PAPER • **OPEN ACCESS**

Methodological Frameworks For Street And Road Environment Improvement With Due Regard To Inclusion Requirements

To cite this article: Tetiana Pavlenko *et al* 2024 *IOP Conf. Ser.: Earth Environ. Sci.* **1376** 012005

Methodological Frameworks For Street And Road Environment Improvement With Due Regard To Inclusion Requirements

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Abstract. The article identifies the main issues and, accordingly, the identified research topic relevance to improve the street and road environment, with due regard to inclusion requirements. As a result, the authors analysed the basic terminological research apparatus and defined the term «street and road environment». Based on preliminary research topic results, the basic principles, techniques and appropriate means of street and road environment improvement are formulated with the consideration of inclusion requirements. Criteria for the street and road environment assessing, with the consideration of inclusion requirements, which control design and reconstruction tools utilization efficiency, are also presented. According to submittal, the algorithm of street and road environment development is determined. The main process stages and decision-making options depending on certain criterion compliance are substantiated.
Keywords: improvement, street and road environment, transport infrastructure, inclusion, barrier-free, universal design.

1. Introduction

Today's environment is tightly urbanized, and it's critical to adapt it to all people's needs equally. The concept of inclusivity in relation to the street and road environment specifies the barrier-free conditions ensuring (safety, comfort, accessibility) for all users.

Means of ensuring barrier-free street and road environment are actively implemented in world practice. But the conducted research revealed a significant number of problems and shortcomings: unsystematic, chaotic application, lack of understanding by the performers of a specific element essence and its tasks, which leads to the accessibility, comfort and safety conditions for all users. Therefore, there was an urgent need of principles application and means of ensuring barrier-free street and road environment systematization and structuring for scientific justification and rational practical use.

In present conditions, the transport settlement system must be constantly changed and updated through the road network construction and reconstruction, while creating all conditions for continuous and rapid movement of all segments of the population. Creating an efficient

transport system is reduced to complex tasks of surrounding space external items interaction with street and road environment. In order to clearly understand the importance of these complex tasks, consider the basic concepts of this research.

Street and road network – a network of streets, public roads, inner and other passages, sidewalks, pedestrian and bicycle paths, as well as embankments, squares, street parking lots with engineering and auxiliary structures, technical means of traffic organization, which is designed for vehicles and pedestrian traffic.

The street and road environment are the environment of all architectural, urban, landscape and transport objects that are located along the settlement street and road network.

Pedestrian traffic system is one of the main systems of settlement environment interaction with the person. The organization of an accessible street and road environment has a primary impact on pedestrians. And in turn, the behavior of pedestrian traffic directly affects the street and road network service quality as a whole.

Following the world experience, there is a task to take into account inclusion requirements and the right of all street and road environment users to a comfortable life and adequate work. Thus, the purpose of the research is to determine the principles, techniques and means of street and road environment improvement with due regard to inclusion requirements.

1.1 The review of the most recent research and publications sources

While Research into barrier-free environment is actively conducted by: Al Taweel, Z. [1], Merchant, W. [2], Bascom, G. W. [4], Bekk, N. V. [5], Bezyak, J. L. [6], Khalil, M.E. [7], Gamache, S. [8, 9], Harsritanto, B. [10, 11], Watchorn, V. [12], Paleyeva, K. [13], Siri Tilekeraytn, Ron Mace, M.V. Sholukh, L.M. Barmashina, J.S. Rodyk, V.V. Kutsevich, V.O. Azin, T.P. Lytvynenko [14, 15, 18, 20], V. Ivasenko [14, 15, 20, 21], T. Pavlenko [20, 21], I. Tkachenko [14, 18], L. Gasenko [15], Y. Hrybalskyi. The National Assembly of People with Disabilities of Ukraine issues technical recommendations for barrier-free environment and transport infrastructure arrangement. However, the existing theoretical studies are scattered, fragmented, unstructured, cover only certain elements of street and road space and do not meet all users' needs.

1.2 Materials and methods

While conducting the research, the integrated basics approach, the simulation mode, theoretical methods of analysis, synthesis, generalization and abstraction technique have been applied. A methodology for street and road environment improving has been developed, taking into account inclusiveness requirements, where special methods are used: analysis of initial data, option method design, method of experimental design.

