Architecture and planning in arrangement of bionic pieces in modern urban landscape

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Abstract. Green construction is a worldwide priority, as it can reduce the negative environmental impact associated with high urbanization. On the one hand, we live in an era of unprecedented economic growth; on the other hand, the man-nature interaction is being altered. The attempts to address the complicated issues of environmental crises in cities, new ways to integrate nature in architecture have been discovered, and new tools have been invented to improve the quality and representativeness of urban landscapes. Not only do these activities help create an ecologically sustainable habitat; they also make nature more important to people in general. Of greatest practical interest is the science of natural biotech, which manifests in the art of arborarchitecture and arborsculpture: the generation of new buildings, or even various architectural and artistic shapes from trees and shrubs. This paper dwells upon the basic ways of integrating bionic pieces in the architecture and planning of Russian cities. As of today, the art of arborarchitecture and arborsculpture is still at infancy. This proves the relevance of an effort to describe such pieces in terms of the basic architectural and artistic composition tools; besides, bionic pieces must be viewed as structural elements of a whole composition.

1. Introduction

“Today, we see stunningly innovative low-energy buildings being designed and constructed. “Green” construction is on the road of continuous improvement, with ecologically sustainable urban architecture emerging as a concept” [1].

Of theoretical and practical interest are arbor architecture and arbor sculpture: two arts that seem most relevant to the today’s urbanism with its sustainable evolution of landscaping.

The generation (“cultivation”) of architectural and artistic pieces or even whole buildings (structures) from trees and shrubs is covered in numerous non-Russian papers and books: K Kirsch [2], H T Hartmann and D E Kester [3], Ni Boonnett [4], R and S Kerwood [5], Mr. Wu [6], J Ask [7], M Kalberer [8], Christopher Cattle [9], Aharon Naveh [10], Hermann Block [11], Dan Ladd [12], P Cook and B Northey [13], Ezekiel Golan [14], B Gale [15], T Link [16], Axel Erlandson [17], R Reames [18], etc., as well as in some Russian papers, like those by A I Koveshnikov, N A Shiriaeva and M A Stavtsev [19], etc.

Literature review reveals that the basic techniques of integrating the bionic pieces (arborarchitecture and arborsculpture) in the architecture and planning of Russian cities have not yet
been covered. This is what makes relevant the goal of this research, which is to identify the basic architectural and artistic aspects of creating arborarchitecture and arborsculpture for a modern city.

Study objectives:
1) to describe arborarchitecture pieces and arborsculpture pieces in terms of the basic architectural and artistic composition tools.
2) consider bionic pieces of an urban environment as structural elements of a whole composition.

The novelty of this study lies in an effort to systematize and generalize the architectural and artistic aspects of creating bionic pieces, as well as in proposing a bionic landscaping concept.

2. Theory
Consider the concept of scale applicably to bionic pieces integrated in the urban landscape. According to D L Melodinsky, the scale is the visual impression of the size of a piece in relation to human height [20].

Let us define the actual size of arborarchitecture and arborsculpture pieces in terms of V.T. Shimko-proposed metrics: taller-than-human; human-size; smaller-than-human [21]. Trees and shrubs grow naturally, meaning their scale changes; this leads to a finding that the elements of natural landscaping used in city architecture and planning (and thus, the arborsculpture as a landscape component) are dynamic rather than stationary over time; one cannot assign a strictly fixed scale here [22]. The scale of arborarchitecture must be considered in the context of the bionic “cultivation” and its structural specifics. Thus, if a “green” tree-shrub building is constructed by using formwork, or if the “cultivation” process implies constructing the building frame in conjunction with the bionic frame, this belongs to the taller-than-human class. If a building has a tree-shrub (i.e. fully bionic) frame, it can change its scale as the plants grow.

“Modern sculpture, including arborsculpture, can comprise an urban element on the scale of the human body.” [23] Human-size or taller-than-human arborarchitecture or arborsculpture pieces can dominate (be the centerpiece of) the composition. Depending on the architectural composition, arborarchitecture can or a first-, second-, or third-order centerpiece, having a vast variety of unique features: shape, color, size, etc. Arborsculptures can be a landscape centerpiece when used as an urban infrastructure elements (which, in the context of prospective development, includes temporary shelters like summer houses or camping sites; marketplace facilities such as kiosks, pavilions, etc.; and road infrastructures, i.e. shelters at public transport stops), or as small architectural forms (garden furniture, sculpture, etc.). However, in the same categories both arborsculpture and arborarchitecture can serve as the compositional accent by having a distinctive visual feature. Placing multiple arborsculptures within sight turns them into background elements of a whole composition.

