

Scientists are learning a thing or two from Meghalaya's living bridges

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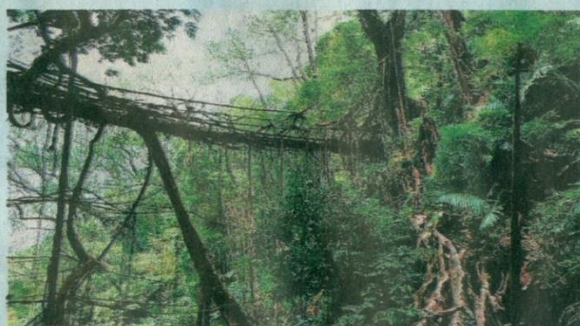
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Urban architects and town planners can learn a thing or two from the living root bridges of Meghalaya.

A team of researchers from Technical University of Munich (TUM) in Germany, which analysed scores of living bridges in the north-eastern State thinks that such botanical architecture of integrating plants in buildings can help adapt better to the impacts of climate change. In a paper (<https://www.nature.com/articles/s41598-019-48652-w>) published in the journal *Scientific Reports* recently, the TUM scientists led by Ferdinand Ludwig, Professor for Green Technologies in Landscape Architecture at TUM said learnings from the traditional techniques of the *Khasi* people can promote the further development of modern architecture

Unique architecture

"The technique of using aerial roots of *Ficus elastica* (Indian



The living bridges in Meghalaya can help adapt better to the impact of climate change F LUDWIG, TECHNICAL UNIVERSITY OF MUNICH, GERMANY

rubber tree) to form bridges is a unique example of botanical architecture grown without the tools of modern engineering design. While there is quite a number of examples of living architecture worldwide, living root bridges provide the only known example of repeated, predictable use of tree growth for structural purposes," the scientists said.

In the monsoon months the

mountain streams in the forests swell into torrential rivers. In order to cross these rivers, people belonging to indigenous *Khasi* and *Jaintia* communities have long built their bridges out of the living aerial roots of the Indian rubber tree. "Stable bridges like these made of closely intertwined roots can reach more than 50 metres in length and exist for several hundreds of

years," says Ludwig. Ludwig along with Thomas Speck, a botany professor at the University of Freiburg analysed as many as 74 such living bridges. While the elders in the community knew the traditional *Khasi* bridge building techniques, very little has been put down in writing in the past. So, the researchers conducted interviews with the bridge builders in order to gain a better understanding of the building process. The researchers took several thousand photographs which they then used to create 3D models, providing insight into the complex root structure. The team also mapped the locations of the bridges for the first time.

Complex structures

"The building process usually begins with a planting: A person planning a bridge plants a *F. elastica* seedling on the bank of a river or the edge of a ravine. At a particular point during the plant's growth it develops aerial roots," says Speck.

The aerial roots are then wound onto a framework of bamboo or palm stems and directed horizontally over the river. Once the roots have grown as far as the opposite bank, they are implanted. They develop smaller daughter roots which are directed to the bank as well where they are implanted. Due to constant plant growth and the application of various winding techniques the roots form highly complex structures which create stable, safe bridges. Newly growing roots are integrated in the existing structure again and again.

The properties of the tree play an important role: "The roots react to mechanical loads with secondary root growth. In addition, the aerial roots are capable of forming inosculation: Possible injuries result in what are called inosculation and callus formation, a process also fa-

miliar from wound healing of trees. For example, two roots which are pressed together and inosculate," says Speck. The bridges are made and maintained by individuals, families or by communities that include several villages which use the bridge. "Living bridges can thus be considered both a man-made technology and a very specific type of plant cultivation," says Speck.

It takes decades if not centuries to complete a living bridge made of *F. elastica*. Often many generations are involved in the building process.

"The bridges are a unique example of future-oriented building. We can learn much from this: Today we are faced with environmental problems that will not only af-

fect us, but also subsequent generations. We should approach this topic as the *Khasis* have," says Ludwig.

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