

# Toward the construction of a comfort model for urban environment

N V Bakaeva<sup>1</sup>, L V Tchaikovskaya<sup>2</sup> and D P Zuleta<sup>2</sup>

<sup>1</sup>National Research Moscow State University of Civil Engineering, 26, Yaroslavskoye highway, Moscow, 129337, Russia

<sup>2</sup>Department of Civil Engineering, Faculty of Construction and Architecture (FCA), Southwest State University, 94, 50 Let Oktyabrya ave., Kursk, 305040, Russia

E-mail: [natbak@mail.ru](mailto:natbak@mail.ru)

**Abstract.** The concept of “comfortable urban environment” is considered in the article, and its components are selected taking into account the principles of harmonious human development in symbiosis with the natural environment, based on the obtained results, a conceptual model of urban environment comfort is constructed and its formal description is given.

## 1. Introduction

The negative attitude of humanity towards Nature led to a significant deterioration in its condition, which, led to a decrease in the quality of living conditions, including in urban areas and described the problem of creating comfortable living conditions for a person in symbiosis with the surrounding Nature.

Currently the concept of “comfortable urban environment” is being considered by a number of researchers [1-11], however, a strictly established definition, as well as parameters for assessing comfort, are currently lacking. Some researchers understand the comfort of the urban environment as the natural purity of air, water, soil and plant layer, the presence of a favorable level of noise, vibration and electromagnetic influences; increasing climatic comfort, etc., thus, include in the concept of comfort the totality of components related to a particular area. Nevertheless, the most complete definition of urban environment comfort is given by the Russian Academy of Architecture and Construction Sciences (RAACS), which includes a combination of the following components in comfort: environmental comfort, functional and spatial sufficiency, spatio-temporal accessibility of vital and socially important objects and territorial connectivity, diversity, structural orderliness and imagery of the spatial environment [4].

## 2. Main part

We will select the components of a comfortable urban environment to further evaluate the comfort of living conditions on the territory of the settlement. Understanding a comfortable urban environment, such urban environment conditions that have developed over a certain period under which a person develops harmoniously in symbiosis with the natural environment, taking into account previous studies [1-11]. Based on the results obtained, we construct a conceptual model of the comfort of the urban environment.



Man is generated by nature and is a part of it, a component of a single huge organism [12, 13]. Without nature, becomes impossible for humans to exist: water and food, raw materials for production, energy resources and building materials are natural resources. Without the natural component, it is impossible to talk about the comfort of the urban environment, and about its presence, in this regard; we can assume that the basic component of a comfortable urban environment should be the **natural component** ( $K_P$ ).

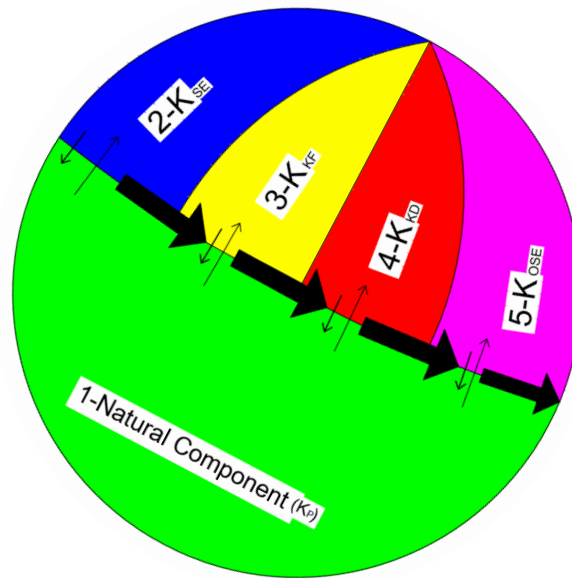
Currently, urban development tasks are the development of scientific and methodological foundations for the qualitative transformation of human life in urban areas and the formation of not only a safe and comfortable, but also a socially-oriented urban environment [14, 17]. Therefore, a harmonious social climate should be created in the settlements, since an unfavorable situation in the urban area leads a such negative changes as an increase in the incidence of disease, a decrease in life expectancy, a decrease in the birth rate, and as a result, an aging population, a decrease in the workforce, etc., therefore, the second component of a comfortable urban environment will be considered the **socio-economic component** ( $K_{SE}$ ).

In addition, for a person to exist in cities, conditions must be created for housing, work, movement, and innovative development of its residents. Moreover, the city should sufficiently satisfy the rational needs of its residents, as if any of the needs is not satisfied, the existence of a person cannot be considered harmonious [18]. In total, seven functions of the city are distinguished, through which five basic human needs are included, included in the Maslow pyramid [19, 20]. The correlation between the levels of the Maslow pyramid and the functions of the city through which certain needs can be satisfied is established in [19]. The need to meet the rational needs of a person through the functions of the city underlies the inclusion in the components of a comfortable urban environment of a **functional component** ( $K_F$ ), as well as a **component of the accessibility of vital and socially important objects to the urban population** ( $K_D$ ) and a **component of diversity, structural ordering and imagery of the spatial environment** ( $K_{OSE}$ ).