2. Results

2.1 Principles, techniques and means of improving the street and road environment with due regard to inclusion requirements

The world experience of street and road environment [1-13] designing includes many planning and architectural decisions on providing barrier-free space. Some of these solutions are structured and match under the general universal design theory. But substantially all this topic variants have occasional and unsystematic behavior.

Therefore, based on world experience generalization [1-13], the principles of street and road environment design and methods of its urban organization are determined, taking into account not only the universal design theory, but also the inclusion requirements. Based on research of an

inclusive street and road environment design, the following inclusion requirements were identified: architectural and planning; technical and socio-economic (Fig. 1.).

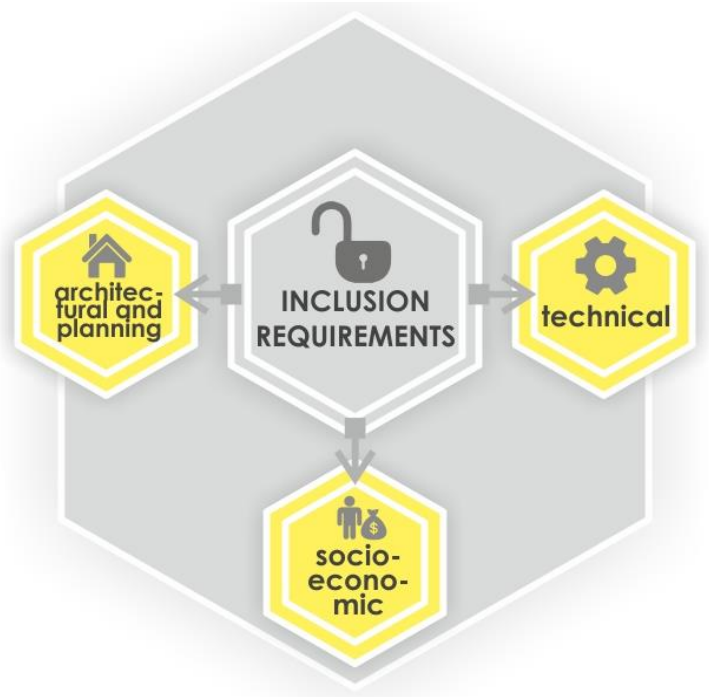

Figure 1. Inclusion requirements when designing a street and road environment.

The group of *architectural and planning* requirements includes: functional integration, functional differentiation, compactness, urban integration, neighborhood, construction of optimal street and road network, functional zoning, non-conflict, modernization, aesthetic appeal, visual perception, compositionality, space corridor simulation [14, 15, 20].

The *technical* group of requirements includes: universal design [7, 10-12, 23], accessibility, amenities, informativity, safety, «smart customization».

Socio-economic group includes the requirements of: social efficiency, social adaptation, participation in public life, employment (Fig. 3.).

Let's consider each requirement in more detail using a system of principles and techniques that provide them (Fig. 2).

Compactness principle is provided by two methods: the method of transit distances minimizing and the method of building an optimal street and road network.

The method of transit distances minimizing consists in conditions formation for the rapid movement of all population layers through the territory settlement, which is characterized by a relatively high density of buildings, which will reduce the cost of construction.

The method of building an optimal street and road environment consists in building the shortest connecting network of the settlement; determination of additional nodal points and links; finding an effective solution to the problem of optimal street and road network, taking into account the inclusiveness requirements. In practice, the scheme of the shortest connecting network of roads is designed, the construction cost-benefit analysis of each street separately and the entire street-road environment as a whole is evaluated.

