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## **IMPROVING URBAN DEVELOPMENT METHODS FOR THE DEVELOPMENT OF AN URBAN TRANSPORT SYSTEM**

**Summary.** The problems of modern urban planning are described and ways to solve these are discussed. Cities of the Russian Federation have low indicators of transport and planning efficiency; the general plan theory of the city does not answer many questions on the development of the urban environment. There are no requirements for the efficient use of urban areas and the formation of a city plan. An integrated approach is considered to improve the productivity of transport infrastructure to the modern level of motorization, develop measures to improve road safety, and also enable the prioritized development of environmentally friendly, economical, and high-speed types of public passenger transport. In this respect, the problems of improving the theory and practice of urban planning are highlighted in a new light. During the period of preparation of this article for publication, a new master plan for the development of the city of Omsk was approved, which included these proposals. The construction of the longest embankment in Eurasia began; a decision was made to use tunnels and stations of the unfinished metro for the development of tram routes.

### **1. INTRODUCTION**

The current state of construction development and the lag in the transport systems in many cities of the Russian Federation are a cause of concern among specialists and citizens. The case of Omsk reveals a number of negative trends. Sometimes, the territories of former industrial enterprises located in the city center are allotted for construction. The population density in these areas increases sharply, but social and transport infrastructure development trails behind and the quality of service decreases. Developers are interested in accommodating the maximum amount of living space in the territory provided for them. The issues of infrastructure for new districts are resolved formally: a kindergarten can be located in the extension of a building, a school is a few blocks away, shops are scattered around the area. A street may go through the common area of a multi-storey building and a car park is placed on the playground. This situation is typical for Siberia. At the same time, for example, in Omsk, even in the city center, whole areas of old estate buildings have survived. There is no renovation in such areas, since nothing special can be offered to people. Private housing does not qualify for the renovation program.

Affordability and accessibility are the key indicators of territory development efficiency and transportation system analysis. It was used in many research papers for evaluating equal public transport investment in the territory [1 - 3]. For example, recent studies of affordability and equity have focused

on the distribution of the public transport system across different income groups [4, 5]. Organizers of transport services, carriers, and passengers treat the quality of transport services in different ways, pursuing their own agenda. A systematic process of quality evaluation, as well as the interaction between passengers and the transport system, can help to improve the situation [6].

In Russia housing affordability index is one of the highest in the world. For every thousand Russians in 2018, there were 456 apartments, and in 2017, for every thousand Russians, there were 442 apartments. For comparison: in the USA in 2017, for every thousand persons, there were 335 apartments, in Canada, for every thousand persons, there were 328 apartments, in Brazil, for every thousand persons, there were 313 apartments and in France, for every thousand persons, there were 385 apartments. However, on the basis of the number of square meters per person - 25.8 in 2019, according to Rosstat, Russia is behind most developed countries, although ahead of many developing countries. For example, in Germany and the USA this figure is 39 square meters and 70 square meters, respectively, in Poland - 25 square meters, in Turkey - 17 square meters. In Russia, for the purchase of an apartment 54 square meters family will need 3.3 years - this is a fairly high level of accessibility. For example, in the United States, this figure is 3.7 years. However, in the United States, the average area of the house based on which the accessibility indicator is calculated is 200 square meters. If a Russian family wants to purchase housing in such an area, it will take more than 12 years to save money. About 7% of the housing stock is rental housing; almost every 10th family rents housing, but this is almost an illegal market. The development of the rental market can help partially solve the housing issue for young families [7].

Work on the development of city centers and improvement of transport infrastructure (except for the regional centers of the Russian Federation) has slowed down. Localized construction is changing; it has become a large-scale venture. This worsens the transport performance of cities, their ecology, traffic safety and quality of life. These factors led us to perform a detailed analysis of the current situation.

In capitalist countries, the urban population averaged 50-60% by the end of the last century, and in socialist countries, the urban population averaged up to 30%. Experts argue that by 2050, 70% of the world's population will be urban: about two billion people will move to cities around the world [8]. The most important task will be the rearrangement of areas that are already in use or occupied, as well as the construction of new roads and development of existing roads. This is much more difficult to do than building a new city.

