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RESEARCH ARTICLE

Using nature in architecture: Building a living house with mycelium and trees

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KEYWORDS

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Abstract

This study proposed the development of a house with the following characteristics: grows, builds, and repairs itself; changes with the seasons; uses the forces of nature and is in harmony with its environment; favors biodiversity and natural equilibrium; low cost and does not require considerable workforce or industrial material; carbon free and waste free; returns to nature when no longer in use; enables sustainable and balanced mankind development. The use of living architecture to decrease or nullify the environmental costs of structure materials was also investigated. Furthermore, the use of living architecture techniques to comply with the current living and construction style with as little change as possible was analyzed. A new envelope material with little to no carbon impact was scientifically explored, and the use of this material to create a sustainable house was technically examined. Findings demonstrate that such a house is not only feasible but also rational and beneficial from the economic and environmental perspectives.

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1. Living construction history

Living architecture is defined as the use of forces and possibilities given by natural living organisms to help and build low-cost and sustainable construction. Living

architecture is not a new concept as it has been used for centuries.

The first popular examples of living architecture are bridges across Asia. Three vine bridges (Figure 1) have been built in Japan across the Iya Valley; these bridges use the strength and properties of *Wisteria floribunda* to hold wooden slabs of bridges of up to 43 m long. Similar bridges can be found in Indonesia (Jembatan Akar bridge) and India (Rangthylliang and Umshiang bridges in Figure 2). The local Indian tribe called War-Khasis used *Ficus elastica* with aerial roots that develop on the tree trunk and then reach the soil.

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Figure 1 Vine bridge in the Iya Valley, Japan (photo from [Funzug.com](http://funzug.com)).



Figure 4 “Oak Chapel” in Jovac (photo from [Mrka](http://Mrka.com)).



Figure 2 Rangthylliang bridge (photo from P. A. [Rogers](http://Rogers.com), 2015).



Figure 5 “Wee house” (photo from Sarah Grote).



Figure 3 “Chêne Chapelle” in Allouville-Bellefosse (photo from “[pintandaport](http://pintandaport.com)”).

By guiding roots in a hollowed branch across the river and pushing them into reaching the soil on the other side, the tribe naturally built bridges up to 50 m long in a 10- to 15-year process.

Similar old and living constructions can be found in France (Figure 3) and Serbia (Figure 4), where an ancient hollowed oak was used as walls to build chapels.

At the present, many “tree houses” are grown around the world. Such houses use living trees as a structure but use industrial materials for building the living space: this practice is the first step toward the real “living architecture” aim of the present study. Striking examples of the said structures are the “Wee house” built in 2013 by Dave Herrle (Wolf, 2006) in the Westbrook forest (Connecticut, USA - Figure 5) and “Teresa and David’s tree house” built in 2011 in the United States (Wolf, 2006).

However, achieving real “living architecture” requires not only using nature as it is but also shaping it to the required form. This process was pioneered by John Krubsack, who realized the first “living chair” in 1914 (Figure 6). The chair was entirely built by shaping living trees as they were growing (Wisconsin, 1922). John Krubsack took 11 years and 32 young seedlings to build the chair, and his

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