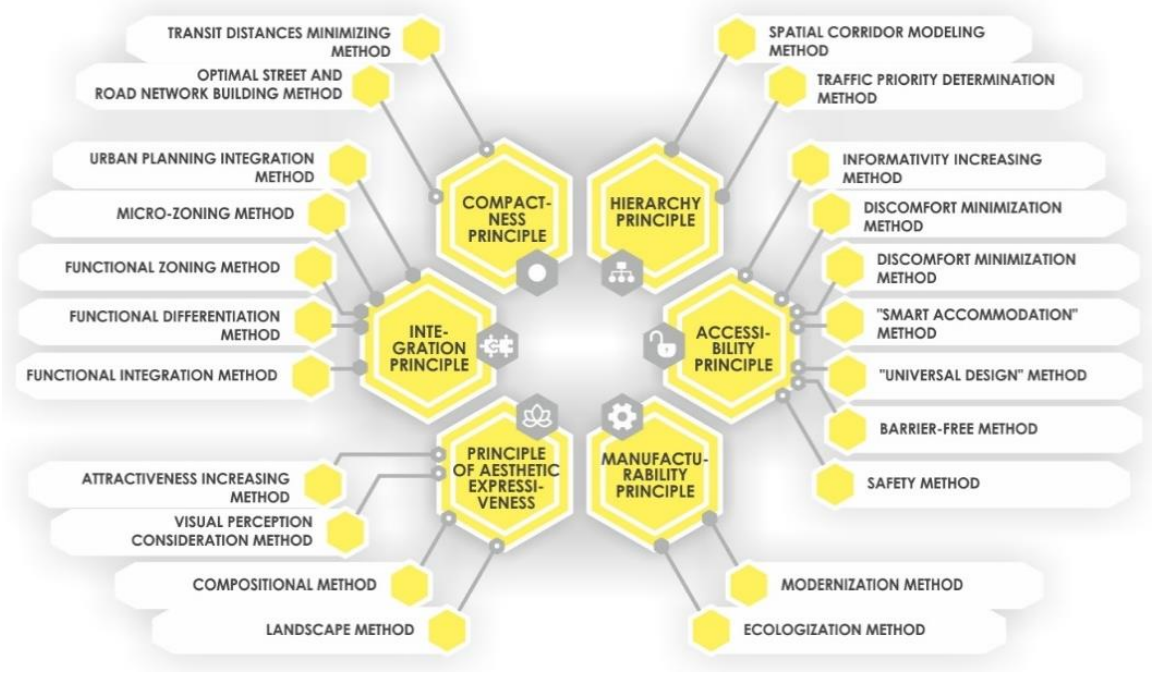

Figure 2. Principles and methods of street and road environment improving with due regard to inclusion requirements.

Figure 3. The main means of organizing an inclusive street and road environment.

Integration principle is provided by such methods: the method of urban planning integration, the method of micro-zoning, the method of functional zoning, the method of functional differentiation, the method of functional integration.

The method of urban planning integration takes into account the features of the optimal objects placement in the street and road environment of the settlement and the rational placement of certain transport infrastructure elements. It also determines the presence of favorable conditions for the street and road environment development.

The method of micro-zoning is based on the unity of residential units around the buildings of everyday service; formation of a sustainable community of residents («neighborhoods»); formation a safe and comfortable living environment; environment arrangement with pedestrian traffic priority.

The basis of the method of functional zoning is a logical sequence («life-work-rest») when designing the street and road environment. This aims to clearly delineate the functions and processes of the street and road environment in the settlement.

The method of functional differentiation is based on the separation of functional zones of the road space and is aimed at the prospective development of streets and roads in populated areas and includes:

- design of separate paths that can be combined with bike paths for an alternative choice of movement (this applies only to people who move with the help of specialized means);
- formation of independent routes and related objects of the street and road environment, with due regard to inclusion requirements.

The method of functional integration is aimed at adapting the existing street and road environment to the requirements of inclusiveness without capital construction measures and can be implemented by:

- allocation of individual traffic lanes;
- speed limits on the streets and roads of populated areas;
- arrangement and rearrangement of recreation areas.

Principle of aesthetic expressiveness is provided by such methods: the method of attractiveness increasing, the method of visual perception consideration, landscape method and compositional method.

The method of attractiveness increasing aimed at increasing the attendance of objects in the street and road environment: arranging an interesting public space, including institutions with popular services in the street and road network.

The method of visual perception consideration consists in preserving the architectural and compositional unity of all street and road environment objects (lighting, landscaping, small architectural forms, objects of transport infrastructure, etc.) with consideration to inclusiveness requirements.

The landscape method is based on the use of elements and groups of elements for landscape design, the inclusion of the scenario type of landscape components location and sequence.

