THE ROLE OF THE FLUID DYNAMICS FOR GREEN BUILDINGS PERFORMANCE

Valeria Cecafosso

Ph.D. in "Environmental Design", University of Rome "La Sapienza"
Tutor: *Fabrizio Tucci*
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Industrial development and the continuing urbanization have implications on the preservation of natural common resources and have caused global and micro-environmental pollution. Building construction sector contributes in a decisive way to the planet's energy consumption and it is universally recognized that it is not possible to focus on economic development without taking into account the sustainable environmental resources. The increased awareness of these issues arouses a growing interest in eco-friendly building construction. In the design phase of a building, one of the most important phenomena and the most complex to envisage is the air flows inside and outside of the building in order to evaluate its energy performance, thermal comfort and air quality. The CFD simulations (Computational Fluid Dynamics) are considered the most advanced tool for the analysis of air distribution and of the related thermal effects caused by it. The study thus aims to develop an integration model of the thermo-fluid-dynamic parameters during the design process. This structured approach tend to get the potential of using simulation systems and focusing on the possible developments related to building performance control. The task is to implement many innovative environmental, energy and bioclimatic issues. The research aims to create a methodology for the application of dynamic simulation to the design process focused on the sustainable development and able to allow the evaluation and the optimization of passive systems in order to achieve better standards in design practice and in the evaluation process to promote an improvement in the general quality of building construction. In this field, it is possible to identify the following specific objectives:

- develop a framework of the type-technological aspects;
- provide ways of governing air flows;
- identify the methodologies of estimating and controlling air flows;
- define the profile of theoretical-scientific reference allowing the correct use of these methodologies;
- draw guidelines for fluid dynamics modeling in the design of buildings with high energy efficiency and environmental sustainability.

The operational research results aimed to make explicit and specific recommendations in support of designers, architects, engineers and researchers interested in the profitable use of natural ventilation and the overall control of green buildings performance. The thesis contributes broadly to the contemporary architecture debate facing multiple topics and offering the possibilities for their further development. The research gives an overview of the advanced experiences in place and suggests the possible developments of fluid dynamics in green buildings.
Computational fluid dynamics studies in fact air flow and can help to take advantage from natural ventilation, caused by wind and thermal buoyancy as driven forces, and in this way helps the control of indoor climate. Natural ventilation can be used as a passive cooling systems and to remove contaminants allowing significant financial, environmental and health benefits compared to mechanical ventilation. The theoretical framework of CFD is based on three differential equations - the continuity, momentum and energy equations - and the Navier-Stokes equations. Nowadays computing platform, in constant evolution, allows to solve this equation by numerical methods of partial differential equation and turbulence models. Key element for a correct applications of CFD method is to create an accurate geometric model, to establish the best physics model to use, to set up initial and boundary condition and to fix mesh and time step. The research develops an operational tool for the design and the control of air flows. It establishes a framework of best practices with a repertoire of type-technological solutions and simulation methods for buildings performance in relation to ventilation and environmental comfort. The study also attains an opportunity to include the parametric methods for the form generation with methods of building performance simulation and analysis of the thermo-fluid dynamic parameters. This model would bring the attentions on the possible evolutions of performance monitoring in buildings to ensure appropriate environmental, energy and bioclimatic solutions. Therefore, dynamic simulation supports the building design from early stages, allows to optimize passive systems and to control indoor environmental quality parameters in terms of thermal comfort and air quality. This gives centrality to the performance requirements through a vision that does not separate energy aspects from other design elements. The approach allows to capture the complexity of interacting qualitative and quantitative factors in order to achieve a holistic approach offering a wider vision of various design components and allowing new architectural expressions intertwined with the environment and the landscape aiming to create an architecture of wind, water and light.