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Accessibility of the Urban Environment: Design of Ramps

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Abstract**: *The article considers the accessibility of the urban environment from the point of view of ensuring the mobility of citizens.One of the tools createdto solve this problem is a universal design.Its main purpose is to adapt the artificial environment to human needs. A "barrier-free" environment is understood to mean the conditions in which unhindered access to social infrastructure facilities and free comfortable movement in urban areas are possible.Persons with reduced mobility are people who have difficulties in movement, orientation in space, and obtaining information or services. They include people with disabilities, elderly people, people with temporary health problems, pregnant women, people with baby strollers. The means providing mobility on the example of ramps, standards for their production and the compliance of devices in use with the specified standardsare analyzed.A special attention is paid to the various types of ramps: stationary, removable, folding.The task of the ramps is to ensure the accessibility and to ease the movement of wheel mechanisms, for example, strollers and wheelchairs.Based onthe normative documents a comparative table "Parameters of ramps for persons with reduced mobility"has been compiled. The average dimensions for the ramps were derived.Several control points were selected where the parameters of the ramps installed in the transitions were measured.Based on the measurements obtained, a table of the actual parameters of the ramps measured in the Moscow metrowas compiled.Deviations in most of the ramps under study from satisfactory values which can significantly complicate the re-movement of persons with reduced mobilitywere revealed.***

Keywords : universal design, mobility, ramp,person with reduced mobility, accessible environment.

I. INTRODUCTION

At the end of the 90s of the last century, Russia began to discuss how to make the urban environment accessible and comfortable not only for a completely healthy people, but also for people with disabilities.

One of the tools created to solve the problem of making an accessible environment is design. If the design doesn't show flexibility, the human body has to show it. The initial purpose of the design is to adapt the artificial environment to human needs and not to adapt people to the environment, because not everyone can do it. Therefore, universal design is a design for those who are not able to adapt well to the environment [1], [2], [4] – [8].

The formation of a safe barrier-free environment is the main condition for ensuring equal opportunities for all groups of the population. A "barrier-free" environment is understood to mean such conditions in which unhindered access to social infrastructure facilities and free comfortable movement in urban conditions are possible. The greatest problems in this area are experienced by people with limited mobility. According to the regulatory documents of the Russian FederationPRM (persons with reduced mobility) are people who have difficulties in movement, orientation in space, and obtaining information or services. PRM include: people with disabilities, elderly people, people with temporary health problems, pregnant women, people with baby strollers [1], [3].Persons with Reduced Mobility (PRM)legislation applies toany type of travel (air travel, maritime travel and inland waterways, rail travel within, bus and coach travel) into, or out of European Union and European Free Trade Association (EFTA) countries and should have theequal access as travelers with unrestricted mobility [10], [11], [12], [13].

The greatest problems during movement are associated with overcoming stairs, slopes, curbs and other elevations. To ensure the free mobility of people ramps, elevators, railings and handrails, special automatic platforms are used [3].

II. PROPOSED METHODOLOGY

Algorithm

Learning the types of ramps
↓
Analysis of documents governing ramp parameters
↓
The choice of real objects of study
↓
Measurement of the necessary parameters of the ramps
↓
Analysis of the measurement results and their comparison with the parameters indicated in the documents
↓
Conclusions

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III. RESULTS

Ramps were chosen as an object for analyzing the accessibility of the urban environment, since this is the simplest and most common tool for ensuring the mobility of people withrestriction of movement.

The following types of ramps are available:

1. Stationary;
2. Removable;
3. Folding.

Stationary ramps are erected during the construction phase of the building, and serve throughout the life of the building. Such ramps are most often monolithic, but can also be made in the form of stationary metal structures.

The feature of the folding ramps is the possibility of their displacement, folding or collecting, in order to free up space in the passage and on the stairs. However, they are not removable, remaining at the installation site.

Removable ramps are also called mobile. If necessary, they can be easily removed and moved to another location.

A ramp is a structure connecting two planes located at different levels. The task of the ramp is to ensure the accessibility and to ease the movement of wheel mechanisms, for example, strollers and wheelchairs. The construction and use of ramps is directly related to the field of human life safety, therefore it is regulated by several regulatory documents at once. Among them are SNiP, and the Code of Rules, and, of course, GOST.

Construction norms and rules govern the requirements, the implementation of which determines the level of accessibility for people with limited mobility the buildings or structures under construction [1].

Based on the presented norms and rules, a comparative table has been compiled (Table 1), in which the average dimensions for the ramps [1] are derived.