The compositional method is based on the harmonious perception of street and road environment, including architectural, urban and landscape composition requirements (compositional dominants and accents, dynamic and static fronts of perception, scenario type, scale, rhythm, contrast, nuance, etc. of street and road environment architectural and urban elements).

Hierarchy principle is provided by such methods: the method of spatial corridor modeling, the method of traffic priority determination.

The method of spatial corridor modeling [14, 18] determines the hierarchical sequence of certain landscaping elements location. This method makes it possible to check the object by means of three-dimensional modeling after the design and allows decisions made quality controlling.

As the basis of *the method of traffic priority determination* the so-called priority pyramid is used (pedestrian – cyclist – public transport – commercial transport – private motor transport), where priority is given to the upper steps in architectural and planning decisions.

Accessibility principle is provided by such methods: the method of informativity increasing, the method of discomfort minimization, the method of social efficiency, the method of «smart accommodation», the method of universal design, the barrier-free method and the safety method.

The method of informativity increasing takes into account the peculiarities of information perception by all population segments.

The method of discomfort minimization aimed at improving the comfortable stay of all population segments in the street and road environment.

The method of social efficiency consists in creating an inclusive communication space for all population segments.

The method of «smart accommodation» consists in the application of effective inclusiveness means in the conditions of street and road environment reconstruction or conversion.

The method of universal design was developed by a group of architects led by Ron Mace [7, 10-12, 23]. The basis of this method is equality and accessibility, flexibility, simplicity and intuitiveness of using objects.

The barrier-free method consists in creating a barrier-free horizontal, vertical and inclined space.

The safety method aimed at creating means of safely overcoming obstacles on traffic routes: exclusion of environment perception false effects, which provokes a risk situation.

Manufacturability principle is provided by the following methods: the method of modernization, the ecologization method.

The method of modernization is aimed at full or partial reconstruction of the existing street and road environment in terms of modern technologies.

The ecologization method aimed at the use of ecological materials, ecological methods of waste collection, increasing the greening percentage, alternative types of energy use, rainwater recycling.

World experience [1-30] shows that the problem of an inclusive street and road environment arranging in each country is revealed differently. The requirements for the means and elements of an inclusive road environment in the world are different. But in general, the street and road environment filling can be structured into one classification of fixed assets and elements of an inclusive street and road environment organization (Fig. 3). An inclusive street and road environment ensuring includes the following: safety, convenience, information capacity. In general, the street and road environment filling can be divided into two types of elements: linear (traffic routes) and point (public transport stops, transport infrastructure, etc.).

Public transport stops providing a communicative and aesthetic function in the street and road settlements environment. To ensure the barrier-free overcoming of the linear intersections elements (pedestrian paths with the traffic way) for people with low mobility groups, it is necessary to arrange easy slip road – approach ramp.

Based on global requirements analysis for inclusive information support along the entire route, the main groups of inclusive information technology were identified: tactile, visual, voice (Fig. 4).

