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## Evaluation of Transport Accessibility as a Basis to Improve the Life Quality of Mobility Impaired Groups of People.

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### ABSTRACT

This article contains the results and conclusions of transport accessibility of urban passengers transport services for mobility impaired groups of people. The method of complex evaluation of transport accessibility is in the basis of the research, taking into account the accessibility of transportation facilities, halting points and pedestrian connectivity to them. The ways of the results obtained, typical for urban agglomerate, are suggested.

**Keywords:** urban transport accessibility, mobility impaired people.

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## INTRODUCTION

Conception of the “sustainable city” presupposes creation of the infrastructure, which takes into account the requirements of mobility impaired groups of people, creation of the complex adapted environment [1, 2, 3]. Accessibility of transport services is the main component in providing the accessible environment for mobility impaired groups of people [4, 5].

According to BN&R (Building Norms and Rules) 35-01-2001, “mobility impaired groups of people (MIP) – people, having difficulties when moving independently, getting services, necessary information or when orienting in space.

Thus, to the mobility impaired groups of people we refer: disabled people, people with temporary health disorder, pregnant women, older people, people with baby carriages etc.

## METHODOLOGY

### Determination of the problems for research

Specific characteristic of transport service of mobility impaired groups of people is in the necessity of specialized running stock availability, providing comfortable entrance and exit into a transport vehicle and out of it, creation of special comfortable conditions of a voyage to a place of destination, organization of transport infrastructure objects accessibility and the necessity to equip these objects (railway stations, stop pavilions and etc.) with facilities, providing convenience, security and reliability when using them, providing the zone of pedestrian connectivity of halting points for mobility impaired groups of people [4, 6, 7].

The whole number of problems was formed because of the absence of the complex approach to solve the most important social task – creation of equal possibilities for mobility impaired groups of people in all spheres of social life by providing the accessibility of physical, social, economical and cultural surrounding [8, 9]:

- imperfection of legislative and normative regulation of questions to provide the transport accessibility for mobility impaired groups of people – incompleteness, insufficient harmonization of normative legislative acts of the Russian Federation, subjects of the Russian Federation with the norms of international law, and also recommended for the implementation character of norms, rules and standards, determining the conditions to form the transport accessibility of mobility impaired groups of people life activity;
- absence of the system of social standards and requirements of the mobility impaired groups of people to public passenger transport from the point of view of accessibility and security;
- absence of the possibility for the mobility impaired groups of people to get the information about the accessibility of public passenger transport routes for trips realization.

Thus, for the practical purposes the method to evaluate the accessibility of city public routes for the mobility impaired groups of people is necessary.

### Developing of methods of research

The main purpose to develop such a method is to improve the quality of life of the mobility impaired groups of people by increasing their mobility and the accessibility of transport services.

According to the official statistic data for the 1 of November 2015 more than 107 thousand disabled people (8% of the total population ) live now in the Tyumen Region, including more than 5,6 thousand disabled children (2% of the total children population of the Tyumen Region). Out of the total number of disabled people nearly 4 thousand wheelchair persons, more than 4 thousand visually impaired persons, more than 2 thousand persons with hearing disabilities live now in the region (figure 1).

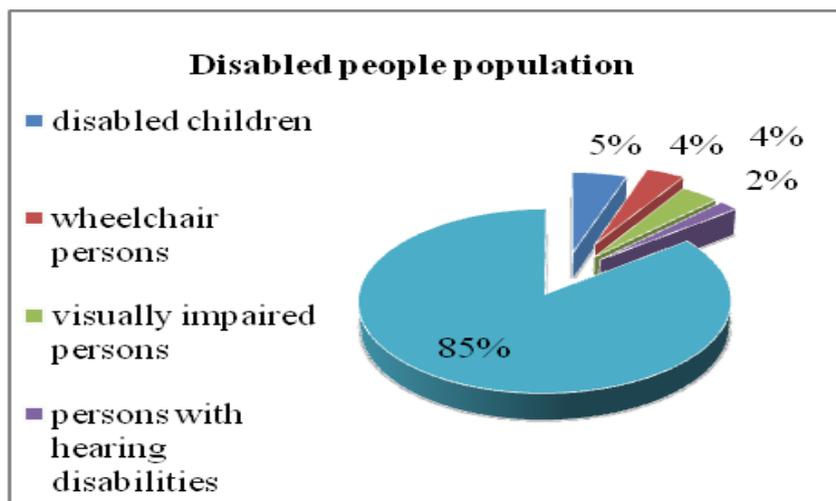


Figure 1. Disabled people population

Now social standards and requirements of the mobility impaired groups of people of Tyumen and a suburban zone (the so-called urban agglomerate) to be served by the public transport are set for the purposes to make investigations [9].

The series of social interrogations and interviews were made, according to the results of which the requirements of different categories of the mobility impaired groups of people to the accessibility of the public passenger transport routes were revealed.

