Biomimicry as a tool for innovation and construction based on nature in Mexico

**BIOMIMICRY**

One of the fundamental ways of building sustainable development is the search for new techniques and design theories to achieve renewal and change the way we understand nature and how we relate to it, and from this understanding, as we modify the environment and adapt our living spaces for their effective integration.

Biomimicry is a new discipline that studies nature’s best ideas and then imitates these designs and processes to solve human problems.

Design innovation inspired by nature. The design that we see in nature is the best example of a design well suited for life on this planet. Nature has been sustainable over the past 3.8 billion years. The Biomimicry proposes a design methodology of learning and where nature is the measure, model and mentor, seeks to understand the conditions for life to generate truly sustainable and regenerative design. This theory seeks to emulate forms, processes or systems in nature and that can help to solve the problems that humanity is facing today.

**NATURE AS A MENTOR**

In this project we seek to understand how plants are constructed themselves. How they solve the problem of save materials and energy having a functional designs while maintaining structural stability. In particular we analyze the structural properties of the Guadua bamboo (*Guadua angustifolia*) and the paddle cactus (*Ountia ficus-indica*).

**NATURE AS A MODEL**

The Guadua Bamboo plant has been widely used by South American indigenous cultures to build many kind of structures. The structural characteristics of this species of bamboo provide great benefits to resolving the forces of compression and tension that occur in construction.

To study the structural properties of bamboo was necessary to dissect one bamboo individual. It was compose by 187 stems. The stems were cut from the base and measured by length and weighed with and without branches. Then we made a random subsample of 20 stems, those were all cut and divided it by segments. All the segments of each stem were counted and length was measured, the inner diameter and outer diameter in both top and bottom. With all this data could make a 3D digital model with which to begin analyzing the structural qualities of the plant.

The Nopal plant is a cactus species used since the mexican Mesoamerican cultures as a food. Nopal plant develops the different layers of tissues that serve as a water storage system and as structural elements. The work with the nopal was limited to make the geometric description of the arrangement of the spines along the stems of the plant.

**PRELIMINARY RESULTS**

We found that bamboo has certain properties constructive relationship with the thickness of its walls and range of interior space. At the bottom of the stem wall thickness is greater and the interior space is smaller, as the greater the height, interior space starts to expand while the wall thickness becomes smaller.

We find that the basic structure of the paddle cactus is in accordance with a Michell's structure.

These criteria allow to develop structures with a minimum volume (a structure having the minimum amount of material) to produce a self-equilibrate forces in the system.

The growth of the rhizome of Bamboo has a form that allows to use the least amount of materials to maintain a system of distribution of nutrients and water optimally.

The Mexican group of Biomimicry is an interdisciplinary group work. Different disciplines such as Engineering, Architecture, Computer Science and Biology converge to the development of better building designs.