Role of Green Spaces in Favorable Microclimate Creating in Urban Environment (Exemplified by Italian Cities)

O Finaeva
Department of Design and Visual Arts, South Ural State University, 76, Lenin Avenue, Chelyabinsk 454080, The Russian Federation

E-mail: finaevaov@susu.ru

Abstract. The article represents a brief analysis of factors that influence the development of an urban green space system: territorial and climatic conditions, cultural and historical background as well as the modern strategy of historic cities development. The introduction defines the concept of urban greening, green spaces and green space distribution. The environmental parameters influenced by green spaces are determined. By the example of Italian cities the principles of the urban greening system development are considered: the historical aspects of formation of the urban greening system in Italian cities are analyzed, the role of green spaces in the formation of the urban environment structure and the creation of a favorable microclimate is determined, and a set of measures aimed at its improvement is highlighted. The modern principles of urban greening systems development and their characteristic features are considered. Special attention is paid to the interrelation of architectural and green structures in the formation of a favorable microclimate and psychological comfort in the urban environment; various methods of greening are considered by the example of existing architectural complexes depending on the climate of the area and the landscape features. The examples for the choice of plants and the application of compositional techniques are given. The results represent the basic principles of developing an urban green spaces system. The conclusion summarizes the techniques aimed at the microclimate improvement in the urban environment.

Keywords: architecture; urban planning; greening; urban environment; microclimate; architectural landscape; landscaping.

1. Introduction
The history of Roman civilization developed for more than one millennium. The culture of Ancient Rome was influenced by the best achievements of Egyptian and Greek cultures and is rightly considered one of the richest in the history of the Ancient World [1,2].

Modern principles of urban greening in Italy are developing in accordance with the established cultural traditions. These traditions originated in the history of Ancient Rome and incorporate a huge cultural heritage, in the area of landscaping as well.

Greening of urban areas is a set of measures for introducing elements of vegetation into an urban environment and creating systems of gardens, parks and green yards in order to improve the urban environment [1-3]. The system of green areas of a city is an interconnected, uniform distribution of urban green areas according to the architecture and planning of the city and the plan for its further development, which provides for its connection with suburban green spaces. Green spaces are a
combination of woody, shrubby and grassy plants on a certain territory. Green land distribution is the ratio of areas occupied by plantations, roads, grounds, structures or other functional zones on a green territory, [4].

Measures for urban greening are aimed at creating the most favorable conditions for managing traffic flow; creating a comfortable acoustic environment; regulating microclimatic parameters of the environment (humidification of air, regulation of the wind regime and the level of solar radiation, etc.), bactericidal action, ionization of air and maintenance of its optimal composition; creating of a positive psychological and emotional environment; aesthetic design of territories.

2. Development of a favorable urban environment for human activity

Nowadays, architectural studies resort to a comprehensive approach to the evaluation of architectural and urban planning processes [5-7] and the interaction of architectural and natural elements in the development of a favorable urban environment and measures for its protection and improvement [8-10].

2.1. The role of green spaces in the formation of an urban microclimate

Let us consider the role of green spaces in the formation of an urban environment that is favorable for human activity.

First of all, greening of urban areas has a geosanitary and phytosanitary function. The main function of greenery is to improve the environment, in particular, with plants absorbing and subsequently decomposing various pollutants, regulating the temperature and humidity, reducing the intensity of electromagnetic fields, enhancing and improving the air structure due to bactericidal and fungicidal compounds evolved by plants.

Green spaces can significantly influence the microclimate, lowering the temperature and increasing the speed of airflow, which has a favorable effect on a human body in a hot climate and creates a comfortable sensation of warmth. Plants, above all, affect the radiation conditions, reducing the intensity of direct solar radiation [1-3]. Also, plants contribute to the creation of the optimal humidity conditions and the microclimate of an urban environment, make for an acoustic barrier and have a windproof, gasproof and dust-collecting effect [11-13].

2.2. Historical aspects of the development of the urban greening system in Italy

The principles of urban greening implementation are determined by the climate and the landscape features of the area.

The climate in Italy differs in every region. In the north, it is colder in winter and not so hot in summer, and in the south, it is hot and dry. Urban settlements also impact on the natural environment, forming special anthropogenic zones over the years. The impact of a natural environment on a city is measured by establishing the greatest deviations of the environmental parameters from the comfortable conditions. The impact of a large city on nature depends on the size of the city, the degree of its industrialization and regard to the local natural conditions in the architectural and urban planning of the city. In old large cities, natural landscapes were transformed a long time ago into natural anthropogenic complexes, “man-made landscapes”, which affects the natural environment of the city [14].

Most Italian cities have preserved the historical core, and modern blocks do not fall out of the general architectural exterior. The preliminary architectural system of historical centers was developed taking into account the existing natural environment and remains in harmony with natural conditions. This is determined by several factors. Firstly, Italy has attractive natural and climatic conditions, and is also rich in natural resources. Secondly, the engineering and technical development of Roman civilization did not allow global changes in the structure of natural landscape, but at the same time it allowed simple but effective engineering solutions for the creation of an urban infrastructure and engineering improvement of the areas intended for building. Thirdly, the complexity of exploitation and construction contributes to a high potential for artistic expressiveness of a landscape, which was
fully realized by Italian masters during the centuries. The arrangement of composition of an object is characterized by a synthesis of arts, i.e. a harmonious combination of architecture, sculpture and landscaping.