In this urban era, with limited material and financial resources, it is necessary to work on project documentation carefully – i.e. design reasonable prospects for the innovative development of useful, convenient, functional, and rational cities.

## **2. ASSESSMENT OF THE URBAN INFRASTRUCTURE OBJECTS**

### **2.1. Assessment of cities' infrastructure in Russia**

The following methods and tools were used in the study: statistical analysis and time-series analysis to assess indicators and their dynamics, mathematical modeling methods, fuzzy set theory, and the theory of transport systems of cities [9].

The effectiveness of planning in large cities of the Russian Federation can be assessed by special indicators - construction and population density; the density of the transport network; and the density of the network of public passenger transport lines in built-up areas.

The main indicators of construction density are as follows:

- construction coefficient - the ratio of the area occupied by buildings and structures to the area of the site (quarter); it varies from 0.4 to 1.0;
- construction density coefficient - the ratio of total floors' area to the area of the site (quarter); it can be 1.6 for apartment buildings and 3.0 in multifunctional business areas.

The population density due to the sanitary regulations (SR 42.13330.2016) is normalized by the following value: "The estimated population density of a city district with multi-story buildings and the norm of 20 m<sup>2</sup> per person should not exceed 450 people/ha." Many cities have a low density index,

which makes it impossible to create a high-quality city environment. We are talking about gross population density, measured in thousands of citizens per km<sup>2</sup>.

The development of transport infrastructure is characterized by the line density of the transport network (km/km<sup>2</sup>). With a low gross population density, the density of the transport network is also low; this in turn affects the transport accessibility of territories and journey time. Due to the increase in length, the cost of the transport network increases.

The population density in the cities of the Russian Federation is as follows: Moscow - 12 thousand inhabitants / km<sup>2</sup>, St. Petersburg - 14 thousand inhabitants / km<sup>2</sup>, Omsk - 4.5 thousand inhabitants / km<sup>2</sup>, and Novosibirsk - 4.0 thousand inhabitants / km<sup>2</sup>. However, in the cities of Siberia, the density of the transport network is below the norm: about 1 km / km<sup>2</sup>.

The cities of developed capitalist countries are focused on the development of private transport; this is especially evident in the United States, where the proportion of streets, sidewalks and parking spots is 1/3 of the populated territory. In cities of the Russian Federation, this proportion does not exceed 5%.

Parking takes up an incredible amount of space and costs American cities huge sums of money. This is the main conclusion in a recent study of parking space in 5 American cities: New York, Philadelphia, Seattle, Des Moines, and Jackson [10].

In the study mentioned the total amount of parking spaces in these cities and the potential cost of their placement have been calculated as well as some interesting metrics such as the number of parking spaces per acre/a household and the cost of parking per a household have been introduced. The maps of parking density in these cities were provided.

There are more than 2 million parking spaces in Philadelphia, 1.85 million in New York, 1.6 million in Seattle and Des Moines, and just over 100,000 in tiny Jackson, where 10 000 people live.

Parking takes up a huge amount of space: Jackson has more than 50 parking spaces per acre - 25 times the size of residential areas. Each household (apartment) has an incredible 27 parking spaces. All statistics are presented in Table 1.

Table 1

Characteristics of parking spaces in US cities

Indicator	New York	Philadelphia	Seattle	Des Moines	Jackson	New York
Parking spaces, million	1.85	2.2	1.6	1.6	0.1	1.85
Density per acre	10.1	25.3	29.7	28.4	53.8	10.1
Density per household	0.6	3.7	5.2	19.4	27	0.6
Replacement cost, \$ billion	20.1	17.5	35.8	6.4	0.711	20.1
Cost for household, \$	6.57	29.974	117.677	77.165	192.138	6.57

USA is spending excessively on parking, despite the fact that there are fewer drivers [11]. For example, the number of people in Seattle with a driver's license and cars declined for the first time in at least 40 years, and the percentage of high school drivers is at an all-time low of 71.5% (2015). At the same time, ride-sharing is popular; both cities and developers are looking to further reduce the demand for parking. Using ride-sharing, fellow travelers find each other online, the driver compensates the costs, passengers give ratings and reviews, the trip can be planned, etc.

