ARCHITECTURE AND CONSTRUCTION

SOME ASPECTS OF VERTICAL LANDSCAPING IN MODERN CITIES

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ABSTRACT

From year to year the population of the earth is growing. Industrialization and modern life attract more and more people into cities. Modern technologies in construction and architecture allow more people to live on a smaller area, ie. population density increases in large cities. The overhauling of major cities around the world and the impossibility of endlessly expanding physical boundaries leads to vertical expan-sion. Quite naturally, vegetation, as an unmoved companion of man, will also go in a vertical direction in future cities.

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Global climate change is already a fact, and in front of us as specialists is the question of how to deal with them and how to manage their consequences. It is clear to all today that cities are one of the most serious heat nuclei and generators of harmful emissions that engage the climate in a vicious circle. One way to catch up or slow down these processes is to increase the quantity and improve the quality of green areas in urban environments. Studies are directed towards the use of vegetation resistant to degraded conditions and adapted to the microclimate (Shahanova, 2016; Kabatliyska, Shahanova, Mitkov, 2017).

In 1898. E. Holard presents his concept of a "city-garden", which is an early notice of the signing of the Athens Charter 30 years later - a concept inspired by social, ecological and utilitarian social problems (Aspa-ruhov, Sofia, 2015). These problems, in recent years, have led to the valuation of urban street and park trees and the ecosystem services provided by them to maintain the balance in cities. (Peteva et al., 2018).

More multimillion cities are becoming more common, with the Tokyo leader having a population of 13,185,502 inhabitants in the city and 37,843,000 inhabitants in the agglomeration. Similarly, Jakar, Delhi, Manila, Seoul, New York, Beijing, and so on. In 2025, the number of megacities with a population of over 10 million will increase from 23 to 36, and the population in the first 600 cities size will grow to 500 million. In the near future, two-thirds of the world's population will live in these megacities. Today, 55% of mankind lives in cities, and in 2050 the share is expected to grow to 68%, which in turn generates more harmful emissions of all kinds. Bulgaria is no exception. In our country, this trend is even more pronounced: 34.1% of the population lives in six cities with a population of over 100,000, mainly concentrated in the three largest cities Sofia, Plovdiv and Varna, and a quarter of the whole population is concentrated in the capital, and by 2030 this share is expected to grow to 50%. The overcrowding of the big cities in the world and the impossibility of endless

expansion of the physical boundaries leads to a vertical expansion. In the major cities around the world, skyscrapers and multifunctional buildings are not new. The first built skyscraper was Woolworth in New York, 241.4m high and 57 floors completed in 1913. Of course here we can mention Trump Tower 1930, Chrysler Building 1930, Empire State Bilding 1931, Moscow State University of Moscow 1953, which until 1990 is the tallest building in Europe. We can not miss the Indian race between New York, Chicago, Hong Kong and Tokyo in the second half of the last century to get to this day when the construction of high-rise buildings is experiencing a real renaissance in the nearby and lighter East. The achievements in Singapore, Beijing, Beijing and the Arab Emirates clearly show the way in which cities will develop in the future. In 2004, the emblematic Burj Khalifa building in Dubai, with a total elevation of 828 m, was completed and at the base of the building is located the largest moul-functional complex in the world. Of course, the championship is challenging for a better result and he is not late. This year will be completed the new Kingfisher Tears in Saudi Arabia with a height of just over 1km.

Quite naturally, vegetation, as an unmoved companion of man, will also go in a vertical direction in future cities. The first attempts are related to the roof gardens as part of the so-called green corridors - bound similar elements of the green city system (Kovachev, Tsolova, Shahanov, 2012). Later, in the 1990s, the idea of vertical gardens - an alternative to traditional landscaping and part of the concept of green construction (Marinova, Shahanov, 2018). Although with a delay of 100 years, compared to the first skyscrapers, today there are already the first bold attempts in the vertical direction. After the first vertical park project in New York to win the EVOLO skyscraper competition in 2010, similar projects are being held in each subsequent edition of the competition, but more importantly, there have already been similar realizations. The first one is:

Bosco Vertikale (Vertical Forest) in Milan, 2014, designer Stefano Boeri.

"Vertical Forest" is an example of a sustainable residential building with environmental recovery and urban biodiversity. This is a model of vertical sealing of nature within the city, which acts in the context of reforestation and naturalization policies within the major urban and metropolitan boundaries. The first example of the vertical Forest, consisting of two 110 and 76-meter-high residential towers, is located in the center of Milan, on the outskirts of Isole district.