Consider arborarchitecture and arborsculpture in terms of the artistic category of magnitude. Magnitude is a compositional tool specific to architecture. “Regardless of what the true magnitude of a piece is, the viewer can describe it as large or small, monumental or neutral, etc. These qualities are found to correlate with the public significance of this or that art piece...” [21]

Bottom line: arborarchitecture and arborsculpture pieces may seem large even if they are actually not large in relation to sundry pieces in the same environment. For instance, a bionic bus stop will seem smaller against a backdrop full of high-rises than it actually is. This is a play of contrast. However, this piece of bionics, with its shrubs and trees, will also seem picturesque and unusual yet very interesting, as such landscaping is still exotic for Russia. Human’s subconscious desire to be close to nature will amp the effect. Arborsculpture is a man-made piece of art comprising woody plants and representing the symbiosis of nature and design; as such, it can cover the basic recreational needs of urban dwellers. When considering arborarchitecture, one must note that the artistic impression they make may be enhanced by the reshaping of crowns and trunks, as well as by flowering; all of these processes are part of the natural growth of the trees and shrubs used in such architecture.

Repeated use of similar arborsculptures is what constitutes the rhythm of a landscape composition. Rhythm can be linear: arborsculptures (or even arborarchitecture) are arranged along streets or roads,
alleys or pathways in parks or city gardens. It can also be *spatial*: arborsculptures are repeated in clusters within city blocks or recreational areas; arborarchitectural elements repeat in the spatial design of a bionic building. Trees and shrubs planted in tubs along the building perimeter will duplicate its bearing frame on each floor; as they grow, they will create closed space of varying dynamic morphology.

Notably, disymmetry is the most characteristic feature of arborsculpture and arborarchitecture alike; a disymmetric piece is one that is generally symmetric but may feature some asymmetry due to the uneven growth of trees and shrubs in its composition. This can further enhance the artistic value. Asymmetric bionic pieces, which are mostly encountered in gardens and parks, have been identified in the retrospective analysis of arborsculpture [24]. These pieces are unique and interesting to the viewer. However, it is not only the asymmetry, but also the functionality that makes them somewhat controversial (Figure 1).

![Image](image_url)

**Figure 1.** The structural elements of the whole composite object arborsculpture.

### 3. Findings

Arborarchitecture and arborsculpture pieces as bionic elements of natural habitat can help balance and harmonize the today’s artificial urban landscapes.

*Finding One:* bionic pieces can alter their scale by growth (i.e. are dynamic), passing to a higher-rank class on V.T. Shimko’s scale.
**Finding Two:** arborarchitecture often becomes centerpiece, while arborsculpture often serves as an accent or to create a compositional background (this is rare and is mostly seen abroad, e.g. in Australia). However, arborsculptures of practical use (exterior elements such as urban infrastructural elements, small architectural forms like garden furniture or sculptures) can still dominate the landscape provided they are human-like or taller-than-human.

**Finding Three:** a human person can perceive a bionic piece as large even if it is not that large compared to sundry pieces in its environment.

**Finding Four:** the authors have analyzed the following compositions as made by the environmental integration of bionic pieces, whereby they determined that the typology of sculptures, or dynamic morphology of arborarchitecture, affects not only the way people perceive such pieces, but also the way they conceptualize the whole space.

4. **Conclusion**

To conclude, we must note that arborarchitecture and arborsculpture as landscaping elements serve both decorative and utilitarian purposes. The analysis of opportunities for the integration of bionic pieces in the architecture and planning of modern cities, together with the results of this study, will help summarize the knowledge on the compositional description of such elements; help architects, arborsculpture artists, landscape designers, and viewers better appreciate such art; and be of use in improving the Arbor software [25] of our development, the newer version of which can identify where to place a bionic piece in an urban landscape while purposefully harmonizing the architectural environment by means of composition tools. This study demonstrates landscape- and ecology-oriented approaches to the development of urban objects, street furniture and interior objects, targeted practical activities in the sphere of landscape design and architecture.