An analysis of the Internet sources shows quite a negative picture in our cities; for example, there are practically no parking spaces in Vladivostok. In the city center, one can still find a couple of locations for a small number of parking places, but they are all occupied. It is impossible to buy any season ticket, and payment is only per hour (about 100 rubles). Moreover, higher and denser houses are built in

Vladivostok. There is a whole residential area with new buildings, which was not built up chaotically, but had been planned as a single project. Now there are more than 30 multi-story buildings with 10 – 24 floors. The number of families is huge, but there is not a single parking spot, whereas the construction density and the terrain make even spontaneous parking difficult.

## 2.2. Analysis of the modern planning structure in Omsk

In 2020, the correction of a general plan began in Omsk. In this respect, it became necessary to assess and correct the shortcomings of the planning structure, which include the following:

- uneven development of urban areas, "disruption" of the urban territory, caused by the terrain, which is formed by the confluence of two rivers;
- lack of transport links and bridges across rivers. Overburden of some transport hubs, rush hour congestion on the main city highways;
- heterogeneity of the urban environment, chaotic distribution of functional areas, alternation of multi-story buildings and private houses;
- construction of the most accessible and easy-to-develop territories (embankments), and as a result, there is an increase in the residence density. In certain areas, there is a burden on the engineering network, and social and transport infrastructure;
- imbalance in the location of residential areas and places of employment as a result of uneven and extensive territory development. The majority of the population commutes to working places located in other city areas;
- there are wastelands
- and abandoned industrial enterprises in the central and arts of the city and its outskirts; and
- lack of parking spaces, parks, pedestrian zones, and their inaccessibility for physically challenged people.

The structural analysis revealed that these shortcomings were caused by the problems affecting the quality citizens' life and the economy of Omsk:

1. High level of motorization and a lag in the road network capacity development lead to an increase in the time spent in passenger and freight traffic.
2. Public transport cannot cope with passenger services because of technological obsolescence, and transport and route network reduction.
3. The high cost of public transport operation and the use of liquid hydrocarbon fuels have a negative impact on the economy, the environment, and health.
4. There is a lack of bus stations and specific locations where passengers can transit from cars to public transport. This leads to poor quality of passenger services on suburban lines.
5. Lack of parking spaces in residential and business areas of the city gives rise to discontent among residents, deteriorates the quality of the living environment and reduces the capacity of streets filled with parked cars.
6. There are problems with the accessibility of the city environment for pedestrians, cyclists, and people with disabilities. The main reason here is a lack of accessible routes and asphalt pavements in the private sector of the city.
7. As a consequence, the number of accidents in Omsk is 2 times higher than that in neighboring Novosibirsk.

## 2.3. Improvement of the route network

The transition of Russia to a market economy has led to a decrease in the share of public transport; people began to use private cars more actively. However, there is a certain percentage of the population that does not have such an opportunity; therefore, it is necessary to establish the route network in accordance with the demand.

In 2019, the list of routes for regular transportation within the city of Omsk included 49 municipal bus routes, 81 bus routes of non-municipal carriers, 9 seasonal routes, 8 trolleybus routes, and 6 tram routes (Table 2). The number of routes has decreased by 17% over the past three years.

The average length of regular transport routes was 22.9 km. The total length of routes decreased by 28% by 2017. The number of public transport units decreased by 8%. There are no large-capacity (articulated) buses after they were decommissioned in 2018. Electric transport numbers 121 trolleybuses and 75 trams. Public route network has reduced dramatically during the last three years.

Transportation flows in the city are formed by passengers who choose a certain means of transport. Nowadays most passengers give their preference to individual transportation and get their driving license. This choice provides a lot of advantages for travelers: door-to-door transfer, increased speed, possibility to go wherever and whenever they want, and more comfortable travel conditions. For city traffic all these leads to shortage of traffic capacity and lack of parking spaces.

Public transport does not have the main advantages of individual transport, but it is more productive and occupies less area of the road network per passenger [5]. In addition, the cost of maintenance is lower. The only advantage that can ensure its competitiveness is speed. To reach this public transport should avoid traffic jams and should not be stopped by general traffic flow.