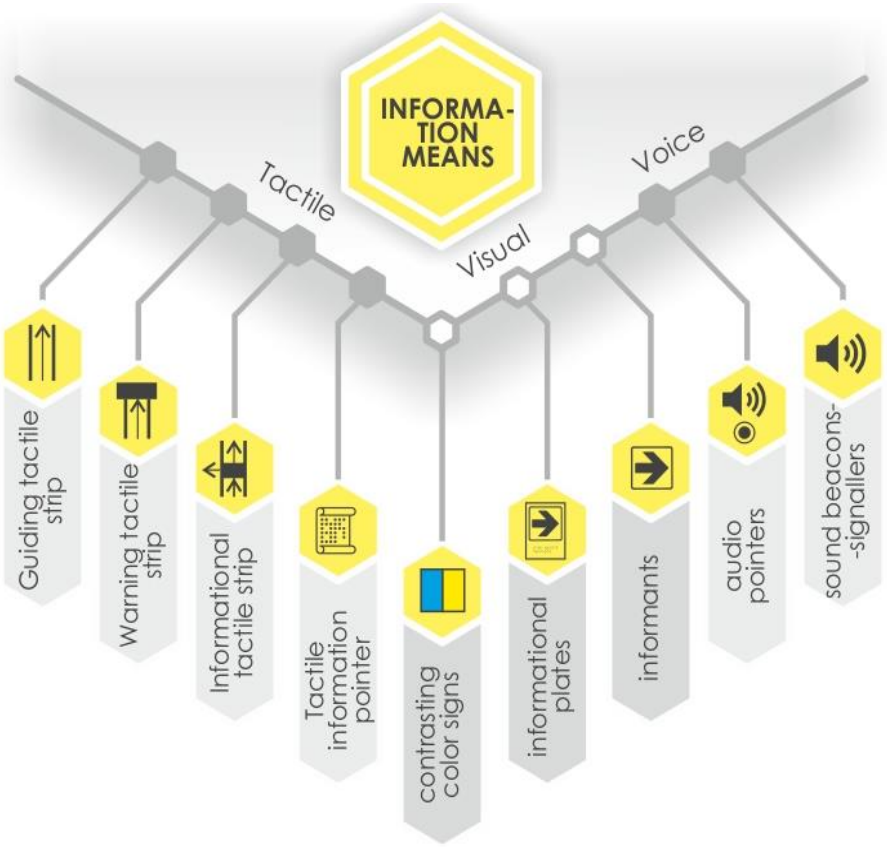

Figure 4. Inclusive information means for street and road environment improving.

2.2 Criteria for assessing the street and road environment with due regard to inclusion requirements
To increase the quality indicators level of transport and operational condition of street and road environment settlements objects, it is necessary to solve numerous substantial tasks. Modern classifications of street and road network are based on transport and operational criteria and traffic organization criteria. These criteria do not fully cover pedestrian traffic and road environment in general.

Based on international practice of residential and public buildings and structures, street and road network design, construction and operation analysis, with reference to experimental barrier-free street and road environment design experience, the following are determined (Fig. 5).

According to the presented criteria, the algorithm for the street and road environment improving with due regard to inclusion requirements is substantiated.

The main stages and features of inclusivity requirements solving in the street and road environment design or reconstruction are defined (Fig. 6): Analysis of the street and road environment, Determination of compliance with evaluation criteria, Search for solutions to improve the street and road environment, Verification of compliance with evaluation criteria, Implementation and realization of solutions in design.

