Iowa State U. Energy Study Proves Fabric HVAC Duct Efficiency over Metal Systems

Mechanical Engineering Department's CFD analysis in 10-month-long study reveals fabric duct is 24.5% more efficient than metal.

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ENERGY STUDY

Traditional round fabric duct by DuctSox Corp.

About the Iowa State University Department of Mechanical Engineering:

The department is one of the largest mechanical engineering departments in the U.S. with over 1,200 undergraduate students and over 150 graduate students. The department boasts internationally acclaimed research programs in biological and nanoscale sciences, clean energy technologies, complex fluid systems, design and manufacturing innovation, and simulation and visualization. Research sponsors include industrial sponsors as well as the National Science Foundation, the Air Force Office of Scientific Research, the National Aeronautics and Space Administration, and the U.S. Departments of Energy, Defense, Agriculture, Justice and Transportation.

AMES, Iowa— Mechanical engineers always suspected that fabric HVAC ductwork is more energy efficient than its metal duct counterpart, but now three members of the Iowa State University's Mechanical Engineering Department have proven an overwhelming 24.5-percent efficiency differential.

The 10-month-long study, "Thermal Comparison Between Ceiling Diffusers and Fabric Ductwork Diffusers for Green Buildings" proved 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.

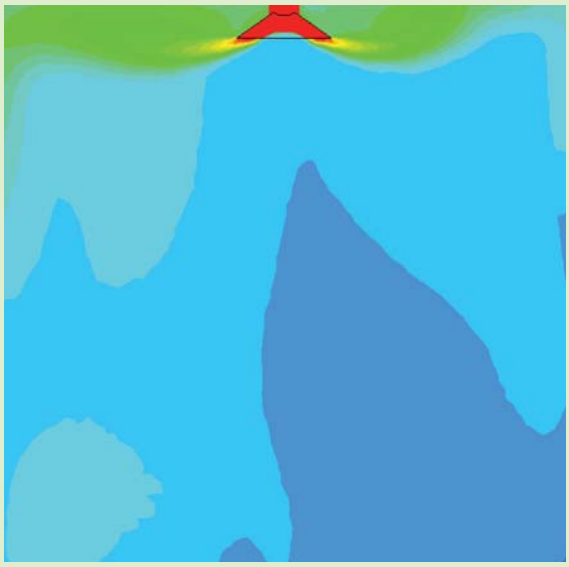
The study is now available free at www3.me.iastate.edu/bglab. It has also been published in Energy and Building Magazine, New York, an international journal of research applied to energy efficiency in the built environment.

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.

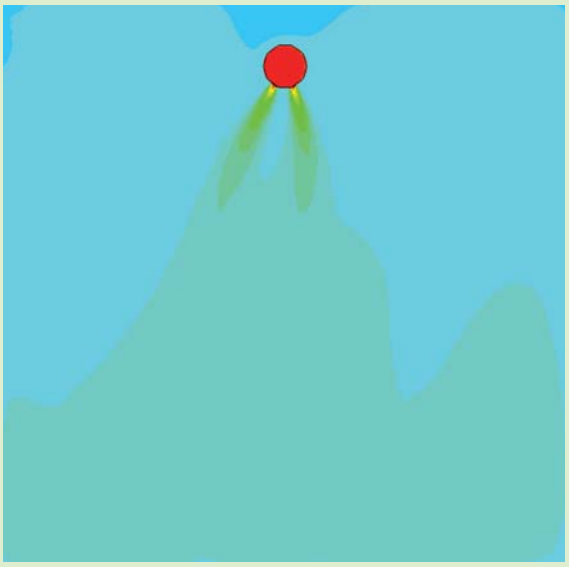
"This is a monumental study for consulting engineers needing proof their fabric air dispersion specifications are green for sustainable building and LEED projects," said Cary Pinkalla, president of DuctSox Corp., Peosta, Iowa, a world leader and U.S. market share leader in fabric duct design and manufacturing.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

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 modeling analyzed 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-foot-long, 6-inch-diameter ceiling-suspended fabric supply duct with 7 pairs of one-inch-diameter air dispersion orifices spaced one-foot apart.

"Ductwork system efficiency tends to 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.



The uneven dispersion of a 4-way metal diffuser. Notice the inconsistentcies in temperatures in the space.



Linear, even dispersion of a DuctSox fabric duct.

While various post-study phases are still being completed, the authors are certain of a slim ±2.5-percent margin of error and that the same 24.5-percent efficiency can be achieved in larger spaces such as big box retailers, warehouses and other commercial/industrial buildings, according to Ganapathysubramanian.

"This analysis is used to construct metrics on efficiency," said 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 the increase in fabric duct's performance shows promise towards the use of fabric ducting systems in the construction of tomorrow's green, energy-efficient buildings, according to Ganapathysubramanian.

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