

# *Burning Issues of Development of the Transport Network of the Largest Industrial City*

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**Abstract** – The article identifies and substantiates the problems of the development of the transport infrastructure of the largest city (for example, the city of Yekaterinburg). The examples are considered and the ways of solving a number of work production issues are proposed. It was concluded that the way out of the current situation is impossible without the use of administrative resources and the exact implementation of the strategic development plan of the city.

**Keywords** – transport infrastructure, contract work, city planning, construction and installation works

## I. INTRODUCTION

In recent years, for the Sverdlovsk region [10,11], as for the absolute majority of the territories of the Russian Federation, there has been a massive migration of the population to the regional center [7]. The population of Yekaterinburg is growing rapidly, which, in turn, causes the construction of new and reconstruction of the old districts of the city. Any construction is unthinkable without the development of infrastructure, including transport [12]. The development of the city's road network lags behind the pace of housing construction, leading to collapse with the daily movement of citizens [5]. A banal increase in funding for the construction and reconstruction of roads, without analyzing the problems in each particular section of the road network, will not give any results [9].

## II. ANALYSIS OF PROBLEMS

“On the ring on Seraphima Deryabina street in the direction of the Academic there was a traffic jam. A traffic jam formed due to the start of road works. Judging by the information table by 2021 there must be a transport interchange here” [3]. The construction of the long-awaited interchange on the ring road and the street to them was stared with such a message. Seraphima Deryabina in Yekaterinburg, which has been discussed for several years. It is planned to spend about 1.5 billion rubles on the construction of new sites only in this area (Tab. 1).

In addition to the construction of new sites, the repair sector is actively funded. In recent years, an average of 1 billion rubles has been spent on repair and restoration work on streets in the city per year (Table. 2).

TABLE I. PLANNED FINANCING OF CONSTRUCTION OF TRIPS FROM THE AKADEMICHESKY DISTRICT, MLN RUB [4]

Section	2018	2019	2020	2021	Total
St. Wilhelm. De Gennin Str.	199,9	117,8	180,0	157,7	655,6
Amundsen Str.	75,3	147,8	24,5	-	247,6
Interchange at the intersection of Seraphima Deryabina Street- District	99,9	118,0	213,3	116,0	547,3

Therefore, significant funds were allocated for the construction of a new road network and the work on the current and overhaul of existing roads. It can be said that the existing state of affairs requires more, but we proceed from what is. According to the media [2], two large road companies in Yekaterinburg received contracts worth RUB 7.5 billion last year.

TABLE II. THE AMOUNT OF FUNDING FROM VARIOUS LEVELS OF BUDGETS FOR THE REPAIR AND RESTORATION WORK OF LOCAL ROADS IN THE CITY OF YEKATERINBURG [6]

Year	Thousand sq.m.	%	Amount of financing, thousand rubles.			
			Federal budget	Regional budget	Local budget	Total
2009	171,1	1,7	-	-	-	-
2010	1076,9	10,8	1 197 889,78	-	64 174,49	1 262 064,27
2011	482,6	4,8	98 078,15	344 537	24 299,68	466 914,83
2012	732,2	5,1	-	525 791,83	450 029,73	975 821,56
2013	645,4	4,4	-	1 274 155,35	74 469,89	1 348 625,24
2014	361,87	2,5	-	825 165,97	304 770,00	1 129 935,97
2015	370,45	2,8	-	528 839,64	34 308,51	563 148,15
2016	815,42	6,2	445 719,59	787 507,82	49 692,51	1 282 919,92
2017	908,02	6,9	126 959,73	1 290 163,74	76 088,07	1 493 211,54
2018 (Plan)	864,79	6,6	764 992,20	700 000	89 764,00	1 554 756,2

In their crushing majority, contracting organizations are commercial structures, that is, they have the goal of their existence to make a profit.

The structure of the estimated cost is determined by the formula as follows:

$$EC = (CL + CA + CO) + OC + EP + UE, \quad (1)$$

- where EC – estimated cost of work;
- CL – cost of labor of the main workers;
- CA – cost of the acquisition, transportation, storage of building materials;
- CO – cost of operating the machines (the wages of machine operators, maintenance and operation);
- OC – overhead costs;
- EP – estimated profit;
- UE – unforeseen expenses.

The profit is part of the estimated cost, therefore, to increase its share, the Contractor needs to reduce costs in other items. What elements can be cut? It is impossible to predict the occurrence and amount of unforeseen expenses at the stage of applying for participation in a tender for contract work. Wages are monitored by labor, tax inspections. Replacing building materials with cheaper counterparts requires coordination with the Customer and the designer. However, in the articles “expenditures for the operation of machines” and “overheads” there are expenditures for the redeployment of equipment and construction camps to the work sites. When analyzing the proposals for the rental of special equipment in Yekaterinburg [1], it becomes clear that the minimum rental period is 4-8 hours plus delivery time. That is, with large amounts of work concentrated on one area, the use of high-performance equipment is justified. But if the Contractor needs to replace one rainwater well ring, or seal one square meter of unusable asphalt concrete pavement, then the cost of transportation to the work site of the equipment will be excessive and drastically reduce Contractor’s profits. Accordingly, the Contractor is interested in performing work on a narrow front of work by the flow method. Small objects require large transport costs per unit area. If you perform work on many small objects, the amount of additional costs becomes quite significant.