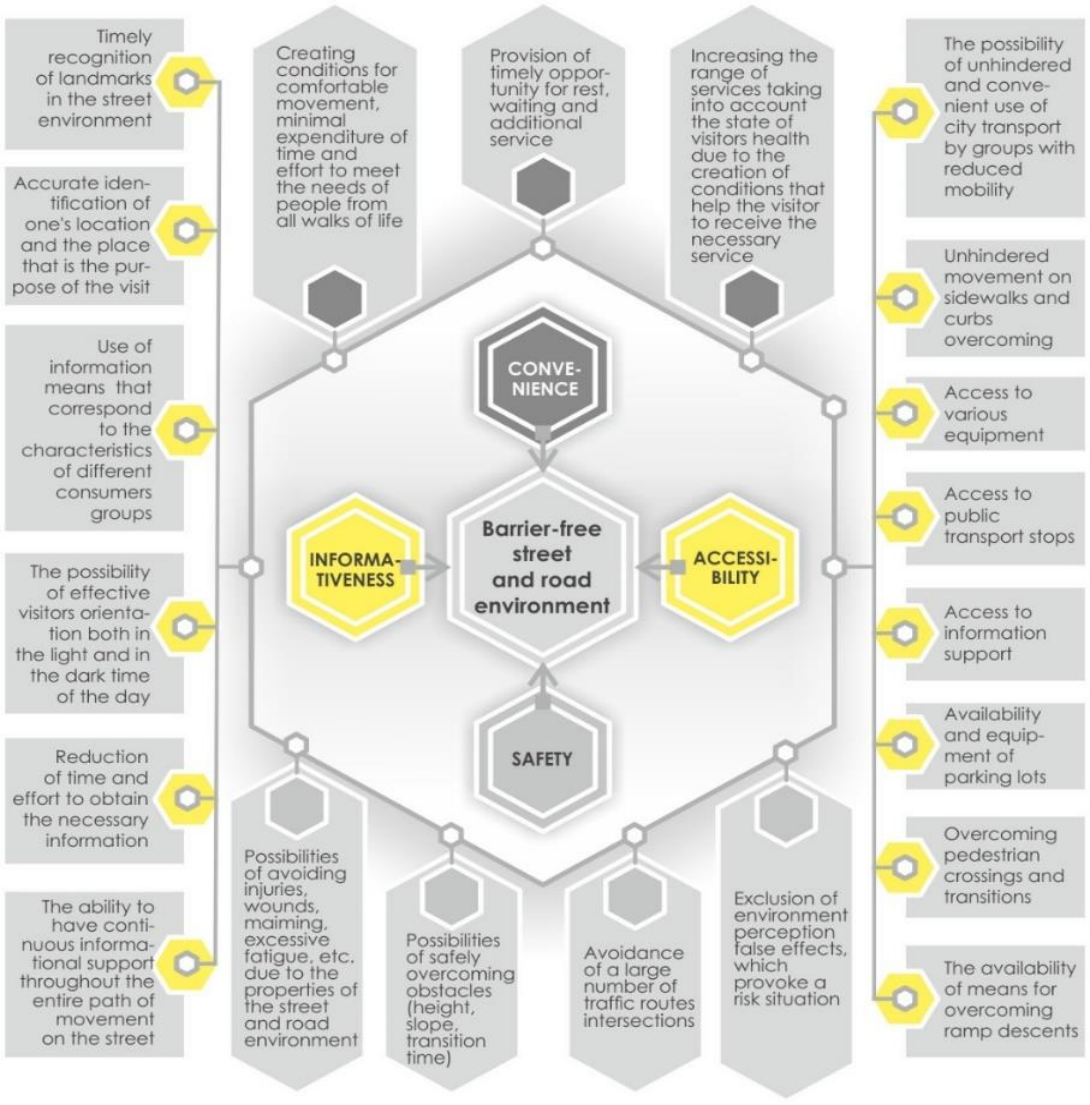

Figure 5. Criteria for assessing the street and road environment street with due regard to inclusion requirements.

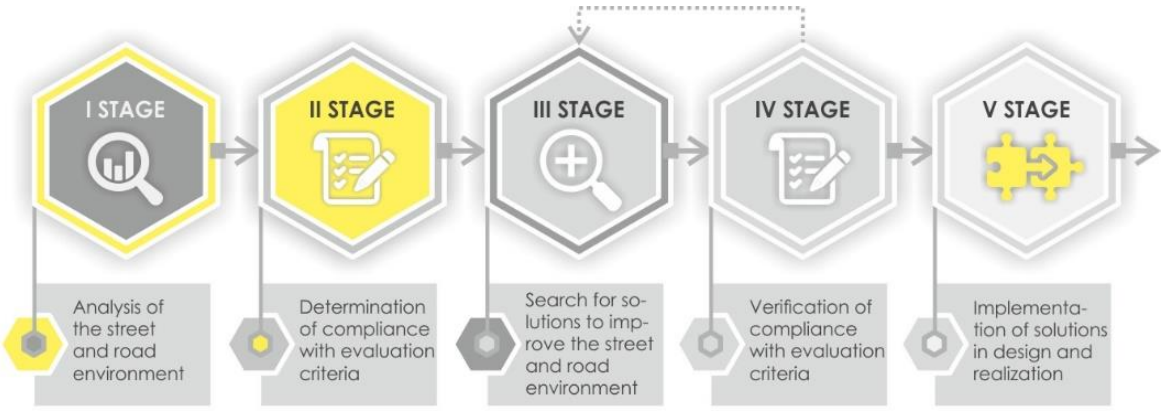

Figure 6. Algorithm for improving the street and road environment street with due regard to inclusion requirements.

3. Conclusions

On the basis of the conducted research, a classification of principles and means that provide them, the improvement of street and road environment, with due regard to inclusion requirements is done. According to submittal, the algorithm of street and road environment improvement with due regard to inclusion requirements is defined. The main stages and features of inclusivity requirements solving in the street and road environment design or reconstruction are defined: Analysis of the street and road environment, Determination of compliance with evaluation criteria, Search for solutions to improve the street and road environment, Verification of compliance with evaluation criteria, Implementation and realization of solutions in design. The use of this algorithm in real design will allow creating an inclusive, comfortable street and road environment.

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