Variability of approaches to arborsculptures

O O Smolina
Department of urban planning and urban management, Federal State Budgetary Educational Institution of Higher Education "Novosibirsk State University of Architecture and Civil Engineering", 113, Leningradskaya Street, Novosibirsk 630008, Russia
E-mail: Zelenoest-vo@mail.ru

Abstract. Various environmental programs are under development today to explore how to bring humanity back to a harmonious coexistence with the nature, to overcome the negative factors of anthropogenic civilization. This paper opens up a new direction in the theory and practice of arborsculptural arrangements in urban environment; in particular, it dwells upon the variability of ways to grow and use bionic objects in spaces that may vary in terms of isolation. Complex analysis of the obtained data revealed that the current state-of-the-art of bionic objects comprises three ways to generate them: cultivation of arborsculptures in open space for later use in enclosed spaces; cultivation and use of bionic objects in enclosed spaces; or in open spaces. Another finding is that the arborsculptures are used as exteriors or interiors, for which there are two strategies. The first strategy is to grow a tree to a specific artistic shape, then cut it and use as an interior or exterior decoration. The second strategy is to preserve the natural structure of a tree and to integrate it into the existing urban environment. Note that the second strategy is a more promising one, as it prolongs the life cycle of the growing trees.

1. Introduction
“Man is a biological spawn of Mother Nature, intrinsically in need of a balanced natural environment...” [1]. The emergent ecocentric path towards a better environment helps resolve a number of environmental concerns. Bionics (biomimetics) as a branch of science defines the natural forms and seeks to rationally apply those in technology by creating man-made counterparts. An arborsculpture is a natural element (specifically, an element of landscaping), whose trunk or crown shape is gently adjusted to give additional functionality relevant for the urban landscape or interiors while not affecting the basic structure of the tree. Thus, an arborsculpture is not a “counterpart” to a living being; it is that being itself. In that regard, arborsculptures must be considered bionic objects [2].

In the field of landscaping and architecture, the factor making this research relevant is that it dwells upon the symbiosis of the multifaceted piece of architectural art with the fundamental ecological elements: arborsculptures that manifest in open and enclosed space alike.

Bionics research and biological approaches to architecture are the subject matter of books and papers by: D Steele, Yu. S Lebedev, T Fritsch, A Sant'Elia, E Glöden, V G Shukhov, F Otto, P Soleri, A Mutnyakovich, V V Seefeld, A Gaudi, Ye. V Denisenko, M I Shumik, K Katola, B Gale, A comprehensive study of shape-ornamental horticulture is based on the theoretical papers by: L P Simirenko, N G Zhuchkov, I V Michurin, I M Shaitan, R P Kudryavtsev, S V Klimenko, V N Lyubimenko, N G Kholodny, A O Sapegin, N N Grishko. Environmental education is the subject
matter of papers by: V I Vernadsky, A A Gorelov, T I Trubnikova, N V Bauer, etc. The process of shaping an arborsculpture is covered in papers by such arborsculptors as K Kirsch, H T Hartmann and D E Kester, Ni Boonnetr, R and S Kerwood, Mr. Wu, J Ask, M Kalberer, Christopher Cattle, Aharon Naveh, Hermann Block, Dan Ladd, P Cook and B Northey, Ezekiel Golan, B Gale, T Link, Axel Erlandson, R Reames, etc., as well as in some Russian papers, like those by A I Koveshnikov, N A Shiriaeva and M A Stavtsev, etc.

The goal of this research is to find, define, and describe the existing and future ways to shape and use arborsculptures.

Study objectives:
1. to consider the key aspects of the cultivation of arborsculptures in various arborsculptural practices;
2. to define the practical focus of bionic objects.

The novelty of this study consists in proposing a novel concept of the bionic urban landscaping, which, being a new addition to the theory of architecture, will help create a sustainable urban environment.

2. Theory

Comprehensive analysis of the cultivation and use of arborsculptures has identified three organizational approaches:

1. Cultivation or shaping in open space for further use in enclosed spaces;
2. Cultivation and use in enclosed spaces;
3. Cultivation and use in open spaces, see Fig. 1.

Another method that may appear in the future as the art of arborsculpture becomes more advanced is to cultivate bionic objects in enclosed spaces for later use in open space. This is entirely possible in warmer regions and requires setting up specialized nurseries for plants, where bionic objects will be cultivated for further planting in the urban outdoors.