The recommendation is automatically suggested: to distribute the execution of small works to small contractors. However, such organizations most often lack the means of mechanization, capable of carrying out road-building and repair work with the proper quality. For example, when constructing an asphalt concrete pavement, the weight of the required rollers is 11–20 tons [8], and in many urban road-building organizations, rollers use no more than 3 tons, which physically does not allow road works according to the “Roads” SNIP.

The next issue that impedes the production of high-quality repair work at small facilities in Yekaterinburg is the difficulty of technical supervision by representatives of local authorities exercising control over the production of works. The surrender to inspectors of hidden works on each structural pavement layer of each repaired hollow is unrealistic from the organizational side. Quality assurance in this case can only serve as a written warranty of the General Contractor to the operating organization, that is, in essence, he is invited to “take the floor”, which makes small construction and repair work on the transportation arteries extremely disadvantageous

to both representatives of the Administration and Contractor’s representatives.

However, from the point of view of significance for the functioning of the city’s road network, small works are comparable to large ones. On the streets of Yekaterinburg there is a significant amount of constrictions, “bottlenecks” that hamper traffic flows, but do not require significant expansion costs. The area of road paving works on such plots ranges from 20 to 100 m<sup>2</sup>, that is, with an average standard consumption of materials (1 ton of asphalt-concrete mix per 10 m<sup>2</sup>), less than one asphalt-concrete mix is required for the reconstruction of each section. Large organizations are not interested in such work due to low profitability.

Let us consider only some of the ‘small’ areas, a minor reconstruction of which will improve the transport scheme of the city.

Moving along Shchors Street in the western direction, after crossing Moskovskaya Street we turn right onto Shaumyan Street (Fig. 1). The capital reconstruction of this site was completed in 2017, but problems in the organization of traffic remained. Rotation of transport is carried out in two lanes, as seen in Fig. 2. Further, after 100 meters, the sign 5.15.5 “End of the strip” is installed, and after a few more meters – the sign 5.15.4 “The beginning of the strip”. Thus, the cars after turning should be reconstructed in one row and immediately return to the movement in two rows. It is enough to extend the two-lane traffic by several meters, and the flow deceleration will be removed to rebuild. No buildings interfere with such reorganization.



Fig. 1. Photo of Section 1



Fig. 2. View of Section 1 from the perspective of a road user

Moving along the Vikulova Street to the north, we cross the street Kraulya (Fig. 3). At the traffic lights, the right turn is on the green arrow with a total red, and the movement is straight and left with a common green traffic light and the prohibition of the right turn. The road has two full-fledged lanes (when driving only cars, without trucks and buses, it is possible to move in three lanes). Cars turning to the right move in the right lane and stop when the resolution signal ends, waiting for the cycle to repeat. Cars moving straight and to the left are in the same left lane (Fig. 4). However, if there is at least one car turning left, it skips passing and oncoming trams, the oncoming traffic and turns most often at the end of the traffic signal. In the meantime, he stands, occupying the only lane left after stopping right turnaround vehicles in anticipation of the enabling signal, the vehicle cannot move directly. There are two ways to solve this node:

- to arrange for a full third lane, expanding the road in the direction of a wide sidewalk for 30 meters. No structures in the expansion zone are located;

- to remove the left turn at this traffic light and organize a turn around the intersection where full-fledged two lanes make it possible to bypass the unfolding traffic in the free right lane.



Fig. 3. Photo of Section 2



Fig. 4. View of Section 2 from the point of view of a road user

The forces of large contractors must be directed to areas that require drastic technical and management decisions. For example, the Sosnovy Bor micro-district (Fig. 5) is currently being intensively built up. However, it has only two departures in the direction of the city center, and one of the trips, although it is called the “street”, is closer in its characteristics to the local passage. New buildings are located in close proximity to the carriageway, which excludes the possibility of expanding the street-road network. In addition, this neighborhood has a physical limitation of the development of road infrastructure due to the location between the railways, the Koltsovsky tract, the Iset River. That is, even a change in the width of the existing internal streets will not lead to a reduction in traffic jams during peak hours, since the narrow spaces are not connected with the width of local roads, but with departures on the city roads.



Fig. 5. Neighborhood ‘Pine Forest’.

1, 2 – departures from the micro-district. 3, 4, 5 – under construction Residential real Estate

The issue of technical control over the quality of work also has its solution. It is recommended to include in the tender documentation a clause according to which the Contractor undertakes in writing for a certain time to bear warranty liability for the safety of the repaired/constructed roads, except for areas where after the construction was completed excavation works or there are traces of other external

influences. In addition, the list of coordinates of the work areas should be included in the executive schemes. Thus, if the deformation of the coverage occurred during the warranty period, falls on the territory bounded by the coordinates of the executive survey, and there are no traces of external interference, then the warranty obligations are borne by the Contractor. In case if the Contractor refuses to eliminate the warranty obligations of the City Administration, it is recommended that this contracting organization is not involved in the repair/construction of city roads anymore. Repair areas (patching) fix coordinates is difficult. They are recommended to be marked actually on the spot by indentation of the marking with the date of work production, as well as by mapping the operating organization.

### III. CONCLUSIONS

Therefore, at present, the transport network of Yekaterinburg is characterized by a significant number of “bottlenecks”, which significantly slow down traffic and increase the economic distance between districts of the city. Contracting organizations are not interested in performing work in minor areas. Administrative management decisions are required to analyze and systematically eliminate these places on the city map. It is necessary to strictly and strictly adhere to the strategic plan for the development of the city.

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