intersection of Malinovskoye Street and Taganrog Highway.

It is known that the traffic of passenger cars is significantly influenced by the presence of heavy freight vehicles in the flow, as well as medium- and large-capacity buses. Heavy-duty trucks are of particular importance, since they have the largest overall dimensions and low dynamic characteristics, which makes them difficult to maneuver in traffic flow. Thus, this type of transport creates additional traffic difficulties for other road users [6].
Fig. 1. Traffic composition diagram.

The diagram shows that in the traffic flow of the intersection under study there is a significant share of freight transport. This is due to the fact that along Malinovsky Street there are a large number of large shopping centers, construction bases and warehouse areas. Large vehicles cause difficulty in passing through the roundabout, resulting in traffic accidents.

Next, conflict points were studied, as shown in Figure 2.

Fig. 2. Conflict points of intersection.

Based on the results of the study, we can conclude that the node is of medium complexity [7-9]. However, a theoretical assessment of conflict situations gives a rough idea of the danger of intersection. In reality, the road situation is difficult due to the high traffic intensity.

One of the main operational parameters of an existing highway is its load level, which is characterized by the road load factor [10, 11]. According to regulatory documentation [12], the load factor of the intersection in question is 0.9. This value corresponds to the following characteristic of the road situation: a continuous stream of cars moving at low speeds, overtaking is impossible. The driver’s emotional load is very high, and the driver’s work experience is inconvenient. Which corresponds to real observations.

In the current situation, there is a clear lack of number and width of traffic lanes.

A solution to the high congestion of the roundabout intersection of Malinovskoye Street and Taganrog Highway may be to divide traffic flows into different levels.
3 Results and discussion

It is known that the best option for a city’s transport system is a system in which there are no traffic lights, and all intersections of traffic flows occur at different levels [13]. Many researchers are engaged in the problem of congestion on city roads and the search for its solution [14-16].

Therefore, to separate traffic flows and reduce intersection points in the area under consideration, a two-level overpass is proposed. The issue of introducing overpasses to eliminate the negative consequences of congestion is reflected in many domestic and foreign sources [17-19].

In the proposed solution, measures to improve transport infrastructure to improve road safety at the intersection of Malinovskoye Street and Taganrog Highway are:

1. Designating a roadway with two lanes for turning onto Malinovsky Street from the entrance to the city.
2. Construction of an overpass for turning from Malinovsky Street to exit the city.
3. Expansion of the roadway of the Taganrog Highway.

4 Conclusion

The stated goal of the study has been achieved. The assigned tasks were solved: the intensity of vehicle traffic was determined; the composition of the traffic flow was studied; conflict points of traffic flows have been identified; measures were proposed to reorganize a section of the road network.

The allocation of a roadway with two lanes for turning onto Malinovsky Street from the entrance to the city will ensure free flow of traffic in the southern direction. At the same time, an overpass for turning from Malinovsky Street to exit the city will eliminate the intersection of flows. This is important for this section, since the main flow of freight transport is observed along Malinovsky Street. Expanding the roadway of the Taganrog Highway will increase the capacity of the road that leads to the city center.

The proposed measures will reduce the traffic load on the section of the federal highway under consideration. At the same time, the travel time will be reduced, the level of stress among drivers will be reduced, and the environmental situation will also improve by eliminating congestion situations.

Convenient transport infrastructure will improve transport links between adjacent territories. Thus, it will have a positive impact on the integration of new territories into the social and economic life of Russia.

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