Principles of the Inclusion Green Spaces in the Public Area of a Residential Building

I V Zhdanova¹, D S Kayasova¹, A A Kuznetsova¹

¹Architecture of Residential and Public Buildings Chair, Academy of Architecture and Civil Engineering, Samara State Technical University, Molodogvardeyskaya str., 194, Samara, 443001, Russia

E-mail: zdanovairina@mail.ru

Abstract. Abstract. The purpose of this study is to explore modern solutions for the introduction of green spaces in the structure of residential buildings. The world practical experience is summarized, which has revealed three ways of external landscaping of buildings – a green roof, a green facade with climbing plants and a green wall. Two groups of public spaces in a residential building are also defined – open and closed, in which different types of landscaping can be used. Also, foreign experience shows the use of landscaping in transit, utility and technical spaces. The study reveals the main methods of introducing green spaces for residential buildings on the example of the city of Samara in the form of conceptual schemes. And also, generalization of the space-planning solutions of a residential building with the introduction of landscaping, allowed us to formulate the basic principles of designing green public spaces: the principle of transit landscaping, the principle of green zoning, the principle of green separation, the principle of green unification, the principle of double landscaping. It is determined that the world experience of the introduction of landscaping in the space of a residential building must be adapted to the Russian conditions. This, in turn, will increase both the ecological and aesthetic component, as well as ensure social interaction of residents and the comfort of living.

1. Introduction
Currently, more than 21 million people live in large metropolitan areas. More and more people are leaving small settlements and moving to more developed cities, where a population more than 1 million people. Scientists estimate that by 2050, the world's population will increase by another 70% and exceed 9 billion people. Statistical calculations indicate that the area per 1 person is about 24 m² in Russia, and on the continent of North America is 69 m². The number of rooms per capita in Russia is 0.9, in Europe this figure is higher than 1.4. In economically developed countries, such as the United States, Canada, and Australia, this figure reaches 2.5 rooms per person. Statistics show that the level of comfort of housing in Russia is two times less in comparison with other economically developed countries. City centers are densely built, and recreational and green spaces are becoming less and less. All this negatively affects the environment and the condition of a person living in a large city. The solution of this problem can be the construction of energy-efficient buildings with minimal environmental impact [1, 2]. One of the varieties of buildings can be buildings with vertical landscaping of facades, landscaping of buildings and open terraces. Le Corbusier and Frank Lloyd Wright started talking about the landscaping of residential buildings inside and outside, as a new design principle.
Primarily, the internal and external landscaping of residential complexes in different countries of the world is used to increase the level of comfort [3, 4]. Developed countries are actively implementing landscaping in order to fight for "green" standards and improve the environmental situation. But the countries with a lower level of economy do not lag behind the global trend. In the countries of Central and South America, there are many implemented projects with different ways of landscaping houses. This is mainly due to the dense urban development, where every green corner is a great value [5]. The reduction of recreational spaces for the recreation of citizens encourages the provision of an operational greening roof in projects as an additional public space. The hot climate of such countries allows you to enjoy flowering plants all year round. Countries with moderate climates, such as Canada and Germany, where temperatures drop below zero, are also actively implementing landscaping in residential buildings, but prefer closed methods of gardening or planting seasonal plants.

In 2020, all countries of the world faced a global catastrophe that negatively affected people, both physically and psychologically. People were forced to stay in their homes under a strict regime of self-isolation for an uncertain period. The apartment and the spaces inside the residential complex have become a place of permanent staying. This world problem forces us to look at the living space with different eyes.

The use of landscaping can favorably affect on the health and working capacity of a person. It is determined that 1 m2 of vertical green wall is able to purify the air for 100 m2 of indoor space. This helps to improve the working capacity on 12 % and reduce negative emotions on 25% and balance the internal state of a person. Plants also help maintain the recommended humidity level (50-60%) in rooms for comfortable living. It is proved that 87% of the toxins that accumulate in the air during the day are absorbed by indoor plants. Greening also has a positive effect on the psychological state of a person. It has been proven that people feel calmer and more productive when they are surrounded by plants.

Modern methods of introducing greening into the structure of residential buildings will help to change the environmental situation, which will undoubtedly actualize the topic of this study. Also, the relevance is confirmed by the fact that at the moment there are no requirements for the design of residential buildings with landscaping, there are no recommendations for areas and functional saturation. And the development of principles for the placement of greening will strengthen the considered problem.

