# The fluid dynamics of air flow in free flow open spaces: An architectural approach to energy efficient buildings

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## Abstract

The proposed project is the first of its kind to focus on the balance and relationship between spatial volumetric layout of building interiors (free flow open space) and the required building energy consumption by using a coupled approach between architectural design and computational fluid dynamics (CFD). The approach involves analyzing the effects of volumetric spatial composition on natural airflow and energy use. A synergistic endeavor, combining the interdisciplinary expertise of architecture and engineering, is proposed to develop guidelines for designing interior spaces in which comfortable natural airflow serves as the primary ventilation system. Our hypothesis is that the energy requirements of standard heating and cooling mechanical systems can be reduced through the effective shaping and composing of complex architectural spaces such as atriums, lobbies, hallways, and connecting rooms. The proposed research will play a critical role in the development of new energy efficient building typologies for the United States, especially for regions with extreme weather conditions.
The design of energy efficient buildings should be based on analysis of the interrelationship of geometry, material, space and volume for energy utilization using natural and hybrid ventilation systems. Thus the purpose of this phase of the research is to develop a CFD method to model, evaluate and quantify the energy gains of natural ventilation in building spaces so that it can be integrated into the architectural design process. The long term goal for our research is to make use of spatial composition and airflow in free flow open spaces to cool and heat buildings thus reducing energy needs for mechanical ventilation systems.