2.3. The role of green spaces in structuring of urban space

In large cities, the importance of vertical greening increases due to the constantly increasing building density. All available techniques are used for greening. At the ground level, a large number of tub plants are used, such as laurel, lemon and orange trees, standard roses and oleanders. Balconies and roofs are decorated with flowers, herbs and garden plants, like on a residential house in Genoa figure 1.

![Figure 1. Genoa. Example of a green roof.](image)

The building is located on a steep terrain and has a stepped layout, descending down the slope. A lawn surface of roof areas, firstly, reduces the level of thermal radiation into the atmosphere and the intensity of the reflected light for the windows of the upper segment of the building [15]. Secondly, coastal cities of Italy are characterized by higher humidity, and the greenery covering consumes part of the moisture, reducing both the humidity level and the roof temperature, which improves both the microclimate and the environment of the building. Thirdly, green terraces are used as a place for walking by the residents of the house, which improves the psychological microclimate and the comfort of living.

Greenery of a larger scale is planted on areas of a complex terrain unfit for construction, such as ravines, feet of steep rock outcrops or areas along open flights of stairs, gaps between the structural elements of constructions or a terrace of retaining walls figure 2. Climbing plants along the retaining walls reduce thermal radiation enormously, as they are heated by the sun figure 3.

Italian urban landscapes, especially in Rome, are notable for the use of stone-pines; these pines have been cultivated for centuries, their lower branches are systematically cut and, as a result, a mature tree has a tall thin trunk and a dense crown, as if floating above the earth and giving a saving shadow. The ancient Romans planted pine alleys along the roads. Furthermore, green verticals serve as space landmarks and contribute to the formation of the compositional structure of a city. Also, the system of green spaces in Rome and other Italian cities has a decorative function - one of the oldest in
the history of landscaping - or is of a commemorative nature, as the aesthetic and educational role of monumental architecture in the Ancient Roman Empire was enhanced by elements of greening.

The lack of green spaces in residential areas is compensated by the creation of urban public parks, both within the city and outside its limits. They also include gardens and parks at villas, such as the Villa Borghese in Rome, the Villa d'Este in Tivoli, the Boboli Gardens in Florence and many others. Large green areas of gardens and parks perform a recreational and, in some cases, a recultivating function.

A classic Italian villa has a small garden and a lawn with several trees with a beautiful graphic crown in front of the main facade. The architectural planning of gardens was made according to natural conditions. They are characterized by a regular planning composition with free inclusions of greenery, a natural and accurate working of the terrain, water, small architectural forms, a compositional integrity of the garden, balanced proportions, a large number of water devices and an emphasis on the continuity with Ancient Rome [16].

2.4. Factors that influence the formation of the principles of urban greening in Italy

Italy is located mainly on a hilly or mountainous terrain, its cities were founded on mountain slopes and villas are located on a steep terrain, which is turned to advantage by gardening and landscaping compositions. Slopes of hills are used for vineyards or olive groves. Level differences allow the creation of sites for a panoramic view of adjacent landscapes.

When planning the gardens and parks adjacent to the villas, such as the Villa d'Este in Tivoli, the complexity of the terrain was taken into account. In the arrangement of its composition, the principle of terracing (see figure 4) was used. A unique ensemble was created on a fairly small territory, where the garden was planned in a compositional connection with the architectural structures. The
architecture of the palace, sculptural compositions, fountains and greenery are harmoniously connected.

Gardens had a rich and luxurious decoration, with plastic elements and water effects - the climate of Italy is quite hot, and in order to help endure the heat and to create a comfortable microclimate, there were large quantities of water structures: cascading and vertical fountains, water mirrors, artificial ponds, etc. Green structures were skilfully distributed over the garden area. When planning gardens and parks, a skilful composition was created using the principles of a landscape park building, which took into account the features of the used plant forms, the graphics of trees and shrubs, the combination of open spaces and the volume of greenery. The distribution of color spots, i.e. flower beds, rockeries, mixborders, serves to accentuate and highlight the compositional centers, the use of hedgerows at different levels aims at zoning the space and planting of single trees focuses on the creation of interesting plan structures when developing the park composition and interesting view areas figure 5.

Figure 4. Tivoli, Villa d'Este. Shady alley on a complex terrain.

Figure 5. Florence, Boboli Gardens. Terracing of an area.

3. Results
Basing on the research, it can be stated that the principles of developing a system of green spaces in an urban environment should include:

- functional zoning of a city and creation of a unified system of green spaces;
- consideration of the peculiarities of the natural conditions and the urban planning case;
- application of vertical greening and creation of green spaces on roofs;
- expansion of the range of available plant forms.

4. Conclusion
Greening, as well as architectural planning, has a significant impact on the formation of a favorable microclimate in an urban environment. In this case, both the planting density and the composition of greeneries should be taken into account. The considered examples of application of various greening methods showed that they allow an increase of the total amount of green spaces under the modern conditions of urban conglomerations, which means an improvement of the urban green land distribution, leading to an enhancement of the environment and a rise in its level of comfort.
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