

Living Root Bridges of Meghalaya

By Sanjeev Shankar



Figure 1. Location diagram of Meghalaya



Figure 2. Butterflies congregating in the rainforest

As we slowly walk through the dense tropical rainforests of Meghalaya (Fig 1), an infinite variety of native plants, wild mushrooms and butterflies (Fig 2) welcome us in an exuberant display of abundance. Dappled sunlight complements the sounds of tropical birds and cicadas in the forest, guiding us further and deeper. Rejuvenated with the richness and diversity of the natural world we finally reach a clearing in the forest and find ourselves standing on an extraordinary living plant bridge spanning a turbulent river. Locally known as *jing kieng jri*, this is the living root bridge of Nongriat in the East Khasi hills of Meghalaya.

Living root bridges are *Ficus elastica*¹ based suspension bridges within dense tropical rainforests of North Eastern Indian Himalayas. Grown by indigenous Khasi² tribes over a time period of 15 to 30 years, these bridges range in span from 15 feet to 250 feet, and last for several centuries. With exceptional robustness³ under extreme climatic conditions, minimal material cost, remedial properties on surrounding soil, water and air, collective grass root involvement across multiple generations, and support to other plant and animal systems, living root bridges offer an extraordinary model for socio-ecological resilience⁴ and sustainability.

Khasis are viewed to be an offshoot of the Mon-khmer branch of the Austro-Asiatic stock and are believed to be due remnants of the first Mongolian overflow into India.⁵ Demonstrating a high degree of self-sufficiency, which in part is owing to their remote location and distinctive environment⁶, Khasis have developed a unique and sustainable relationship with nature. Through an elaborate attempt to balance individual needs with the needs of the larger community, they have nurtured an ecosystem, which acknowledges the interdependent and interconnected nature of all life. Relevant systems worth highlighting include the practice of sacred groves⁷, coherent classification of land and forests⁸, an independent village-durbar based system of governance, an eco-theandric⁹ vision of reality, laws of inheritance and succession, and laws of consanguinity and kinship. These ecology related management practices are an indispensable part of Khasi life and critically contribute to resiliency within the Khasis.

Living Root Bridges

The collective nature of Khasi tribes and their intimate relationship with the forest is epitomized in the living root bridges (Fig 4) seen throughout the East Khasi Hills of Meghalaya. Developed from the aerial roots of *Ficus elastica*, these pedestrian bridges play an integral and critical role in Khasi life connecting remote mountain villages in a vertical landscape. The underlying growth process (Fig 3) involves recurring inosculation (joining by twining¹⁰) of *Ficus* aerial root fibres over a gorge or river. The process begins with placing of young pliable aerial roots in hollowed out *Areca catechu* trunks¹¹. These provide essential nutrition and protection from the weather, and also perform as root guidance systems. This assemblage is structurally supported by a bamboo scaffold, which spans the river and performs as a temporary river crossing for the local community. Over time, as the aerial roots increase in strength and thickness, the *Areca catechu* trunks are no longer required. Periodic replacement of green bamboo poles is essential with increase in aerial root thickness and gradual deterioration of bamboo owing to wet tropical conditions of Meghalaya. This periodic engagement also ensures a continual relationship between the living bridge and the local community. Gradually, more roots are inosculated to the primary root system with geometric variations like steps and handrails integrated at a later stage. Dead load, in the form of heavy stones, timber planks, leaves and soil is added in succession to plug the gaps and to test the entire living root structure for weight. Heavy humidity, ambient moisture content and pedestrian movement together contribute to soil compaction. Eventually, over 15 to 30 years, the root assemblage becomes strong and stable enough to support substantial human and material weight without the bamboo scaffolding. Unlike contemporary construction materials and bridge structures, these living root structural systems become stronger, more robust, resilient and productive with time and use. They also successfully withstand storm surges and flash floods. With contemporary concrete and steel bridges requiring specialized support and substantial funding from the government, living root bridges continue to perform as critical infrastructure solutions for rural connectivity in Meghalaya.

