Learning from nature as a tool for innovation in architecture

Javier PIOZ
Dr. Architect
Co-founder and Principal
Cervera + Pioz Architects,
Madrid, Spain
jpioz@cerveraandpioz.com

Professor ETSAM, Polytechnic University, Madrid. Received his degree and Ph. D. in architecture from the Polytechnic University of Madrid. Master of Science in Building Design, GSAPP, ColumbiaUniversity. Fellowship at the "Academia Spagnola di Belle Arti" in Rome and "Akademie für Bildende Kunst" in Salzburgo. Cervera + Pioz has won international architectural contest and received award such as the “Golden Global Award”. C+P work has been widely published and displayed in exhibitions.

Rosa CERVERA
Dr. Architect
Co-founder and Principal
Cervera + Pioz Architects,
Madrid, Spain
rcervera@cerveraandpioz.com

Director Master in Advanced Project of Architecture and City, AlcalaUniversity (Spain). Received her degree and Ph.D. in architecture from the Polytechnic University of Madrid. Fellowship at the "Academia Spagnola di Belle Arti" in Rome and "Akademie für Bildende Kunst" in Salzburg. Former Dean of the School of Architecture, AlcalaUniversity. Pioneer researcher about Bionics and Bio-mimicry and its application to architecture. Author of awarded buildings and books and written about architecture.

Summary:

The present moment claims an attitude of reflection about our relationship with Nature, to coexist with environment in a sustainable and balanced way. The learning of the natural mechanisms is the base of the work here presented. The goal is “to get more with minimum effort”, or, in other words, to minimize material and energy without renouncing to variety or formal exploration. The union of the following concepts: Biology, Engineering, Architecture, opens new research fields able to be applied to the construction of large structures.

Experimenting with Biological Structures and their application to new construction models is the starting point to create a new area of research, applicable both intellectually and within the practice of architecture. Here we put forward a few of the projects in place that are working towards investigating the formal and structural organization of vegetables and animals. We follow a methodology that consists in identifying those elements that could be compared to their architectonic equivalents and draw our conclusions. Once the models have been identified we analyze their formal, geometrical and structural configurations. From there on onwards we study their behavior and usually come across some strikingly innovative results. Using current calculus programs we are able to compare the different behaviors that occur in different settings. An example would be the investigation around the structural-formal organisation of water lilies by using parametric programs that enable the study of variations. Here the structure model is similar to a cantilevered circular slab that relies on a central support. The shear efforts and bending or flexors are studied and later compared to those of a slab that has used a conventional reticular framework. The results speak for themselves; a much more efficient structure is that of the water lilies and their “radial-arboreal” organization.

Cervera + Pioz Architects apply some of the outcomes of their research into their own professional architecture designs. Several works have been designed and built by translating this research into practice resulting in structural and energy savings of 30% compared to more conventional models. The twin Towers of Shristi (Kolkata, India), the Hai-He Bridge (Tianjin, China) and the Tai-Da Towers (Chengdu, China) are examples of efficient structures. The pinnacle of this research is the project of the Be-Bionic Vertical City.

Keywords: bio-structure, biological structures, efficient structures, green buildings, sustainable architecture

https://doi.org/10.2749/222137814814069967