Table 2

Main indicators of the route network in Omsk

Indicator	2017	2018	2019	%
Number of transport units:	2711	2609	2505	92%
- municipal bus	549	481	493	90%
- trolleybus	143	137	121	85%
- tram	75	75	75	100%
- non-municipal bus	1944	1920	1816	93%
Number of public transport routes:	174	147	144	83%
- municipal bus	60	50	49	82%
- trolleybus	9	8	8	89%
- tram	6	6	6	100%
- non-municipal bus	99	83	81	82%
Length of public transport routes, km:	3406,5	2640	2436,6	72%
- municipal bus	1134,6	965,9	859,9	76%
- trolleybus	119,0	113,5	113,5	95%
- tram	62,8	62,8	62,8	100%
- non-municipal bus	2090,1	1497,8	1400,4	67%

As a solution, it is necessary to i prioritize city public transport in general plans, e.g. the development of new modes of transport and reservation of required territories.

## 2.4. Transport infrastructure

A large number of parking spaces with high car ownership level (of 800 vehicles per thousand people) in the United States are compensated by the almost complete absence of public transport. The car ownership level in the Russian Federation, according to experts' forecasts, should stabilize at the level of 350-400 vehicles per thousand people. This means that it is necessary to bring the performance of the transport network to this level and focus on the development of public transport.

The need for new types of transport is urgent, but their development is hampered by the legislation, namely, the lack of new types of transport, for example, a high-speed tram or guided transport, which could be developed on the basis of unfinished metro, abandoned or existing tram lines, and special sections of the road network. The advantage of a guided bus is that it can move outside the equipped line like a regular bus (electric bus, trolleybus) on city routes.

In Omsk, there is a difficult situation with bus stations. One bus station is located in district № 6 on Komarov street, 2. Another one is right in the railway station building on Lecont street, 1A. There are no bus stations, but there are organized and unorganized places of arrival and departure.

The federal law [12] claims the need to "reduce the load on streets and highways, locate bus stations near the places where access roads cross the boundaries of settlements."

The analysis indicates that the main bus station does not meet the established requirements. It is located in a residential area, which places a burden on residents in terms of traffic intensity, noise, and emissions. The architecture of the station building can be called original and not typical for Siberia, because it was a project for the southern climatic zone. We can see waiting rooms located on the second floor and balconies; therefore, they are closed in winter. Passengers are exposed to freezing temperatures and inhale fumes while waiting for departure on the aprons, because buses cannot be seen from the waiting room. There are no bus stops in front of the station, and no taxis and car parking near the station square. Everything is crowded in a cramped transport area at a considerable distance.

The bus station serves 349 directions. The lack of departure points can be seen from the schedule posted on the “Omskoblavtotrans” website. The departure points are bus stations on Komarova street, 2, Lekont street, 1A, Dergachev street, DK Lobkova, 20th Line, "Triumph", Budarin street, Partizanskaya street, Suvorov street, and 21st Amurskaya street. In addition, there are a lot of nondefined places of departure for commercial service.

The bus station, railway station, airport, and river port are located in different parts of the city and not connected. For example, there are no express routes. These places are linked only by one trolleybus, a bus, and a couple of fixed-route taxis.

The number of passengers transported on intercity routes in relation to the number of city passengers is a significant value (about 30%). This must be taken into account in the solutions proposed in the general plan. The concept of Transport Interchange Complexes (TIC) on the main city highways can improve the situation with passenger service on inter-municipal routes and allowing of combined external modes of transport. The implementation of the TIC concept will make it possible to free up territories that are currently used as terminal turning points for buses with limited functions (for example, Budarina street, Partizanskaya street, etc.). They can be used for the development of the city region.



Fig. 1. Layout of transport facilities and perspective of their development

All this requires the adoption of program measures to regulate the places of departure, ensure their safety, comfort, and legalization of income from out-of-city transportation to the municipal budget.

## 2.5. Ecological effects of urban transport

Of two sources causing environmental pollution (natural and anthropogenic), the second is of more concern. According to official data for our country [13], back in 2018, emissions from cars reached 15.1 million tons, with an increase of 19% compared to 2012. At the regional level, the largest volume of emissions was found in Moscow (933.9 thousand tons, + 2%) and Moscow region (805.4 thousand tons, + 14%). These two regions in 2018 accounted for 11.5% of the total volume of emissions from cars in

the Russian Federation. The increase in emissions from cars is due to the increase in their sales. According to PwC, in 2018, sales of cars increased by 13.2% compared to 2017, sales of light commercial vehicles increased by 3.4%, and sales of trucks increased by 2.7% [14].

