Lidia Badarnah: 'Nature provides a huge source of solutions' [1]

Submitted by Wilfredo Mendez Vazquez [2] on 8 August 2014 - 9:43am

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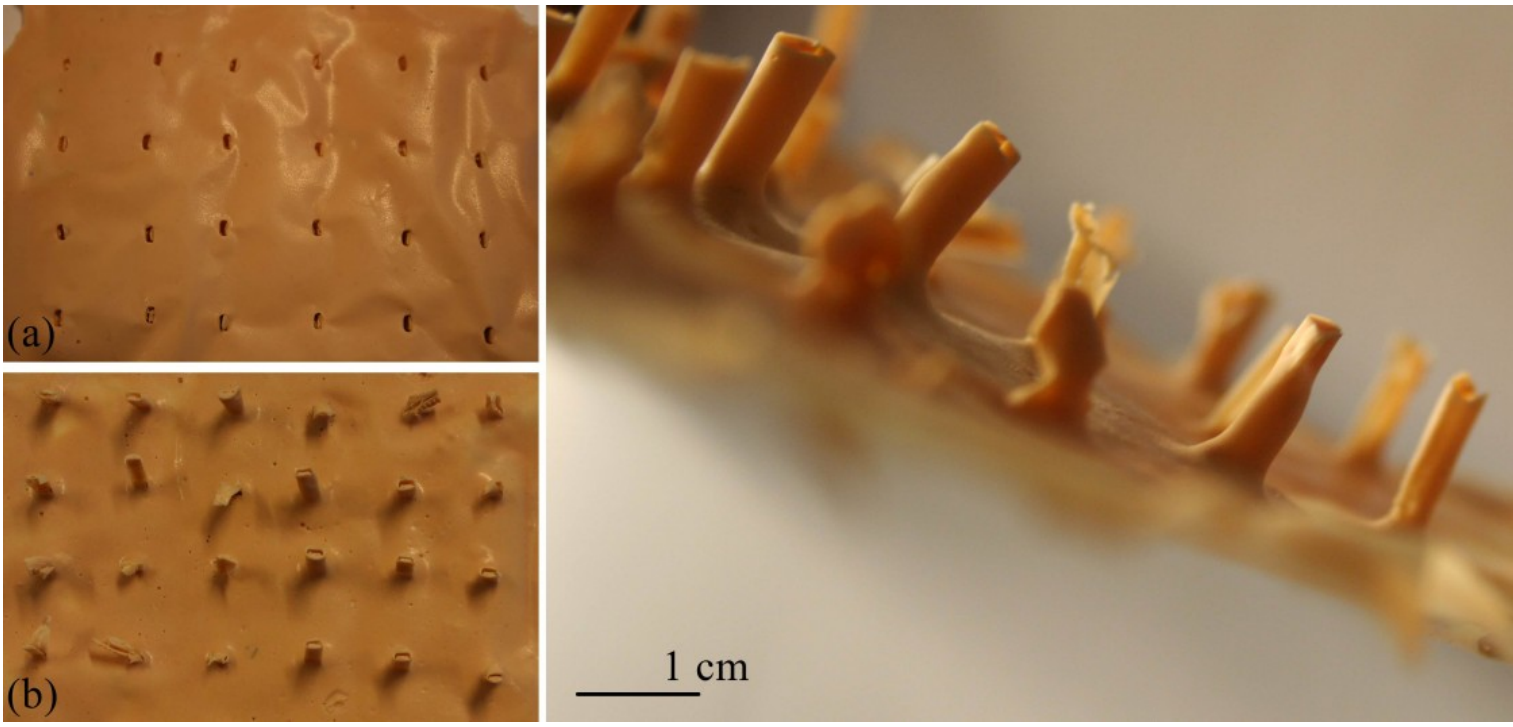
Lidia Badarnah is a Postdoctoral Research Fellow at the Building Technology Program of the Massachusetts Institute of Technology (MIT). Badarnah obtained her Ph.D in Biomimetics in Architecture at Delft University of Technology. She has specialized in biologically-inspired strategies for building envelopes adaptation and recently has developed a methodology for the generation of novel biomimetic design concepts. The crossover between architecture and scientific concepts is evident in Badarnah's work that ranges from biology to thermodynamics. She shared with us her insights intertwining the theoretical anxieties of her investigation and the future of architectural design.