The specific-purpose audience of interrogations and subsequent investigations are disabled people and also other representatives of mobility impaired groups of people:

- persons with locomotive disabilities, using different devices for walking or wheelchairs;
- temporary disabled people, limited in movements;
- older people, having difficulties in movement;
- pregnant women and people with children in baby carriages.

The results of interrogations allowed to set the system of MIP to the accessibility of public passenger transport routes [9].

#### THE EVALUATION OF ACCESSIBILITY OF PUBLIC PASSENGER TRANSPORT ROUTE

##### The content of the accessibility evaluation

Under the accessibility of public passenger transport route in the purpose of investigations is understood the interconnected complex of the requirements, consisting of the following main groups:

- placement of the halting point;
- provision of the necessary facilities of the halting point;
- information provision of the halting point;
- transport vehicles, servicing the route.

Criteria of transport accessibility according to the groups of requirements:

##### Placement of the halting point:

- distance between two neighboring halting points;
- availability of pavements, pedestrian paths and zebras at close quarters, projected in accordance with their accessibility for the MIP;
- availability of the places for MIP to relax at close quarters.

*Provision of the necessary facilities of the halting point:*

- dimensions of the halting site (bus bay);
- dimensions of the landing site;
- dimensions of the holding apron;
- availability and equipping of the pavilion for waiting;
- availability of ramps and handrails on the necessary territories;
- availability of toilets , including accessible for the MIP;
- improvement of halting points with places for sitting and with litterbins.

3 marks – an accessible route;

2 marks – a route of average accessibility;

1 mark – an inaccessible route.

On the basis of the requirements revealed, the method of a complex evaluation of accessibility of a HP was formed on the routes of public passenger transport by the four-level system:

1. Model accessibility of a HP (3.7...4.0);
2. Good accessibility of a HP (3.4...3.7);
3. Satisfactory accessibility of a HP (2.5...3.4);
4. Unsatisfactory accessibility of a HP [0...2.5].

**The model of a complex evaluation**

Model of a complex evaluation of a HP accessibility on the routes of public passenger transport is presented in the form of a formula (1):

$$D = [(d)_{TM} + d_{HP} + d_{HP}^{ped}] \cdot V, \tag{1}$$

where

$D$  – a complex evaluation of a HP (0...4);

$d_{TM}$  – coefficient of transport means on the route (0...2);

$d_{HP}$  – coefficient of transport accessibility of a HP (0...1);

$d_{HP}^{ped}$  – coefficient of pedestrian accessibility of a HP (0...1);

$V$  – coefficient of veto, which equals to 1 and turns to 0 in the case, if at least one of the indexes does not correspond to the evaluation criteria.

From formula (1) it is seen that the evaluation of a route accessibility  $D$  is aggregated and represents by itself the sum of private indexes.

Accessibility of transport means is revealed in the formula (2).

$$d_{tr} = d_{total} + d_{sv}, \tag{2}$$

where

$d_{total}$  – coefficient of total accessibility of transport means on the route (0...1);

$d_{sv}$  – coefficient of special vehicles on the route (0...1).

$$d_{total} = \frac{n_{sv}}{n_{total}}. \tag{3}$$

where

$D$  – quantity of special vehicles on the route (0...1);

$d_{TM}$  – total quantity of transport vehicles on the route.

**EMPIRIC RESEARCH**

To determine the ranging list of the evaluation criteria of transport services it is reasonable to use the method of expert evaluations. By the results of the interrogation of

*Information provision of the halting point;*

- availability of information technical means about the organization of transport passenger service and technical means to organize the road traffic(road signs, road marking and etc.)
- rational placement and accessible display of the information about the routes organization;
- placement of directing and preventing signs;
- availability of an information plate or an electronic table;
- availability of tactile signs.

*Transport vehicles, servicing the route:*

- a number of specialized vehicles on the route;
- technical equipment of specialized transport means (sites, ramps and etc.)
- information provision of a specialized transport vehicle.

**The complex evaluation of public passenger transport routes**

On the basis of the requirements revealed, the method of a complex evaluation of public passenger transport routes was suggested.

The complex index meets the requirements of universality, normalization, comparability [10], used to integral estimations and is evaluated by the three-marks scale; the representatives of different categories of MIP in Tyumen the ranging lists of indexes influencing the accessibility of HP were formed.

The collection of initial data for the evaluation of HP accessibility was also made according to the method set, by the complex accessibility evaluation. As an example for making research the route № 63 of public passenger transport in Tyumen was taken on the travel line of which all halting points were studied.

As a result of investigations it was determined, that within the limits of one public passenger transport route the accessibility of separate HP differs considerably. Graphically it is reflected on figure 2. On the x-axis on the graph the halting points were presented on the travel line, and on the y-axis – their numerical values of accessibility.

