

PhD in Architecture. History and Project (DASP)

Research Title: Biomimetic Architecture: Adaptive Building Envelopes in Complex Buildings

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Context of the research activity	<p>In contemporary architecture, the envelope plays an increasingly important role by virtue of its ability to characterize and qualify the project.</p> <p>Recent developments in scientific research in the field of envelope have led to the conception and development of adaptive envelopes, i.e. dynamic multifunctional systems, in which the physical separator, or part of it, between the internal and external environment is able to change configuration, function or behaviour in response to transient performance requirements and boundary conditions. It originates adaptive architectures.</p> <p>It is well known that it is possible to grasp a parallelism between the behaviour of adaptive envelopes and the processes of environmental adaptation of biological organisms of the natural world. In the analysis of adaptive architectures, the liaison between technology and nature is grasped by the scientific world in terms of both form and performance.</p> <p>The mutual connections between the technological and biological domains have led the research to deepen more and more the study of the biomimetic design and its methodologies, starting from those ones developed by Janine Benyus.</p> <p>Each adaptive dynamic system (both natural and artificial) is characterized by its own intrinsic degree of complexity. In biomimetic design, the problems both of understanding and, above all, of managing this complexity are shifted from the natural world to the technological-artificial one.</p>
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The complexity of the adaptive envelope systems is a transitive "quality" that is translated to the whole architectural artefact, as the "skin" is a constituent part of the building organism. Therefore, buildings that are characterized by having adaptive envelopes, which are systems intrinsically complex, both in terms of function and structure, are themselves complex systems.

In the framework of the research conducted at the DAD of the Politecnico di Torino, the application of these technologies has been investigated starting from the reconstruction of the state of the art with the aim of defining a technological taxonomy to declare the operating principles (mechanical, physical-chemical, bio-integrated) and the control principles (self-regulating or programmed). The survey has correlated the degree of complexity of the adaptive technological envelope systems to their degree of fragility and resilience.

Objectives

The objectives of the research consist in deepening the biomimetic architectural design across the time, its technological applications and related design approaches, generating a multidisciplinary investigation in line with the themes and the objectives of the DASP.

It is expected that the advances of the research can lead to the development and testing of an innovative technological system for the building envelope, characterized by adaptive and auto-poietic capabilities, in relation to the action of external environmental stresses, with particular reference to the case of complex buildings.

The attention will focus on the aspects related both to the formal outcome of the identified solutions (form-finding of tessellated and deployable surfaces), and on the technological aspects (characteristics, behaviour, compatibility and coupling of materials and the study of the implementation of technological systems).

This will be done with the goal of implementing already developed envelope solutions taking into account some case studies such as the Water-reactive biomimetic facade (Chao Chen, Royal College of Arts London), the Hygroscope and Hygroskin Pavillions (University of Stuttgart - Institute for Computational Design and Construction), the Al-Bahar Towers (ARUP), the One Ocean Pavillion (Soma Architects), etc.

The research may be developed in collaboration with other institutions, even abroad, such as the Institute for Computational Design and Construction of the University of Stuttgart (within the research projects: "Adaptive Beauty: Transferring Natural Elegance to Architected Materials" and "Hygroshape") and the Institute for

	<p>Advanced Architecture of Catalonia (within the projects related to the research field "Responsive Design").</p> <p>The results will be returned through the work on scientific publications and their dissemination with possible impacts on innovative teaching. Furthermore, collaboration in experimentation and prototyping activities is foreseeable.</p>
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Skills and competencies for the development of the activity	<p>He must have carried out research on the topic of adaptive envelope in complex buildings and possess skills related to the use of computational and parametric design tools because they will be exploited for the conception and the formal description of the envelope system and the simulation of its performance behaviour.</p> <p>Furthermore, he must have gained study experience relating to buildings of great complexity.</p>
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