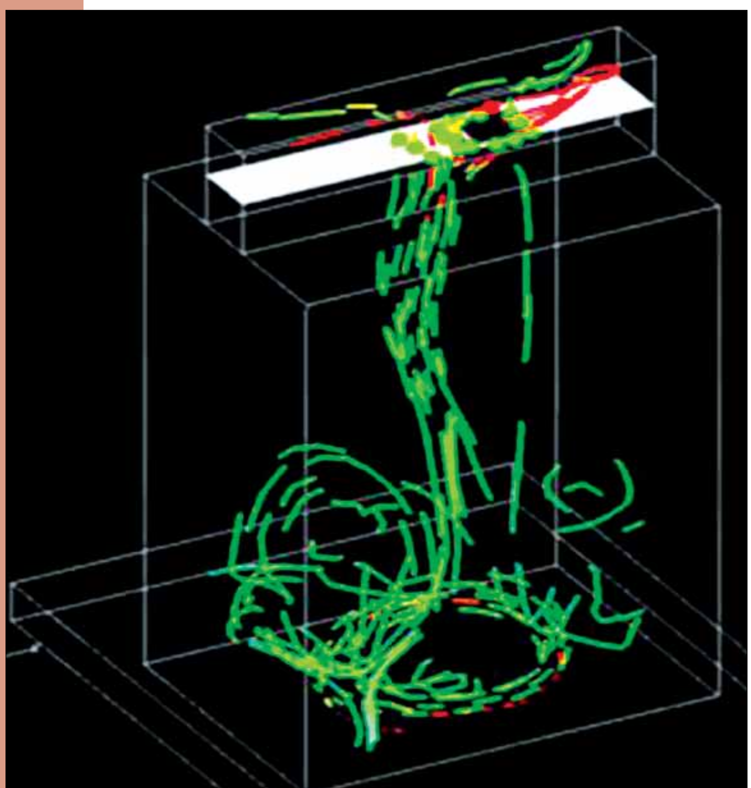
MATHEMATICAL MOMENTS

Building Efficiently

Buildings use so much energy that cutting consumption by one-half would be equivalent to taking every passenger vehicle and light truck off the roads for a year. Such a reduction can be done by integrating components, such as air conditioning and lighting, into one continually monitored system, as is done with hybrid cars. This integrated approach depends on mathematics: Fluid dynamics is used to locate vents and heat sensors optimally, while graph theory and linear algebra help identify the most important parameters in the huge amount of data the sensors collect. This makes it possible to make real-time adjustments essential to the system's efficient operation, which is cool for the occupants and the planet, too.

Perhaps ironically, many state-of-the-art buildings use some of the same practices (such as facing south) developed centuries ago before central heat and air conditioning became common. Yet those re-discovered practices aren't enough by themselves to make today's buildings energy efficient. Modern mathematics and engineering are necessary to quantify the uncertainty of collected data, coordinate the energy use on spatial scales ranging from office to floor to building, and understand the complicated flow of air. The successful implementation of these new designs depends less on finances, since costs are recoverable in 5-10 years, than it does on initiative and innovation.


Coupled thermal and air flow computational fluid dynamics study in a building.

For More Information: "Control, estimation and optimization of energy efficient buildings," Jeff Borggaard, et al., *Proceedings of the 2009 American Control Conference*.

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