Iowa State University Study Shows Fabric HVAC Duct Beats Metal

Three members of the Iowa State University's Mechanical Engineering Department have proven an overwhelming 24.5% efficiency differential when comparing fabric duct to metal duct.

The 10-month-long study, "Thermal Comparison Between Ceiling Diffusers and Fabric Ductwork Diffusers for Green Buildings" showed fabric duct heats rooms faster and more uniformly to satisfy temperature set points versus metal duct/diffusers, which results in reduced mechanical equipment runtime, thus saving energy in the process.

It has also been published in Energy and Building Magazine, New York, an international journal of research applied to energy efficiency in the built environment. The majority of its funding came from the National Science Foundation, Arlington, VA, and the Iowa State Institute for Physical Research and Technology, the latter which fosters the development of green technologies, such as fabric ductwork diffusion.

Metal duct

Fabric duct

"This is a monumental study for consulting engineers needing proof their fabric air dispersion specifications are green for sustainable building and LEED projects," says Cary Pinkalla, Peosta, Iowa, a world leader and U.S. market share leader in fabric duct design and manufacturing. "We knew fabric duct was more efficient, simply from the feedback of occupants who experience better indoor air comfort, but 24.5% more efficiency is an incredible discovery," Pinkalla says.

The study used computation fluid dynamics (CFD) analytics in an 8 x 8 x 8-foot room with a ceiling-mounted return air vent, which is a typical commercial office space heating configuration. CFD modelling analysed the airflow of a typical 1 x 1-foot metal ceiling supply fixture with a 4-way diffusion pattern. Then compared it to the performance of an 8-ft.-long, 6-in.-diameter ceiling-suspended fabric supply duct with 7 pairs of one-inch-diameter air dispersion orifices spaced one-foot apart.

"Ductwork system efficiency tends take a secondary importance to mechanical equipment efficiencies in project specifications, therefore we have now provided engineers with the data that will make air distribution more efficient as well," said Michael G. Olsen, Ph.D, an associate professor of mechanical engineering, who conducted the project along with Iowa State University mechanical engineering department colleagues, Baskar Ganapathysubramanian, Ph.D., assistant professor; and Ph.D candidate/graduate assistant, Anthony Fontanini.

“While various post-study phases are still being completed, the authors are certain of a slim ±2.5% margin of error and that the same 24.5% efficiency can be achieved in larger spaces such as big box retailers, warehouses and other commercial/industrial buildings. This analysis is used to construct metrics on efficiency," according to Ganapathysubramanian. "A number of different flow rates are examined to determine the performance over a range of operating conditions. Transient finite volume simulations consisted of over 13 million degrees of freedom for over 10,000 time steps. The simulations utilized HPC (High Performance Computing) for the large scale analysis."

The study's demonstration of fabric duct's performance increases shows promise towards the use of fabric ducting systems in the construction of tomorrow's green, energy-efficient buildings, according to Baskar Ganapathysubramanian.