When the project is completed, they will accommodate 800 trees (each 3, 6 or 9 meters), 4,500 bushes and 15,000 grassy and flower plants, distributed according to the exposures and the lining of the individual facades. The vegetation of each of the two towers is equivalent to 20,000 square feet of conventional forest. This system of vertical forest construction contributes to the improvement of the microclimate, increasing air humidity, absorbing CO2 and dust and producing oxygen. It also helps protect homes from harmful sun rays and greatly reduces acoustic pollution. "Vertical Forest" increases biodiversity. It helps to create an urban ecosystem in which vegetation creates a vertical environment allowing colonization from birds and insects and therefore becomes a magnet and symbol of the spontaneous regeneration of the city with vegetation and animals. The creation of a number of vertical forests in the city can create a network of ecological corridors, creating prerequisites for a quantitative and qualitative improvement of the green system.

A "vertical forest" can also be seen as a measure against rampant urban growth. It could control and diminish urban expansion, since each of its towers is equivalent to an urban expansion zone with family houses and buildings of up to 50,000 square meters.

Trees are a key element in the spatial composition of cities and their green systems. In this case, the selection of the species is made to fit their positioning on the facades in a vertical direction. The plants used in this project will be grown specifically for this purpose and will be pre-cultured with an extended introduction process.

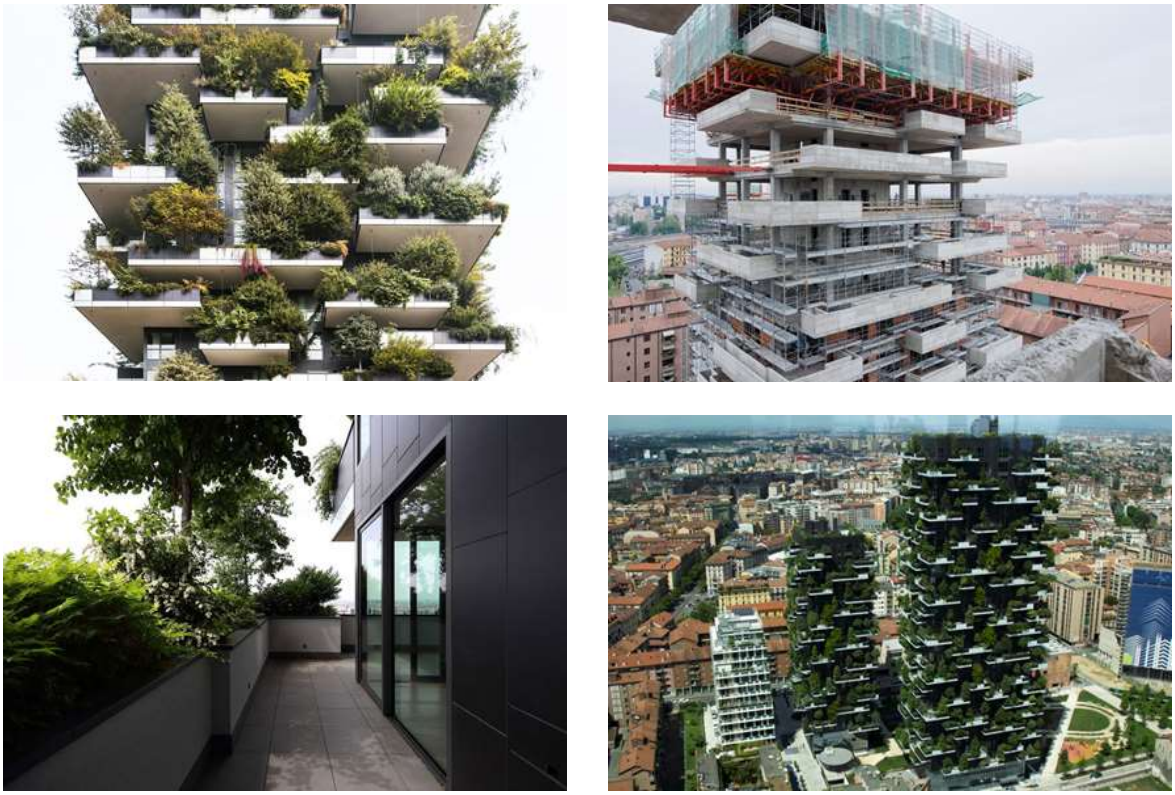

Fig. 1. Bosco Verticale, Milan. Fragments of construction and general view

We can also mention:

• **Royal Park** in Singapore, designer WOHA.