The analysis of traffic flows in Omsk in 2020 is presented in table 3. In total, 25 main sections and traffic intersections were surveyed for an hour in each direction. During the survey, 141,918 vehicles were recorded (100%). Cars accounted for 87.2%, minibuses for 5.5%, buses for 2.6%, and trucks and other units for 2%. The change in the ratio of different types of transport in the traffic flow is stable and fluctuates within 2% during the day.

Table 3

Distribution of transport according to the survey in Omsk, 2020

Mode of transport	Number of vehicles	Share
Cars	123,790	87.2 %
Minibuses	7770	5.5 %
Cargo transport (up to 3 tons)	3710	2.8 %
Buses	4,274	2.6 %
Cargo transport (over 3 tons)	1520	1.1 %
Specialized transport (ambulance, police, fire engine, etc.)	854	0.6 %
Total:	141918	100.0 %

Analysis of traffic flow intensity based on the results of surveys of opposite directions of one section shows two peak periods during the day: from 7:00 till 9:30 a.m. and from 3:30 till 7:30 p.m. The directions of traffic are different in the morning and evening hours. As a rule, in the morning, the intensity increases from the residential areas to the city center, and the traffic in the opposite direction is intense in the evening.

The solution for the difficult environmental situation is seen in increasing the environmental class of vehicles, the use of gas-powered vehicles, electric vehicles, and the decommissioning of outdated models.

In this respect, it is reasonable to amend the current standards (GOST R 56162-2019), related to the ecological class of transport units. When developing the general plan, this will help to compare various options for the transport system over the estimated period.

Increase of road safety: It is necessary to create conditions to increase road safety over the estimated period and for the future. The safety and quality of people's lives depend on these measures.

During the research, it was found that the dynamics of road accidents and their consequences on a national scale have a cyclical nature. A stable dependence of road fatalities on the national economy has been observed. Namely, the beginning of the crisis is accompanied by a decrease in the number and severity of road accidents. This is due to a decrease in the purchasing power of the population, and a decrease in economic activity, total mileage, and frequency of car use. Positive dynamics of accident rates is mistakenly associated with the effectiveness of road safety measures. During the period of economic recovery, the accident rate indicators change gradually – the higher the economic growth, the higher the accident rate indicators. These trends are stable and were observed during the last crises of 1998, 2008, and 2014. In this respect, to implement the Road Safety Strategy for 2018-2024, it is necessary to take into account the results obtained.

## 2.6. Formation of urban space

From time to time, residents celebrate the New Year, Victory Day, National Unity Day, City Day, and other events together. For some large cities, this is a major problem, since it depends on the availability of special zones – central squares, both in old and new cities. In theory, every district or residential area should have a central part as a meeting point for citizens.

The tradition of a public center is characteristic of Russian architecture. It goes back to ancient history – the Athenian agora and the Roman Forum. Our ancestors set up city centers for discussing important state problems and to hold public events. These are the squares of Kiev, Veliky Novgorod, Suzdal, Moscow, etc. Unfortunately, these traditions have not continued everywhere; for example, in the city of Omsk, there is no city square, despite its age: more than 300 years. Sobornaya square is located on the roadway; in order to arrange facilities for a celebration it is necessary to close the road for several days. As a result, traffic jams occur, and the city center becomes inaccessible for transport. At the same time, there is an area available for the city center; it just needs to be set up.

The embankments in Omsk are in poor condition. The one on the right bank is completed partially while the left bank has no embankment at all. The river Om had practically no embankments. This affects the planning indicators and landscaping of the city. The quality of the urban environment is also an important indicator that is significantly affected by swamps, wastelands, wild beaches, and landfills [15].

Historically, rivers were natural transport routes; therefore, they were developed in all major cities: Moscow, St. Petersburg, Paris, Venice, and Dresden. If there are vertical embankments in Omsk, it will be possible to build highways and sidewalks along rivers. This will increase the efficiency of the urban area, distribute transport and pedestrian flows more rationally, and improve the image of the city. The section of the Irtysh embankment along the Omsk fortress should be named in honor of F.M. Dostoevsky, who spent several years here and wrote a book about it.