Let us discuss the arborsculptors who practice one or two of the above ways, and consider the key aspects of cultivating such objects.

**Cultivation or shaping in open space for further use in enclosed spaces (first method).**

John Krubsack (born 1858 — died 1941) was a U.S. arborsculptor, who grew a single chair naturally from several Fraxinus trees, then cut it off for use as an interior piece of furniture. Today, this bionic chair is kept by Noritage Furniture, a furniture company based in Embarrass, Wisconsin, United States [3].

Peter Cook and Becky Northey are arborsculptors from South East Queensland, Australia, who work with Prunus and Myrobalan gray [4]. Some ideas from the authors' growing trees are used as small architectural forms for open spaces (like garden furniture) while some of their arborsculptures grow into exclusive interior furniture, i.e. are used in enclosed spaces.

This method has also been practiced since 2000 by Mr. Wu, an arborsculptor from Shenyang, Liaoning, China. He cultivates bionic furniture from Ulmus trees, which he cuts after fully shaped and then uses as chairs and armchairs in his house. Mr. Wu hopes that one day, people will be able to grow their furniture instead of buying it [5].

This method limits the duration of tree growth and is therefore not recommendable. It is mainly used by the arborsculpture beginners to cultivate a complex structure, or to create singular exclusive interior elements; however, the time it takes to shape anything makes the method rather impractical.

**Cultivation and use in enclosed spaces (second method).**

Ezekiel Golan Yale Stav are the founders of plantware, Tel Aviv, Israel; they work with with the Ficus roots to make interior items [6]. This method is suitable for arborsculptures intended for interiors, i.e. for sculptural compositions and functional elements for small size that will have space to grow indoors.
Dr. Christopher Cattle is an English arborsculptor who in 1978 decided that furniture could be grown from growing plants. Bionic furniture is mostly shaped in enclosed spaces [7]; however, both Mr. Cattle and Nirandir Boonnetr [8], an arborsculptor from Thailand, have since 1983 cultivated arborsculptures by the third method.

Cultivation and use of bionic objects in enclosed spaces (third method)
Axel Erlandson (1884 – 1964) from Hilmar, California, United States, practiced this method since 1919 [9]; Dan Ladd from Northampton, Massachusetts, United States, did so since 1977 [10]; Konstantin Kirsch [11] and Hermann Block [12], Germany, as well as Aharon Naveh from Israel — since 1989 [13]; Richard Reames, a U.S.-based arborsculptor, has been experimenting to create bionic forms integrated in the tree structure since 1993 [14]; the German Marcel Kalberer has been doing so since 1998 [15]; Richard and Suzanne Kerwood, England, since 1999 [16]; Laird Funk, United States, since 2002 [17]; etc.

This is the preferable method, as it prolongs the life cycle of the growing trees and shrubs while contributing to the sustainable development of cities. After fully shaped, bionic forms are usually turned into small architectural forms.

3. Findings
Arborsculptures are used as exteriors or interiors. Exterior bionic objects are urban structures and small architectural forms; interior objects are sculptures, functional positioning elements, furnitures. In the context of how arborsculptures are arranged, there are two basic strategies.

The first strategy is to grow a tree to a specific artistic shape, then cut the arborsculpture and use as an interior or exterior decoration.

The second strategy is to preserve the natural structure of a tree (i.e. not cut it and not remove the roots) and let it grow after being integrated in the existing architectural environment as garden.
furniture and/or sculptural compositions. The second strategy is better, as it keeps the trees growing, improves the landscaping quality and level, makes urban landscapes more representative by integrating arborsculptures.

4. Conclusion

Arborsculpture embraces the bionic urban elements which help create a sustainable urban environment and improve the micro-level ecology (and will likely help improve meso- and macro-levels, too, in the future) by using a natural populations of trees as a landscaping element. From the standpoint of economics, an arborsculpture is an alternative to the existing small architectural forms. However, despite their advantages, such pieces are rarely used in urbanized areas. The main reason behind such fragmentary use is that arborsculpture takes very long time (four to fifteen years, or even more) to fully form [18, 19].

To conclude this paper, note that the research results are integrated in Arborsculpture: Advanced Range of Plants software [20]. The search for new ways to improve the ecology of urban cities, to bring them to a whole new level of quality, a level at which man comes closer to nature, is an important challenge to address — and a great opportunity for landscape architecture. The results of this study will enrich the existing theoretical and empirical scientific knowledge of landscape and ecology-focused approaches to making bionic objects.

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