World Academy of Science, Engineering and Technology
International Journal of Environmental and Ecological Engineering
Vol:9, No:07, 2015

Flexible Design Solutions for Complex Free form Geometries Aimed to Optimize Performances and Resources Consumption

Authors : Vlad Andrei Raducanu, Mariana Lucia Angelescu, Ion Cinca, Vasile Danut Cojocaru, Doina Raducanu

Abstract : By using smart digital tools, such as generative design (GD) and digital fabrication (DF), problems of high actuality concerning resources optimization (materials, energy, time) can be solved and applications or products of free-form type can be created. In the new digital technology materials are active, designed in response to a set of performance requirements, which impose a total rethinking of old material practices. The article presents the design procedure key steps of a free-form architectural object - a column type one with connections to get an adaptive 3D surface, by using the parametric design methodology and by exploiting the properties of conventional metallic materials. In parametric design the form of the created object or space is shaped by varying the parameters values and relationships between the forms are described by mathematical equations. Digital parametric design is based on specific procedures, as shape grammars, Lindenmayer - systems, cellular automata, genetic algorithms or swarm intelligence, each of these procedures having limitations which make them applicable only in certain cases. In the paper the design process stages and the shape grammar type algorithm are presented. The generative design process relies on two basic principles: the modeling principle and the generative principle. The generative method is based on a form finding process, by creating many 3D spatial forms, using an algorithm conceived in order to apply its generating logic onto different input geometry. Once the algorithm is realized, it can be applied repeatedly to generate the geometry for a number of different input surfaces. The generated configurations are then analyzed through a technical or aesthetic selection criterion and finally the optimal solution is selected. Endless range of generative capacity of codes and algorithms used in digital design offers various conceptual possibilities and optimal solutions for both technical and environmental increasing demands of building industry and architecture. Constructions or spaces generated by parametric design can be specifically tuned, in order to meet certain technical or aesthetical requirements. The proposed approach has direct applicability in sustainable architecture, offering important potential economic advantages, a flexible design (which can be changed until the end of the design process) and unique geometric models of high performance.

Keywords : parametric design, algorithmic procedures, free-form architectural object, sustainable architecture
Conference Title : ICESBE 2015 : International Conference on Environmental Science and Biological Engineering
Conference Location : London, United Kingdom
Conference Dates : July 25-26, 2015