Improving the city planning: This issue is rarely mentioned in general plans of cities; however, studies show that the geometry of the city has an impact on the economy, the length of engineering and transport communications, and the traffic flow between districts [16]. European cities have historically developed from fortresses with roads leading to them. This form of transport planning is called radial-circular planning. Most cities in the United States are rectangular in shape to provide convenient streets with one-way traffic. There are cities with mixed transport planning, with a circle, square, triangle, rectangle, and ribbon.

Calculations have shown that if we assume a population of 100% that can be accommodated in a circular city, then of these, 79% will live in a square-shaped city, 53% will live in a triangular city, 50% will live in a rectangular city, and only 28% of residents will fit in a city with ribbon-shaped planning.

Within the urban planning policy, this indicator can be influenced to determine the city's development for the future.

## 2.7. Accessibility of the urban environment

The formation of an accessible environment is a requirement of modern legislation. However, the current regulations change quite often and have made this process so difficult that it has practically stopped. For example, the main document - the Set of Rules SR 59.13330 "Accessibility of buildings and structures for people with limited mobility" has 5 editions - 2001, 2010, 2012, 2016, and 2020. Every time changes are made in this document, local specialists and regulatory authorities do not have time to put them into life. When reconstructing central streets, it is impossible to organize tactile paving for pedestrians who are vision impaired because yellow tiles do not match modern streets.

The methodology for creating an accessible environment includes object- and route-oriented approaches. It provides accessibility in residential and urban environments, and to transport itself. This work has been going on in Omsk for a long time. 3,235 objects have already been certified and mapped as accessible. Some of the facilities have been adapted at the expense of the state program "Accessible Environment".

Public transport stops are reconstructed annually; traffic lights with sound are installed at pedestrian crossings. The share of public transport accessible to people with disabilities and low-mobility groups is constantly growing and, in 2019, amounted to 66% for buses, 16.5% for trolleybuses, and 23% in total (Table 4).

The problem with statistical reports on accessibility remains unresolved. Canadian experts consider accessibility of public transport for people with physical disability [17]. This particular social group is studied because public transport accessible to a person in a wheelchair can be significantly different

from that accessible to the rest of the population due to physical barriers, i.e. stairs at metro stations, bus stops, or buses. These barriers and difficulty in gaining employment pose significant challenges for a sub-group of people with disabilities. They are likely to remain unemployed or underemployed compared with the rest of population for a long time [18]. However, the authors do not offer units to measure the accessibility of objects and vehicles. They use specific values - the share of accessible objects among the total number.

Table 4

Accessible public transport in Omsk for the period 2017 – 2019

Indicator	2017	2018	2019	2019/2017, %
The share of public transport accessible to people with disabilities and low-mobility groups, %	6	15	23	379
- municipal bus	25.5	27.2	65.7	258
- trolleybus	14	14.6	16.5	118
- tram	5	6.67	6.67	133
- non-municipal bus	--	11.8	12.4	105

The lack of accessibility indicators is a problem to be resolved. They are necessary for reflecting the progress in accessibility policy proclaimed in the UN Convention on the Rights of Persons with Disabilities. Russia ratified this document in 2012.

In the Russian Federation, there are no parameters for measuring the state of buildings, structures, and settlements accessible for people with disabilities and limited mobility. There is only a linguistic characteristic of zones and structures: inaccessible, partially, or completely accessible to everyone or for a certain category of people with disabilities.

Use of a score system is, in which linguistic indices are converted into numerical parameters by visual and instrumental control: 1 - The structure is not accessible; 2 - the structure is accessible with unauthorized assistance; and 3 - the structure is accessible [19]. If the points are lined up in a certain sequence corresponding to the categories of disability (W – people using wheelchairs, V – vision disability, H - hearing disability, M - musculoskeletal impairment), an object accessibility code will be obtained, for example - 1223. This means that it is inaccessible for people using wheelchairs, accessible for blind and deaf individuals with assistance, and disabled people with musculoskeletal impairments can access the service on their own. If we add the safety coefficient, information availability, and the level of comfort, we will obtain an indicator for the quality of the urban environment.