Biomimetic design proposes a shift of paradigm in typical architecture, which usually relates to arts and humanities, towards a more scientific field. Trained as an architect, how did you become interested in biomimicry?

I have always been fascinated by the harmony of nature, the interrelation and integration of endless geometries, colors, and functions for optimal performances. Becoming an architect enabled me to look at built structures as part of the environment. Initially, my PhD research focused on technological solutions for integral building envelopes. Soon after, I realized that often the implemented technologies have a very narrow focus and aim, attempting to solve problems that our applied solutions have created. An approach that is often limiting and inadequate. Having this understanding in mind, I sought for an alternative approach, and nothing seemed to be more promising than learning from the endless database of nature, not by mimicking but by extracting and applying principles and mechanisms found in natural systems.



As explained in the introduction of your paper "A methodology for the generation of biomimetic design concept", form is the most common trait to be transferred from natural systems into architecture. Is this approach still feasible for the architecture and cities for the future?

Yes, as long as it has a functional justification. From the laws of physics we learn that having a special morphological configuration determines the flux of physical properties, to enhance the flow of energy and other aspects between mediums, which are essential for survival. The implementation of design solutions that exploit these morphologies is how our future cities should be designed.

What do you think is the kind of architects needed in the future?

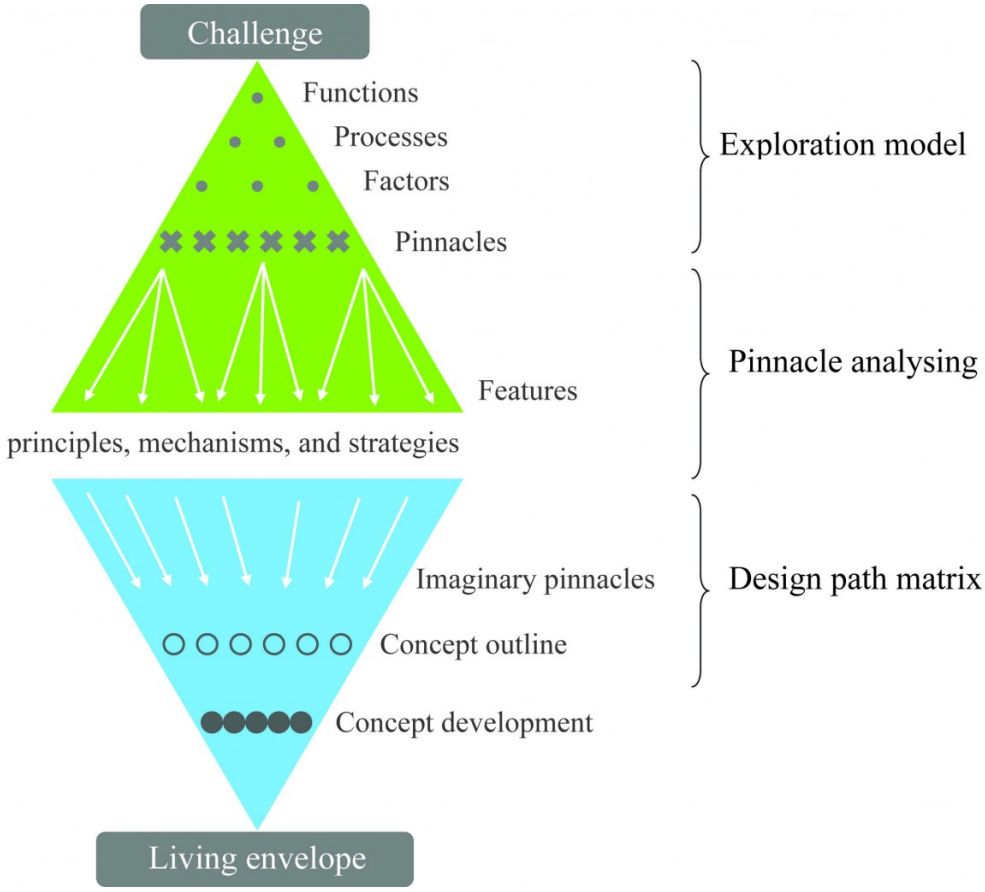
Multidisciplinary architects. With increasing environmental awareness and the necessity to develop responsive built environments for sustainability, the role of architects in the design process becomes broader and requires managing different processes and aspects simultaneously.

