New Approaches to Performance Modelling

Wassim Jabi's paper: Linking Design and Simulation Using Non-manifold Topology in ASR 59.4 is the featured paper for this edition.

The aim of this paper is to propose a different method to design buildings by using and enhancing a representational technique called non-manifold topology (NMT).

The methodology, pioneered by Prof. Robert Aish, is currently ignored by current Building Information Modelling (BIM) software in favour of a component-based approach. While the topological information embedded within NMT has many uses in the spatial representation of architecture, including building occupancy analysis and structural analysis, the focus in this paper is on the efficacy of NMT in linking design and building performance simulation (BPS).

The proposed approach avoids the process of simplifying polyhedral models produced by BIM software to conduct BPS. In particular, NMT allows for a clear segmentation of a building, unambiguous space boundaries, and perfectly matched surfaces and glazing subsurfaces. The NMT approach was tested through a software prototype that integrates 3D modelling software and an energy simulation engine.

This research has resulted in Dr. Jabi receiving a £300,000 ($420,000 USD) research project grant from the Leverhulme Trust in collaboration with Prof. Robert Aish (The Bartlett, UCL) and Dr. Simon Lannon (Cardiff University). This research will challenge the current Building Information Modelling (BIM) orthodoxy through the development of a more appropriate representation of architectural space so that it is available both for immediate use in conceptual design and as a partner technology in a future unified computational design system.

This new modelling approach will be supported by an expanded set of tools that allow architects to create models that are consistent, flexible, and extensible while maintaining design creativity and desired spatial complexity. In this project, the team will develop a conceptual framework and schema for the hierarchical and cellular spatial representation of buildings through NMT and a set of algorithms and tools that test the potential of this approach. Four use case scenarios will be conducted in the areas of: Energy Analysis, Structural Analysis, Spatial Reasoning, and Fabrication Planning.

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Author: Victor Olgyay

Motivation for the new edition of the classic text by Victor Olgyay comes from the steady demand for this book. The seminal work in 1963 when it was first published underlines a way of making buildings respond to their region through designing with climate in mind. Regional aspects of architecture are thought of as culturally based however this treatise looked beyond the vernacular as a scientific basis for designing for the climate conditions. The approach draws on a range of disciplines: biology, climatology, technology and architecture. With this climate-based approach new skills where identified that come from the interpretation of architectural principles that respond to climate. This includes site selection, solar orientation and control, and the way buildings work with nature, wind effects, airflow and effects of materials.

Finally, book looks at application in terms of planning and climate specific recommendations. The essays that form the new edition extend the content and provide insight into the creation of the approach. Ken Yeang places the work in a recent context discussing the way a bioclimatic approach can be extended to Eco Design exploring further the connection with nature. This is a large and complex area and brings into play the need for more buildings that improve the sustainability of our communities. John Reynolds examines the roots of Bioclimatic design. After World War 2 there were differences in thinking emerging those that the world can share one comfort zone created by airconditioning as compared to those that preferred a passive approach building passive solar houses. Design with Climate grew from the latter.

The application of these ideas are seen in the essay by Victor W Olgyay. His father learnt much from the vernacular buildings and how this could apply to modern architecture. He calls this a rational regionalism. Hence we see in the project described how this thinking was tempered with the process of scientific analysis to generate projects that responds to environmental conditions in which they are situated. Finally, the essay by Donlyn Lyndon discusses how one can learn to design with climate using the basis of data collection and analysis. The tools and process since those times have changed with increased use of computers to do most of the number crunching. Olgyay, as part of the learning process, remarked “measurement is a wonderful thing.”