References

[1] Kornienko S V and Popova E D 2017 Green construction in Russia and abroad Construction of unique buildings and structures (St. Petersburg: Civil engineering Institute of St. Petersburg Polytechnic University) 4(55) 67–93

[2] *Tree Dome by Konstantin Kirsch (Electronic Materials)* http://treeshapers.net/tree-dome-by-konstantin-kirsch

[3] Hartmann H T, Kester D E, Geneve R L and Davies F T 2001 Hartmann and Kester’s Plant Propagation: Principles and Practices New Jersey No 7 (New Jersey: Pearson Education (US)) p 928

[4] Boonnetr N 1985 *Life Art (Electronic Materials)* http://treeshapers.net/life-furniture-life-art-by-nirandr-boonnetr

[5] Kerwood R and S 1998 *Willow (Electronic Materials)* http://treeshapers.net/windrush-willow-by-richard-suzaaner-kerwood

[6] Mr Wu’s 2000 *Trees (Electronic Materials)* http://treeshapers.net/mr-wus-trees

[7] Ask J 2012 *Tailored Trees – Tree Shaping in a Public Environment* vol 15 p http://stud.epsilon.slu.se/4755/1/ask_j_120903.pdf

[8] *Living Willow Structure – Auerworld Palace – Aeurstedt, Germany* http://pithandvigor.com/plants/living-willow-structure-auerworld-palace-auerstedt-germany/

[9] Cattle C 1996 *Grown up trees* http://treeshapers.net/grown-up-trees-by-chris-cattle

[10] Naveh A 1985 *Tree sculpture* http://treeshapers.net/aharon-naveh/

[11] Block H F 2008 *We plant a gazebo: building with living trees* (Staufenbei Freiburg: ökobuch) p 101 https://www.book2look.com/vBook.aspx?id=9783936896336

[12] D Ladd 1978 *Extreme Nature* http://treeshapers.net/extreme-nature-by-dan-ladd

[13] Cook P and Northey B 2010 3 *Methods of Tree Shaping every aspiring tree shaper should be aware of – 1 st edition* (Yangan: SharBrin) p 14 http://www.pooktre.com/extra/3/methods.html

[14] Golan E 2003 *Plantware* http://treeshapers.net/plantware-by-zeekiel-golan-yale-stav
[15] Gale B 2011 The potential of living willow structures in the landscape. Master’s thesis (New York: State University of New York) p 50
[16] Link T 2008 Arborsculpture: An Emerging Art Form and Solutions to our Environment (Davis: University of California) p 33
[17] Circus tree story https://www.gilroygardens.org/circus-trees/a-circus-tree-story
[18] Reames R Arborsculpture Solutions for a Small Planet http://www.arborsmith.com/how-to-grow-a-chair/
[19] Kulikov V G, Kolesnichenko M P and Geeves E S 2012 Design technology of structural insulated procompetitive Science. Construction. Education 1 http://www.nso-journal.ru
[20] Melodinsky D L 2014 Architectural scale in the works of domestic authors of the first half of the XX century Actual problems of modern science ed S S Chernova (Novosibirsk: Publishing house CRNS) 32 6–19
[21] Shimko V T 2006 Architectural and design projects. Fundamentals of theory (environmental approach) (Moscow: Architecture-C) p 384
[22] Smolina O O 2017 The Concept of scale in environmental organizations arborsculpture Materials of 10nd all-Russian scientific-technical conf.: Current issues of architecture and construction (Novosibirsk: Novosibirsk state University of architecture and civil engineering) pp 91–3
[23] Polupanova M S, Dunin E V and Dunin V E 2014 Importance of sculpting in architectural education New ideas for the new century: proceedings of the int. scientific and practical conf. of FAD TOGU (Khabarovsk: Pacific national University) 2 415–20
[24] Murashko O O 2015 Historical trend analysis of landscape design – arborskulptura Volga scientific journal (Nizhny Novgorod: Nizhny Novgorod state University of architecture and civil engineering) 3(35) 178–83
[25] Smolina O O 2016 Arborsculpture - advanced range of plants Pat 2016617494 RF http://www1.fips.ru/wps/portal/IPS_Ru#1529563517325