Designed as a multifunctional building with hotel, office and garden, this project is an example of how building can not only preserve the greenery but also multiply it in a remarkable way combined with the principles of sustainable development.

The goal of WOHA designers was to create a lush tropical forest, attractive not only to humans, but also to birds and birds, which is a natural extension of the green areas of Hong Lim Park and encourages biodiversity in the city. The building is designed to be a vertical extension of Hong Lim Park and contains 15,000 sq. m. intensively landscaped areas.

Fig. 2. Royal Park, Singapore. Shared view and fragment

• **Tao Zhu** in Taiwan, 2018, designer Vincent Calebo.

Inspired by DNA, designed to be energy-saving and carbon-absorbing, so as to limit emissions and be a means of combating climate change. The facade, the roof, and the terraces of the building will be planted with 23,000 trees and shrubs - almost as many as there are in Central Park in New York.

The skyscraper will absorb 130 tonnes of carbon dioxide per year, which is the equivalent of the emissions that emit 27 cars in 12 months. This is very important because, according to the latest

data, Taiwan generates more than 260 million tonnes of carbon emissions annually. The Tower represents a pioneering concept of sustainable housing eco-construction, which seeks to limit the environmental footprint of its inhabitants.

Fig. 3. Tao Zhu, Taiwan. Perspective, fragment and general view

• **Sky Forrest** in Sofia, under construction, designer ARHIMAT

In the example of world models, the first attempts to achieve energy efficiency and "zero footprint" are made by vertical landscaping.

The public significance of this project lies above all in the fact that the building will be the first green building in Sofia. Rich landscaping unfolds not only in the yard but also on the façade of the building. It will be planted over 2400 plants - tall trees, shrubs and climbing plants, which will produce over 60 kg of oxygen per day. The entire roof of the building will represent a photovoltaic field with solar panels that will provide its own energy for the common parts of the building.

Fig. 4. Sky Forrest, Sofia. Project visualizations

In the world, we can also mention a number of conceptual developments that day by day are close to reality:

• **Vertical Central Park,** Manhattan, designer Jeffrey Lee, Rui Liu, Tina Kue

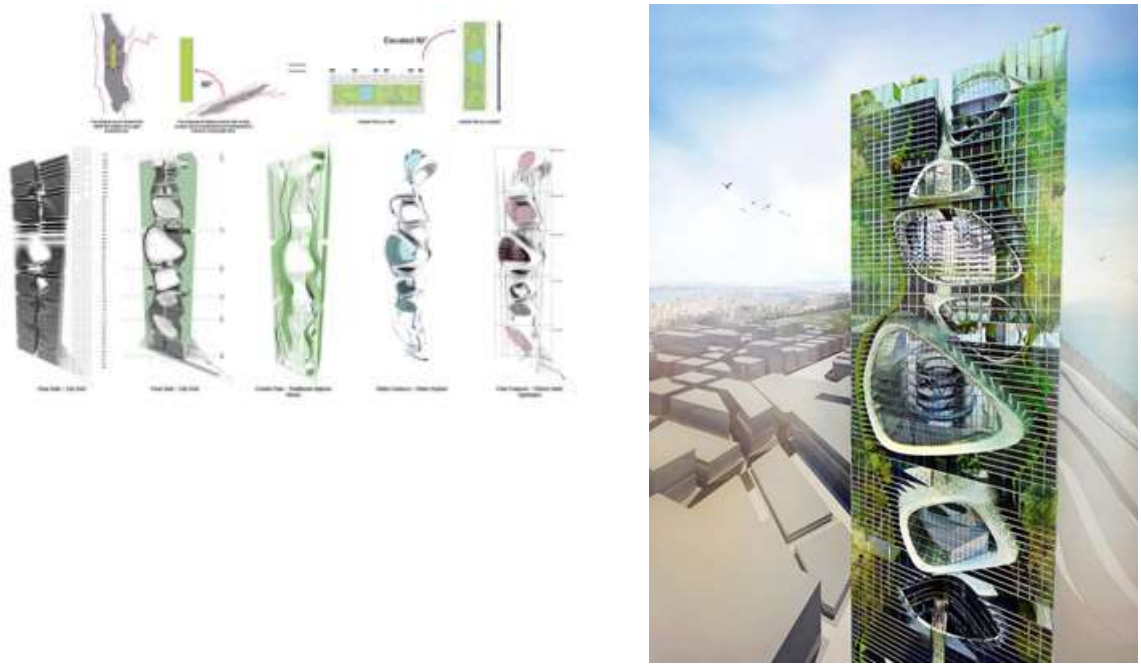

Fig. 5. Vertical Center Park. Conceptual design

• **Stackable Solar Skyscraper**, Mexico City, designer Jorge Hernandez de la Garza

