INFRASTRUCTURAL PHOTOSYNTHESIS! – The trees at Fly Ranch

Traditionally, urban or rural infrastructure is grounded on site, drastically disrupting the continuity of the natural ecosystems and landscapes we inhabit. Now, what if we could ‘unground’ our infrastructure and lift it above the natural ecosystems on which they would otherwise stand? This way, the landscape would flow uninterrupted by our presence and our infrastructural needs. Now, at this point you might be thinking... but hey! buildings don’t fly! And you’d be right! But maybe they can fly at Fly Ranch! And all we need is some low impact fractally designed structure to provide us with the lift we need to enjoy amazing views of the desert and generate the lowest physical footprint on the land we choose to settle in. What if this structure could also supply our infrastructure with sustainably generated power, some shade, and a venue for outdoor gatherings and celebrations?

The idea behind the tree is to minimize our footprint on the landscape while maximizing the surface used to harvest solar energy through the use of monocrystalline silicon photo-voltaic panels. The fractal design of the structure means that the loads from the panels and the shelters that hang from the tree branches are gradually concentrated onto an increasingly smaller load bearing section as the structure approaches the ground. This, in turn, clears an exponential amount of ground surface compared to the total area occupied by the photo-voltaic grid-like array 10m above the structure’s base.

The 324sqm photovoltaic array provides more than enough energy to power the eight shelters that can be hanged from the designated structural quadrants, but also produces a generous amount of additional power to supply a variety of additional activities taking place at Fly Ranch. The idea is that the trees work as self-sufficient micro power plants that have the added capacity to power the infrastructure around them. The photovoltaic modules rest on a 18m x 18m structural grid on top of the structure, and thus can be arranged in a number of patterns depending on the energy needs of the shelters, or the nearby buildings. This also adds to the aesthetic of the design by introducing an element of randomness and customization to the general layout.

The shelters hang from structurally strong points on the tree, and have the ability to be lifted up or lower to the ground depending on the user’s needs and desires through a set of pulleys cleverly concealed on the gabled roof of each shelter. Two people can be allocated inside each cabin, which gives a total o 16 people per tree.

The structure is built using glued laminated timber, which is a kind of structurally engineered wood component constituted by layers of dimensional lumber bonded together with durable, moisture-resistant structural adhesives. The structural strength of the material comes from laminating a number of smaller pieces of lumber. The material is environmentally friendly since it optimizes the structural value of wood, which is, of course, a renewable resource. Because of their composition, large laminated timber members can be manufactured from a variety of smaller trees harvested from second-growth forests and plantations. Laminated timber provides the strength and versatility of large wood members without relying on the old growth-dependent, solid-sawn timbers. As with other engineered wood products, it reduces the overall amount of wood used when compared to solid-sawn timbers by diminishing the negative impact of knots and other small defects in each component board. Bolts and steel dowels are used to connect the different pieces together.

The shelters are built using traditional timber, since their size and structure does not require additional reinforcement. Each shelter is connected to the tree structure through a set of cables that run through a pulley and a cable that provides it with the energy harvested by the pv panels on top of the structure. A set of batteries hidden on the roof of each shelter stores the unused harvested power.

With roughly 6 hours of direct sunlight per day, each monocrystalline silicon photo-voltaic panel could produce a total of 500-550 kWh of energy per year. Considering that the structural grid could allocate a total of 144 panels, each tree could produce a total annual power output of 72.000 kWh.

ON-SITE PROTOTYPE DEVELOPMENT:

In case of prototyping, the project could be downsized as to provide a scale model that showcases the structural attributes of the fractal design and the configurational versatility of the solar grid. Utilizing the same materials conceived for the full-scale structure, a mock model could be built on site using basic tools and without requiring specialized labor. A single shelter-like structure could be hanged from the fractal composition and powered by a single pv panel as to illustrate how the overall design would operate.

ENVIRONMENTAL IMPACT SUMMARY:

Since laminated structural timber is manufactured utilizing small pieces of lumber, and therefore minimizing the amount of wood required to build structurally strong members, the total number of trees required to produce the material is far less than with regular timber. At the same time, the versatility of the material allows it to be used as beams, columns and arches that can span large distances thanks to its strength and stiffness. The size is really only limited by transportation and handling constraints, that is why the different pieces of the tree are designed to be ‘transport friendly’, meaning, small and light enough to be moved around without difficulty, hence minimizing the amount of carbon emissions required to transport the material from the manufacturer’s location to the site.