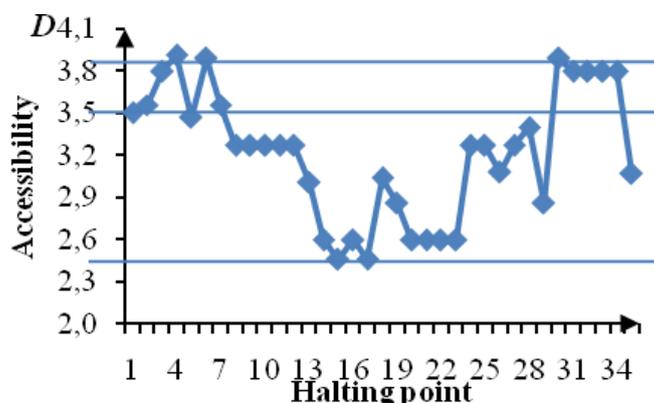


Figure 2. Graph of HP accessibility on the route № 63

**THE WAYS OF PRACTICAL APPLICATION**

The worked out method to evaluate the passenger transport accessibility services allows to give a complex evaluation of halting points accessibility on the routes and is made on the basis and with taking into

account the requirements and wishes of the majority of disabled people representatives. The method presupposes the estimation on the basis of the indexes complex, influencing the accessibility of HP and the route as a whole.

The ways of practical usage of the results obtained were worked out. They include the development of the accessibility map of the public passenger transport routes of the city of Tyumen and its suburbs.

The map of the accessible HP of Tyumen and its suburbs may become the basis to develop the appendix for mobile telephones, allowing the users to evaluate the possibility of transport movement with taking into account individual physical limitations (figure 3).

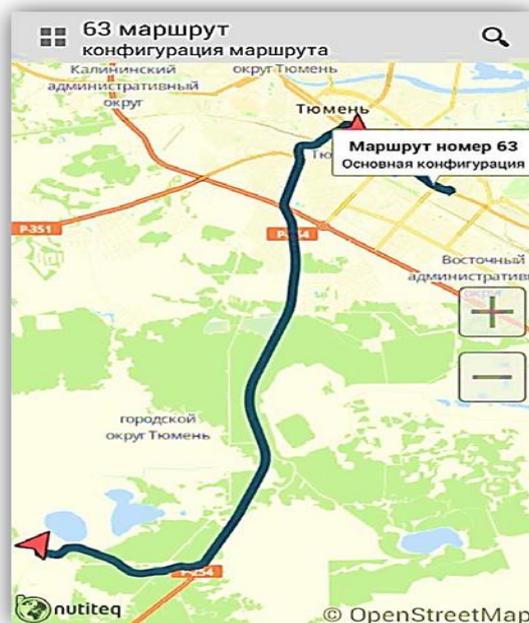


Figure 3. The view of the appendix for mobile telephones

The given information about the accessibility is suggested to be used as an additional option to the already worked out program complexes for the given moment, such as “2GIS” or “Tyumen. Transport”.

The main task of the appendix –is formation of the route for the concrete user by the accessibility criterion at the given points of start and destination, and also the chosen category of the user mobility.

The result of the complex evaluation of the transport accessibility of public passenger transport routes is presented on figure 4.

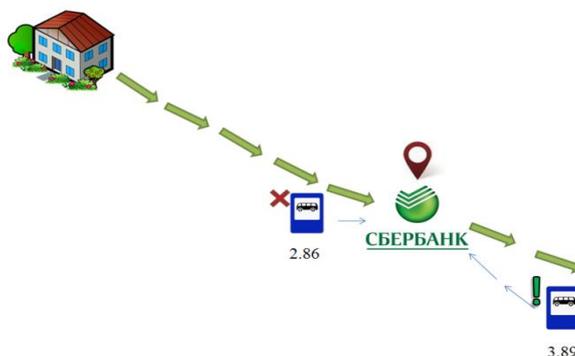


Figure 4. The result of the complex evaluation of the transport accessibility of public passenger transport routes

At changing the condition of the HP, the route travel line or changing the quality of specialized transport vehicles for MIP and the time of its arrival the appendix efficiently “gives” actual information.

The aim of creating a handbook is increasing of the population mobility, and also reducing the number of complaints, coming from the users of urban public transport.

### CONCLUSIONS

The results, obtained during the investigations made, allowed to make the following conclusions:

1. To create the accessible urban transport infrastructure, which takes into account the requirements of mobility impaired group of people, the integral evaluation of the transport accessibility of public passenger transport routes is necessary. It must meet the requirements of different categories of mobility impaired groups of people and fully take into account the accessibility of transport vehicles, halting points and pedestrian accessibility to the halting point.
2. The evaluation of transport accessibility, made within the frames of the city, can serve as the basis for creation the information system for the purpose of MIP mobility, the argument basis to make decisions for the purpose of transport infrastructure optimization for MIP, and, thus, to assist in upgrading the quality of MIP life by improving their mobility and accessibility of transport services.

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