Table- I. Parameters of ramps for persons with reduced mobility

Document Parameters	RecommendedOptions		CompliantOptions
	SNiP 35-01-2001	SP 59.13330.2016	
Maximummarchheight, m	0,8	0,8	0,8
Maximumramplength, m		9,0	0,9
MaximumMarchSlope, %			
0,8 m	8	5	5
≤0,5 m	8	8	8
≤0,2 m	10	10	10
Rampwidth, m	≥1,0	1,5/0,9 – 1,0	1,0
Wheel breaker height (side), m	≥0,05	0,05	0,05
RampHandrailHeight, m	0,9 0,7 0,5	0,85 – 0,92 0,7	0,85 – 0,92 0,7 0,5

The analysis of normative documents revealed the parameters of the ramps that meet the standards. Also, during the study of SP 59.13330.2012, a contradiction was revealed regarding the width of the ramp: the width of the ramp should be taken according to the width of the lane (paragraph 5.2.13): b = 1.5 m, but the width between the handrails (a) (paragraph 5.2.15): a = 0.9 ÷ 1.0 m, therefore, the handrails limit the working area of the ramp and can interfere with movement.

Several control points were selerыышфcted where the parameters of the ramps installed in the transitions were measured.

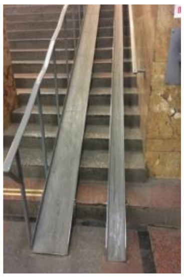

Fig. 1. Ramp 1

Fig. 2. Ramp 2

Fig. 3. Ramp 3

It should be noted that in most cases stationary ramps in the subway junctions consist of two canvases (Fig. 1, Fig. 2, Fig. 3). They are separated by a series of steps, designed to move the accompanying. On the inner and outer side of each web wheel-mounted devices are installed. The height of the wheel chippers fits into the acceptable dimensions, but often they are installed on the inside part of the track, preventing the movement of suitcases with small wheels and strollers, especially with dual wheels, since the wheel chambers fall between them. The slope (1) of the ramp is determined by the ratio of the height of the march to the horizontal projection of the ramp.

$$x = \frac{h}{l} \quad (1),$$

where x – the ramp slope, h – the ramp height, l – the horizontal projection of the ramp.

The normative documents provide the numerical value for the ramps, which PRM use independently, without the support of an attendant. However, the subway junctions were originally designed without taking into account the installation of ramps, and, accordingly, the ramps have the wrong slope. Therefore, in the further analysis the bias is not taken into account.

Based on the measurements obtained, a table of the actual parameters of the ramps measured in the Moscow metro was compiled (Table 2).

Table- II. Parameters of ramps for persons with reduced mobility

Ramp Criterion	Ramp 1	Ramp 2	Ramp 3	Compliant Options
Location	**Komso-molskaya**	**Cherkizo-vskaya**	**Preobra-zhenskay Square**	
Ramptype	**Stationary**	**Stationary**	**Stationary**	
Marchheight, m	**1,75**	**1,52**	**1,42**	**0,8**
Ramplength, m	**4,83**	**4,31**	**3,93**	**0,9**
Righttrack, m	**0,3**	**0,14**	**0,2**	**Notregulated**
Lefttrack, m	**0,16**	**0,31**	**0,47**	**Notregulated**
Totalrampwidth, m	**0,77**	**0,77**	**1,09**	**0,9 – 1,0**
Righttrack, m	**0,3**	**0,14**	**0,2**	**Notregulated**
Lefttrack, m	**0,16**	**0,31**	**0,47**	**Notregulated**
Totalrampwidth, m	**0,77**	**0,77**	**1,09**	**0,9 – 1,0**
Wheel breaker height (side), m	**0,04**	**0,03**	**0,05**	**0,1**
RampHandrailHeight, m	**0,82**	**1,01**	**0,97 0,67**	**0,85 – 0,92 0,7**

IV. CONCLUSION

The analysis of the table allows us to draw the following conclusions: the actual width of the ramps is less than the norm, the height of the handrails has deviations from the norm, the width of the canvases of the left and right tracks of the ramp is not spelled out in regulatory documents. Thus, in most of the ramps under study, deviations from satisfactory values which can significantly complicate the re-movement of PRM were found. In addition, bumpers with a height of more than 0.05 m impede the movement of suitcases on small wheels, three-wheeled strollers and double-wheel strollers.

Thus, a special attention should be paid to the data presented in the standards regarding the accessibility of buildings and structures, which have contradictions and inaccuracies, and to the development of standards regarding the parameters of double-track ramps, taking into account the design features and size types of most suitcases and strollers.

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