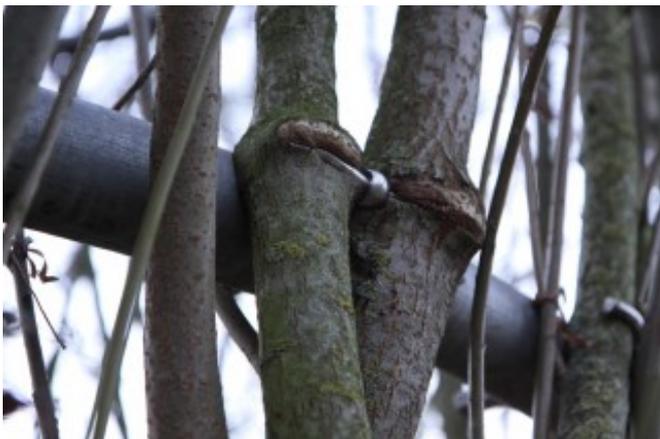


## Living plant construction: the vivification of architecture

**Trees do not just provide timber, they can also be harnessed for construction without the need to cut them down. The term Baubotanik, Living Plant Construction in English, refers to combining modern materials with tree shaping. It shows how a new kind of architecture allows trees to continue growing when joined to temporary steel structures. It uses new design techniques, is climate friendly and of practical use.**



Steel and trees don't go together? Who says so? Bureau Baubotanik from Stuttgart proves that quite the opposite is true. © Jorinde Duthweiler

In 2006, the Institute of Design and Architecture Basics (IGMA) at the University of Stuttgart, established a special research group involving architects Ferdinand Ludwig, Oliver Storz and Hannes Schwertfeger. The aim of the group was to integrate trees into architecture. Rather than taking trees as natural models in construction as bionic researchers do, the three architects wanted to work directly with living plants. They therefore spent several years investigating ways in which growing trees could be used as load-bearing elements in buildings as an integral part of building design. Ludwig is still at the IGMA, Schwertfeger and Stolz decided to establish their own company in 2010. The company, called Bureau Baubotanik, brings together an interdisciplinary team of architects, structural engineers and natural scientists.



This footbridge in a living plant construction park in the German city of Kamen currently has a load-bearing scaffolding. However, as the red oak trees grow, they will be able to support a greater and greater load, and replace the man-made construction materials. © Sebastian Becker

“We want to take living plant constructions to practical application and find out what people want and what is feasible. Our projects are aimed at finding a way to use plants in high-tech environments and integrate living plants into buildings, offering a high quality of life. We are also interested in using plants for aesthetic purposes and creating a new way of connecting spaces,” says Schwertfeger. Schwertfeger and his colleagues see particular potential in the urban space of high-density cities. With their innovative buildings, the architects hope to bring back some natural quality of life into cities. Pavilions, bridges, walkways and exhibition spaces are practical examples that show that many things are possible. The team also envisages integrating living plants into residential buildings. “If we could find a building contractor, we would start right away. We have been involved in a study on residential building design,” says Storz. At present, the team receive most of their commissions from public institutions, foundations and companies.

## Living plant construction refers to the entire process, not just the final building structure

Architects who use living plants by no means reject conventional materials, quite the opposite. The structures they make are blends where steel and trees complement each other. As young trees are naturally not yet able to bear the loads required by the structures, a steel scaffolding takes over the supporting role until the trees have reached the required size and strength. Over time as the plants gain enough strength and stability, the temporary steel scaffolds are gradually removed. “The trees grow into the structure, and how they do so is calculated in advance. In general, we make two static calculations, one on the basis of the steel construction, and another that takes into account the tree and branch thickness required to bear the load,” says Oliver Storz. The calculations also allow for the fact that the wind creates an additional load, and that the tree stability has to be checked on a regular basis, as it does for any urban trees. This approach deliberately makes the architects dependent on growth processes. They want to show that it is possible to deal with the uncertainties associated with the use of living structures.