2. Materials and methods

The theoretical basis compiled by fundamental scientific works that address the following issues: problems of compensation for green spaces (Batygin A. S., Vishnevskaya E. V., Voronin A. A., Kordyukov P. S., Okolnikova G. E., Osintseva M. S., Petrova L. V., Skabelkina O. A., Shchegolev M. S., Yatsenko V. V.); problems of organizing the environment with the help of landscape (J. Simonds, Barsova P. V., Vergulov A. L., Nefedov V. A., Mikulina E. M.); the use of recreational spaces in residential buildings (Merzhanov B. M., Meshcheryakova S. Yu., Novikov N. V., Rudakova V. A.). The introduction of techniques for the use of recreational spaces in buildings and taking into account the problems of compensation for green spaces will increase not only the level of comfort of living in the building, but also the consumer qualities of the designed object, which in turn will affect on the environmental and aesthetic qualities of the environment [6].

The study solves the following main tasks: to summarize the practical experience of designing and constructing residential buildings with the organization of green spaces in them; to identify the main methods of implementing green spaces for residential buildings; to formulate the basic principles of designing landscaping for public spaces of residential buildings or apartments.

3. Results

Landscaping of buildings has a number of advantages. In winter, it creates additional thermal insulation, and in summer, it cools and reduces the temperature of the air in the premises, thereby reducing energy costs. The vegetation on the roof provides ventilation, protects from noise and dust, and absorbs precipitation like a sponge. It also creates a natural environment, making up the lack of landscaping in large cities.
Currently, landscaping of buildings is gaining more and more popularity. First of all, this is one of the ways to make a building energy efficient in order to reduce the negative impact on the environment. So, the residential towers "Bosco Verticale" were recognized as the best skyscrapers in 2014; on its balconies trees and shrubs are planted around the perimeter.

The world experience in designing residential buildings with landscaping has shown that landscaping can be applied both in countries with a hot climate and in countries with a moderate climate. In countries with a moderate climate, where the temperature can drop below zero, preference is given for landscaping the facade with climbing plants on cables, operated green roof and open terraces with mobile landscaping, as well as closed winter gardens and greening the interior. Most of the projects show the placement of a public area on the ground floor, where various landscaping techniques can also be implemented.

As a result, based on the analysis of foreign experience, it is possible to identify three main ways of external landscaping of buildings: a green roof, a green facade with climbing plants and a green wall.

The analysis of world experience shows that public spaces, based on the location in the house, can be divided into two groups: open and closed. For example, open collective spaces are usually located on the roof, as well as in the courtyard of the house. In open spaces, it is possible to use seasonal landscaping. In countries where the winter temperature drops to -20°C, next to an open public area, an indoor winter garden is provided for seasonal mobile gardening in flowerpots. Closed collective spaces can be placed on any floor, they can use all types of landscaping, such as a green wall with artificial light, a winter garden, a greenhouse.

Also, foreign experience shows that landscaping can be used in transit, utility and technical rooms of the house. For landscaping these spaces, wall landscaping in modules or landscaping with climbing plants on metal cables is used.

Summarizing the information obtained on the use of landscaping in the public spaces of a residential building, and adapting it to Russian conditions, it is possible to identify the main methods of introducing green spaces for residential buildings on the example of the city of Samara (figure 1). The main techniques are presented in the form of conceptual schemes. The number of possible landscaping techniques in the structure of the house directly depends on its total area. The more space you have, the more greening options you can apply.

As a result, it can be concluded that greening in a residential building will help to increase not only its aesthetic appeal, the level of comfort of living, human health, but also to establish social interaction of residents.
Figure 1. Conceptual schemes for the introduction of landscaped spaces into the public area of a residential building.

4. Discussion
Generalization of space-planning solutions of residential buildings with the introduction of green spaces allowed us to formulate the basic design principles that can be implemented in the design of landscaping of public spaces of a residential building or apartments:
* the principle of transit greening-performs primarily a decorative function in passageways or temporary stay areas.
* the principle of green zoning-involves the division of one space into functional zones, but with the possibility of unhindered movement.
* the principle of green separation-this principle suggests replacing the partition that separates the two rooms with a glass block of the winter garden.
* the principle of green association-involves exit from two different rooms in an open or closed green area.
* the principle of double gardening is the use of two different or identical methods of gardening in the same room.

The proposed principles can be reflected in the definition of the space-planning structure of a residential building with the introduction of landscaping in experimental design, as well as for educational purposes, during course and diploma design for students of architectural universities who receive a bachelor's degree (figure 2).
5. Conclusions
At the end, we can conclude that the design and construction of residential buildings with the inclusion of green spaces, taking into account the principles, is a promising direction. Moreover, modern reality has forced us to look at housing from a different point of view, as a place that should not only have a beneficial effect on the psychological state of a person, create conditions for social interaction, but also provide improved consumer qualities in the environmental and aesthetic aspects [7, 8].

6. References
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