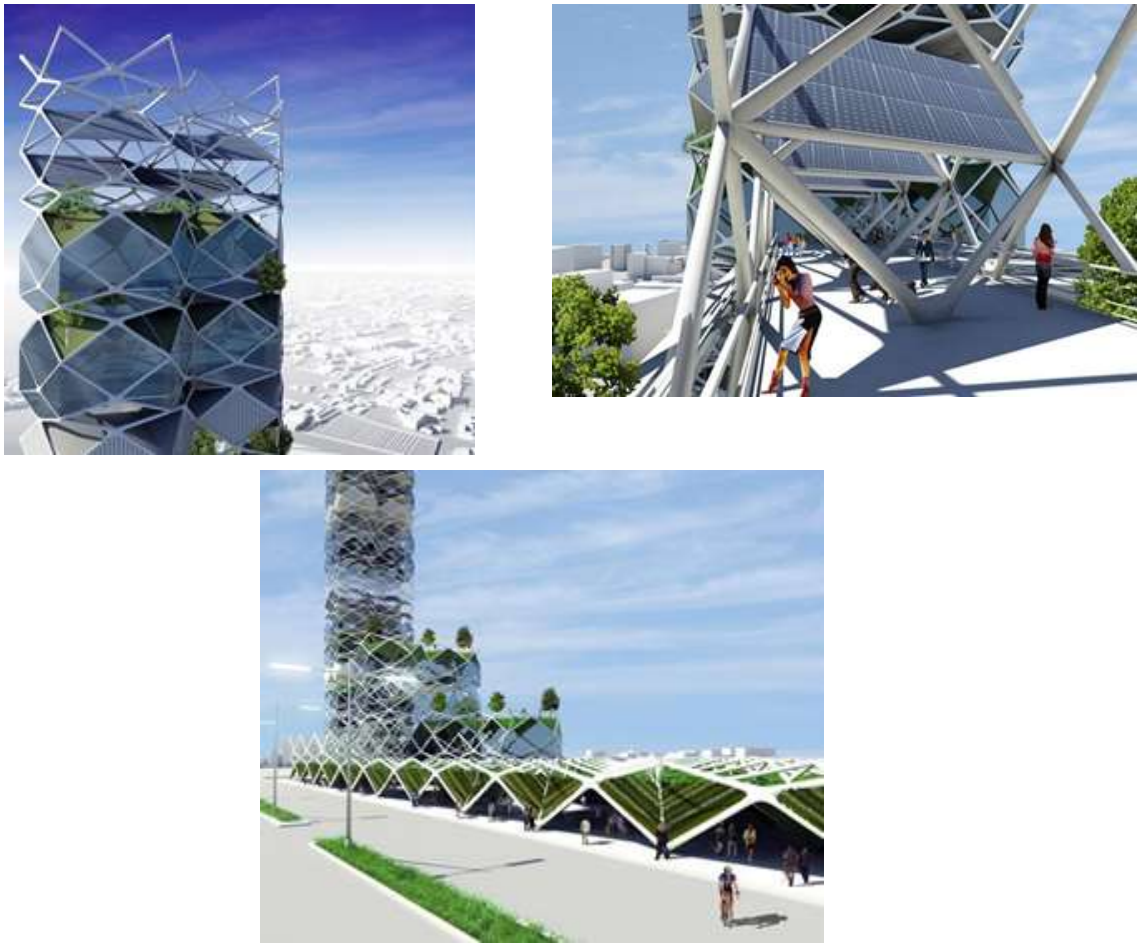

Fig. 5. Stackable Solar Skyscraper. Conceptual design of a vertical park without habitation function

• Bionic-Arch, Taichung, designer Vincent Callebaut

Fig. 6. Bionic-Arch. Conceptual design of a vertical park without habitation function

There are many other examples in the world illustrating the contemporary man's striving for contact with nature, all of which mark a breakthrough not only in architecture, but also in the landscape architecture, but also in the overall conception of cities in the future, in line with the challenge of global climate change and ever-changing urban aspects, all of which are united by the concept of a sustainable, energy-independent architecture with a minimal carbon footprint.

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