However, uncertainties are not always appreciated by building regulations authorities. Even with a great deal of amplitude in the calculations, biology might confound expectations. Schwertfeger and Storz are obviously aware of this. “Trees do not grow at the same rate, some



Trees and steel complement each other in a coherent aesthetic concept. The use of plants for this platform in the Steveraue area will contribute to long-term processes of landscape change clearly visible. © SFD Heine & Becker

might be infested and damaged by pests. Like any other tree in urban areas, constructions involving living trees need to be pruned and inspected on a regular basis. Parts of a tree that lose their stability can be replaced by steel structures," says Schwertfeger. The concepts are so well thought out and convincing that the team have yet to encounter problems with the authorities. "We understand architecture as a process that has to be adapted whenever changes occur," says Schwertfeger summarising the idea of using living plants for buildings and other structures.

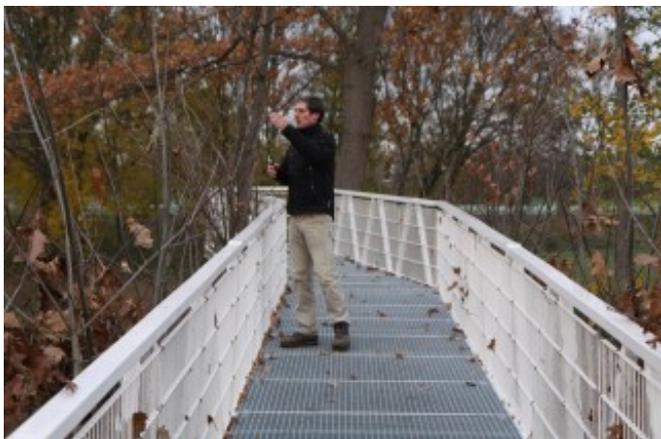
## The plants must be suited and fit into the structure where they are used

The particular type of tree that is suitable for buildings and other structures depends on the requirements and conditions of the site where they will be used. At the beginning of their venture, the team from Stuttgart worked mainly with willows, which are fast-growing and easy to handle. They can also be used as saplings. However, willows are not suitable for all locations. "They are relatively weak pioneer species, as they grow quickly in order to outgrow their neighbours. They might be suitable in floodplains with high water intake, but unsuitable for other areas. Basically, we use trees that grow best in a certain area. This is why we first look at what is growing in the area where we plan to erect a building, bridge or something else." For

example, red oak trees (*Quercus rubra*) were used for a footbridge in a park in the German city of Kamen. The trees grow quickly, approximately 2.5 m per year. In cities, plane trees are very popular for this purpose because they are very robust whereas exotic *Ficus* species are being used for a cooperative project in Rio de Janeiro.

A pilot centre in the city of Freising near Munich shows that the focus is not always on trees. In a cooperative project with researchers from the Weihenstephan-Triesdorf University of Applied Sciences, the team from Stuttgart is investigating the potential of climbing cucumbers for use in building structures. The Stuttgart team tends to work mostly with climbing plants. "We are studying these types of plants so we can integrate a larger number of constructive elements in our concepts. For example, we are studying how effective net structures where climbing plants grow are as shading elements. We are also investigating whether it is possible to grow such plants on the roofs of underground garages. We also design plant constructions that can grow on high-density surfaces and thus replace conventional trees," says Storz.

## The overall ecological impact



The maintenance and pruning of trees help turn the use of living plants for the construction of bridges and buildings into reality. © Jorinde Duthweiler

The team from Stuttgart is also seeking to contribute to biodiversity improvement through its projects and is therefore looking for plant species that fit well into the plant community at a particular construction site. This also complements ecological and climate protection objectives usually associated with such projects. "In the Berlin district of Wedding, we have started a project to improve the microclimate, and we are seeking to integrate living plants that can bind particulate matter and improve the microclimate on hot days into a residential development area," says Storz. The team achieved success with this project in the German Environment Agency's Blue Compass competition in July 2016. "Construction projects involving living plants can also be ways of compensating for paving over green areas," says Storz. Schwertfeger and Storz are very much on trend with their sustainability approach. A living plant construction that the Stuttgart architects designed in cooperation with Studio2050, Werner Sobek and Atelier Margraph achieved a notable third place in a recent tender for the German Pavilion at Expo 2015.



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## Article

18-Oct-2016

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## Further information

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