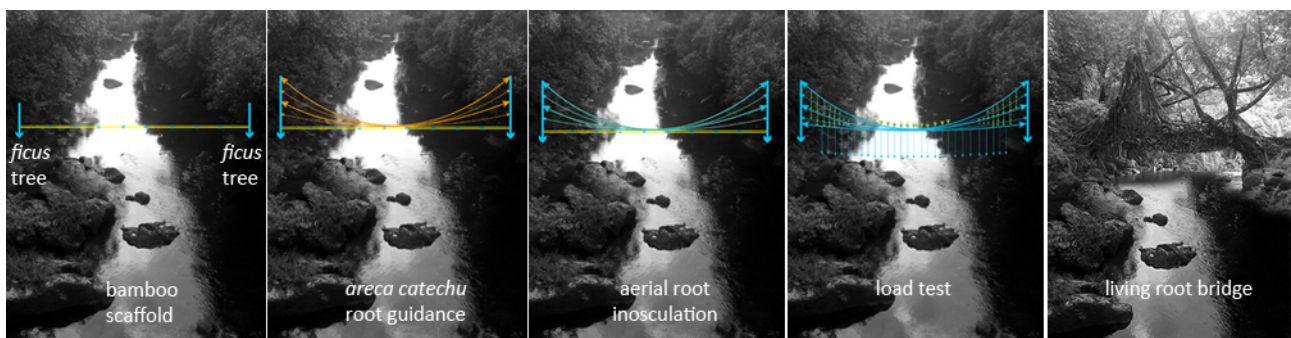


Figure 3. Growth process of living root bridges



Figure 4. Living root bridge, Nongriat



Figure 5. Khasi girl and grandmother, Nohwet

Vision

Ficus plant specie plays a keystone¹² role in the local ecology and is used for rainforest regeneration in the tropics. *Ficus elastica* based living root bridges offer an exemplary model for sustainable community based infrastructure solution, which ensures forest regeneration and remediation of the soil, water and air. We envision precise scientific analysis, improvement and propagation of the living root bridge technology for a statewide rural connectivity, conservation, education and livelihood project. Implementation of this initiative will alleviate the nexus between poverty, population explosion and environmental degradation in North East India, and create a unique precedent for living plant based grassroots infrastructure solutions, which engage all stakeholders (local communities, scientists and government authorities) in an inclusive, participatory and non-hierarchical manner. Successful translation of this indigenous knowledge can lead to its application in the Western Ghats and Andaman Islands, and other comparable tropical and sub-tropical regions around the world. Khasi tribes can lead such initiatives in a unique collaboration between ancient wisdom and contemporary science.

Statement

As custodians of this planet, we define and shape the world we want to live in. Each individual and community contributes to the world we inhabit and leave behind. It is upon us to question our actions and reframe our thoughts, and encourage the next generation to live responsibly. Living root bridges exemplify a sacred relationship between humans and nature, and highlight the essential human value of living with sensitivity and respect for all life. The values and beliefs embedded in these structures can inspire a healthy, inclusive and symbiotic future; a future where we restore the balance of this planet and celebrate all life; a future, which manifests through a collective search for finding appropriate solutions, which nurture deep transformation and change from within.



Figure 6. Interconnectedness of life

References

- [1] Native from the Himalayas to Malaysia, Sumatra and Java, *Ficus elastica* (or India rubber tree or India rubber fig) is a broadleaf evergreen shrub or tree that may grow to 50-100' tall in its native habitat. With high drought tolerance, pest resilience and diverse soil tolerance it is widely grown in the tropics as an ornamental tree. Mature *Ficus elastica* trees (family: *moraceae*) develop *Ficus benghalensis* (banyan)-like aerial roots. <http://www.missouribotanicalgarden.org/gardens-gardening/your-garden/plant-finder/plant-details/kc/b597/ficus-elastica.aspx>
- [2] The term “Khasi” means “born of the mother”. For a detailed elaboration, see Shangpliang R. *Forest in the Life of Khasis*. New Delhi, Concept Publishing Company, p. 1, 2010.
- [3] Robustness is used to describe a system that can survive extreme external variations. For a detailed elaboration, see Weinstock M. *Self-Organization and the Structural Dynamics of Plants*, AD Emergence: Techniques and Technologies in Morphogenetic Design, Vol 76, No 2, 2006.
- [4] Resiliency is the ability of a system to change and adapt to external disturbances and yet remain within critical thresholds. <http://www.stockholmresilience.org/21/research/what-is-resilience.html>
- [5] Bareh, H. 1985. *The History and Culture of the Khasi People*. Guwahati: Spectrum Publications, p.15.
- [6] North East region is a global hot spot for bio-diversity. Characterized by a varied physical geography, it is marked by distinct orography, heavy monsoon rains and a diverse range of flora and fauna. Shangpliang, R. 2010. *Forest in the Life of Khasis*. New Delhi: Concept Publishing Company, p.5.
- [7] ‘Sacred groves’ (or *Law Kyntang*) are fully developed virgin forest patches from pre-agrarian age. Removal of timber or forest produce from these groves, is prohibited. Tiwari, B.K. *et al.* 1999. *Sacred Forests of Meghalaya*. Regional Centre, National Afforestation and Eco Development Board, NEHU, Shillong, p.14.
- [8] Khasi Land Tenure system deals with three types of land in Khasi hills, viz., community land (or *Ri Raid*), privately owned land (or *Ri Kynti*) and Government land. Community land is managed and owned by the community and performs the role of an emergency reservoir for the benefit of all people. Shangpliang, R. 2010. *Forest in the Life of Khasis*. New Delhi: Concept Publishing Company, p.17.
- [9] An eco-theandric vision of reality refers to a firm belief in God, Nature and Man as one single indivisible entity. Khasis idolize the earth as “mother earth”, which is a seamless and indivisible combination of land, forest, rivers and streams. Vidyarthi, L.P. and Rai, B.K. 1976. *Tribal Culture of India*. New Delhi: Concept Publishing Company, pp.111-140.
- [10] Twining is a type of weave structure, which involves the twisting of two or more linear elements around another set of linear elements, which are perpendicular or inclined to the first set. Dunkelberg K., IL 31, Bamboo, Kraemer Karl GmbH + Co, p. 357, 1985.
- [11] *Areca Catechu* (betel nut) is a slender, single trunked palm that can grow to 30 m (100 ft). It is cultivated from East Africa and Arabian Peninsula across tropical Asia and Indonesia to the central Pacific and New Guinea. <http://agroforestry.org/images/pdfs/Areca-catechu-betel-nut.pdf>
- [12] A keystone species is a plant or animal that plays a unique and crucial role in the way an ecosystem functions. Without keystone species, the ecosystem would be dramatically different or cease to exist altogether. http://education.nationalgeographic.com/education/encyclopedia/keystone-species/?ar_a=1