Biologically-inspired design is continuously presented by media as one of the most relevant approaches for the future of sustainable design, however, some have pointed out that nature has not already solved all problems and cannot always provide a design model. What are your thoughts about this contradiction?

One of the fundamental phases of biomimetics is to recognize relevant and valuable natural strategies, where a physical, chemical, or behavioral property can improve a particular application. First we have to define a problem or a purpose, and then strategically develop a solution. Nature provides a huge source of solutions. In the absence of a useful selective method that identifies appropriate solutions systematically and selectively, the mission of finding solutions in nature becomes a needle in a haystack. Thus, we might fail finding a solution in nature, not because it doesn't exist, but due to an ineffective seeking approach. Nevertheless, even if a sought solution does not exist for a given function, biomimetics might still provide solutions for subparts of that function. For example, consider a space shuttle as a whole complex system; it provides a solution for a problem that is not identified in nature. However, such a system is constructed from many different parts, that developers often use biomimetics to improve their technical application. After all, throughout 3.8 billion years nature has evolved many solutions to challenging conditions that we can learn from.

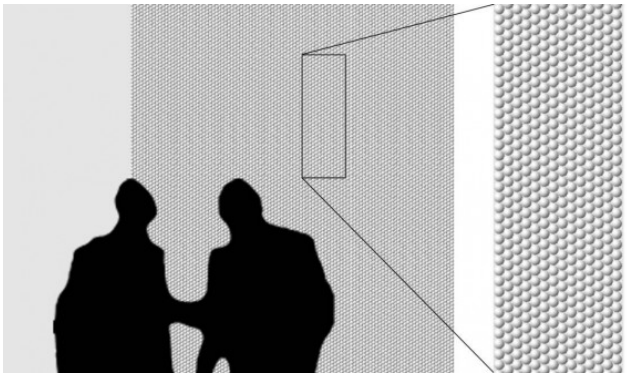
How does your current research on a strategic methodology for the generation of biomimetic design concepts facilitate the implementation of the biomimetic approach?

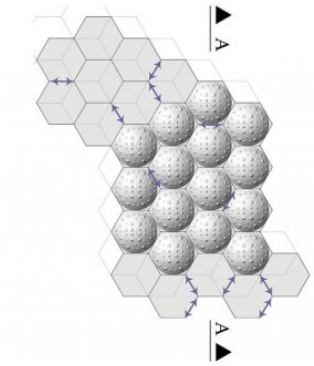
The main concerns in existing biomimetic strategies for designers are the broad range of possibilities, the difficulties in the representation of the biophysical knowledge, and the challenging abstraction of relevant principles. The major benefit of the recently developed BioGen methodology (Badarnah & Kadri 2014) is present in its applicability to different disciplines as a problem solver, and not only to architecture and building envelopes. This is due to the generality of the design tools, which elaborate on how to carry out a biomimetic design process; create platforms of biophysical information; find analogies; abstract principles; and translate principles into design concepts, rather than provide specific elements to mimic.

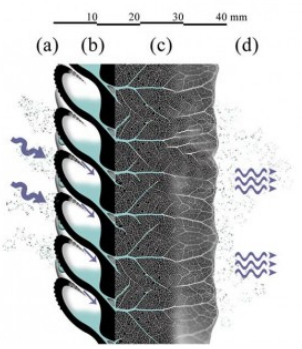


Can you tell us more about the current developments of your research and your future directions?

My current research study focuses on the investigation of new biomimetic solutions to improve the thermal performance of building insulation materials and systems. In the context of heat regulation and the need to reduce energy demands, developing services and technologies, that modify heat transfer, is essential for improved thermal performances (less energy consumption and better thermal behavior). Maintaining a thermal comfort condition is one of the aims of the building envelope for the enclosed spaces occupied by people. The envelope is often considered as a thermal barrier or a shield that has to be insulated to prevent heat loss. Conceiving the envelope in this way limits potentially efficient solutions, where the building envelope is considered as a medium rather than a barrier, just as in living organisms (their skin or built structures). In this regard, biomimetics, as a design approach, provides a huge potential for innovative solutions for improved thermal performances in general and for buildings in particular. Throughout the research study, thermal biomimetic solutions will be proposed and validated by a series of prototypes that exploit unique morphological tactics for thermoregulation.







Reference:

Badarnah, L., & Kadri, U. (2014). A methodology for the generation of biomimetic design concepts. *Architectural Science Review*, 1-14. doi: 10.1080/00038628.2014.922458

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