Due to the coding system, we can obtain accurate values of accessibility for separate objects and services. It is also possible to monitor changes in their accessibility over time and rank the road network by its accident rate. The numerical parameters make it possible to encode and select the parts of the logistics chain on the routes of passengers with disabilities. This kind of accessibility assessment can be used at the municipal, regional, and federal levels, as well as for assessing the implementation of the UN Convention on the Rights of Persons with Disabilities.

### 3. CONCLUSIONS

Many large cities of the Russian Federation have to create a balance between different modes of passenger transport – public and private, electric, gasoline, and bicycles. It is necessary to wipe out the lag in the development of the road traffic network, reduce traffic jams, provide the required number of parking spaces, and, at the same time, create a public transport system that provides reliable and fast communication between central areas and external transport zones. An integrated approach provided in the general plan includes the following measures:

- Technical renewal of public transport. It is assumed that up to 100% of the total number of vehicles will use the fuel of ecological classes "Euro 4" and "Euro 5";
- Renewal of the urban electric transport (trolley buses and tram cars) up to the standard level. It is also recommended to purchase a new type of public transport: electric buses;

- Ensuring the accessibility of public transport for people with limited mobility at the level of 50–55% by 2030 (in accordance with the objectives of the Transport Strategy of the Russian Federation until 2030);
- Improvement of the route network and ensuring its accessibility for people with limited mobility;
- Arrangement of bus stops, especially for passengers with limited mobility;
- Construction and reconstruction of transport infrastructure objects are influenced by the development of residential, industrial, and suburban areas of Omsk. It requires the widening of existing highways and the construction of new streets, roads, junctions, overpasses, and public transport stops;
- Development of the road network and parking spaces, designed for a promising car ownership level of 350 cars per thousand citizens throughout the city (paid and alternative variants);
- Road safety improvement by providing visibility triangles, highlighting additional right lanes, organization of traffic light intersections, roundabouts, and level junctions, construction of overpasses, and pedestrian crossings;
- The development of transport and public complexes has been proposed to reduce the shortage of bus stations, terminal turning points, intercepting parking lots, car service facilities, gas and electric filling complexes, medical services, catering, and rest for drivers;
- Formation of a single system for high-speed road transport using environmentally friendly fuels and reservation of territories for further development using the existing sections of metro tunnels;
- Implementation of a route-oriented approach to ensure the accessibility of the urban environment by providing pavements accessible for pedestrians, cyclists, and people with limited mobility;
- Development of recreational areas free from vehicles. This barrier-free environment will allow active recreation and sports for all categories of population.

The principal solutions will, on the one hand, decrease the rate of motorization, and on the other, increase public transport productivity. This is why a unique system of guided transport based on the unfinished metro and abandoned tram lines was proposed in Omsk. This system is to be linked with transport and public complexes, including bus stations, transfer hubs, parking spots, service facilities, and gas and power stations. Meanwhile, a number of problems have to be solved, e.g. reducing the travel time for passengers, improving the accessibility of the urban environment, and improving the ecological, economic, and social conditions in the city.

The measures discussed above will yield the following results:

1. Reducing the time of passengers and freight traffic along the main and secondary lines.
2. Development of a reliable, high-speed, economical, and environmentally friendly system of flexible transport that can reduce the travel time for passengers.
3. Improving the ecology of the city through the development of gas and electricity filling stations network.
4. Providing transfers from cars and suburban transport to city public transport; increasing the accessibility, comfort, and demand for public passenger transport; and improving the working conditions of drivers by installing better equipment.
5. Reducing the discontent among the population by arranging special parking spaces instead of haphazard car parks in the yards and streets.
6. Development of walking and cycling options for people, promotion of healthy lifestyles among citizens, and protection of the environment by limiting the use of personal transport.

Federal Law No. 494-FZ "On Amendments to the Urban Planning Code of the Russian Federation and Certain Legislative Acts of the Russian Federation in order to ensure the integrated development of territories" adopted on December 30, 2020 will help to change the situation. Its goal is to ensure the balanced and sustainable development of settlements and urban districts by improving the quality of the urban environment and improving the appearance, architectural, stylistic, and other characteristics of capital construction facilities, ensuring the achievement of indicators, including in the field of housing construction, and improving the housing conditions of citizens.

The transport system modeling, which takes into account all factors of socio-economic efficiency, will help to assess the developed version of road network.

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