Thus, a comfortable urban environment includes the following components:

- **natural component** ( $K_P$ ) - greening of the territory, amount of emissions / capture of pollutants into the air, volume of fresh / recycled, reused water used, amount of wastewater discharged into surface water bodies, level of waste accumulation, amount of pollutants in food products, etc.;
- **socio-economic component** ( $C_{SE}$ ) - social and economic parameters of society, population dynamics and demographic characteristics of the population, well-being of citizens, human resources, etc.;
- **functional component** ( $K_F$ ) - the availability of housing, educational and sports facilities and playgrounds, hospitals, transport, engineering infrastructure, garages and parking lots, places of recreation, amusement parks, etc. ;
- **component of the accessibility of vital and socially important objects to the urban population** ( $K_D$ ) - coverage of the population of the city with existing residential, recreational, sports, transport facilities necessary to meet rational needs;
- **component of diversity, structural ordering and imagery of the spatial environment** ( $K_{OSE}$ ) - the degree of uniformity of development, the amount of dilapidated and emergency housing, the level of landscaping, etc.

The amount of comfortable urban environment can change, but it is important to strike a balance between them. In other words, conditions must be created on the urban territory to meet the rational needs of man, corresponding to the capabilities of the natural environment to fulfill these needs. Based on this, suppose that the level of natural comfort is the average value of the comfort of all other components. Then the conceptual model of comfort of the urban environment will have the following form (Figure 1).



**Figure 1.** Conceptual model of a comfortable urban environment: 1-natural component ( $K_p$ ); 2 – socio economic component ( $K_{se}$ ); 3 - functional component ( $K_f$ ); 4- component of the accessibility of vital and socially important objects to the urban population ( $K_d$ ); 5 - component of diversity, structural ordering and imagery of the spatial environment ( $K_{ose}$ ).

Formally, the state of comfort of the urban environment could be written as follows:

$$\begin{cases} \frac{\sum K_i}{n} = K_p \\ K_p \rightarrow \max \end{cases} \quad (1)$$

where  $K_i$  - is the comfort level of the  $i$ -th component of the urban environment;

$n$  is the number of comfort components;

$K_p$  - level of natural comfort.

In fact, the probability of achieving this equality is small, and the following situations are possible:

$$\begin{cases} \frac{\sum K_i}{n} > K_p \\ K_p \rightarrow \max \end{cases} \quad (2)$$

$$\begin{cases} \frac{\sum K_i}{n} < K_p \\ K_p \rightarrow \max \end{cases} \quad (3)$$

### 3. Results

As a result, in an urban area, one of three states can be established:

- The state of *balanced comfort* C1 described by expression (1);
- The state of *fatal comfort* C2 in accordance with expression (2);
- The state of *backup comfort* C3 in accordance with expression (3).

The ideal situation is when all the components of a comfortable urban environment are implemented to a sufficient degree, if the state of biosphere compatibility is established (state C1).

The case described by expression (2) is characterized by a high level of socio-economic indicators of society, equipped with infrastructure, but this leads to an increase in the load on the natural environment, excessive withdrawal of natural resources, throwing a huge amount of waste into it. This state of the urban environment is degrading in terms of impact on nature and requires innovative management decisions in the field of urban development. In this case, high socio-economic indicators of society and its apparent prosperity are possible to a greater extent due to the withdrawal of natural resources. The anthropogenic load is high; the environment is not capable of self-healing.

The most favorable is the state of reserve comfort described by expression (3), which is characterized by an excess of the value of the natural component over the integral indicator of the implementation of other components. However, in this situation, there is a possibility of a low level of socio-economic indicators of the society, as well as parameters of accessibility of vital and socially important objects to the urban population, diversity, structural ordering and imagery of the spatial environment. In this situation, if it is necessary to carry out activities aimed at improving these indicators, the state should be maintained for as long as possible by taking adequate managerial decisions aimed at developing the urban environment.

#### 4. Conclusions

To conclude with it can be noted that the urban environment that provides a harmonious existence and human development can be considered comfortable. A modern city should satisfy all kinds of needs: biological, social and spiritual. Unfortunately, most modern cities cannot be considered comfortable; therefore, it is advisable to carry out the urban development process on a new basis, using the principles of ensuring a safe and creating a comfortable urban environment, which should be fixed normatively.

Measures to create a comfortable urban environment should be carried out at all stages of the construction of the city, from the moment of planning it as a whole, as well as individual microdistrict, until the commissioning of built-up territories.

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