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Engineer Solves School's Kitchen HVAC Ventilation Challenge with Lab Diffusers

Elk Grove Village, Ill.—A consulting engineer using a fabric-based HVAC laboratory diffuser to solve a seemingly impossible cafeteria kitchen ventilation challenge may have discovered a solution for the age-old problem of foodservice area airflow and exhaust imbalances. Elk Grove High School (EGHS), Elk Grove Village, Ill., gradually added additional dishwashers, stove/draft hoods, and other exhaust-requiring appliances over several years. This increased the kitchen area's exhaust to approximately 20,000-cfm without adding to the 12,000-cfm make-up supply air resulting in a negative air pressure. Without enough supply air, the added exhaust systems began drawing air from nearby rooms, which unfortunately in EGHS's case, included the shop department's automobile repair learning center. Consequently, the exhaust systems were drawing vehicle emissions through the nearby hallways and into the kitchen.

Township High School District 214 hired CS2 Design Group, an Elk Grove Village-based consulting engineering firm that specializes in mechanical and electrical engineering design for educational institutions. CS2's Principal, Steven Schafer, P.E., LEED® AP and Peter Kaczor, mechanical engineer, discovered the negative pressure during a study that also revealed little retrofit flexibility in the cramped space above the 1,500-square-foot kitchen's ceiling. Above the kitchen, the 16-inch-high bar joists were spaced approximately three feet on center with only four inches between the bottom of the joists and the suspended ceiling. Even with proper air balance in the space, the existing conventional 2x4-foot metal ceiling diffusers presented too much draft and turbulence for exhaust hood performance.

Typically, engineers would have specified critical environment metal diffusers to provide an acceptable turbulence and velocity of make-up air that is slow enough for the cooking draft hoods and other exhaust vents to draw air properly. Unfortunately, the metal diffuser profiles available to the HVAC industry surpassed the four-inch space between the ceiling and joists. Lowering the existing nine-foot-high ceiling to accommodate these special diffusers would have raised the project cost significantly in

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rerouting utility piping, reducing heights of draft hoods, and other construction costs.

As an alternative to the costs associated with critical environment metal diffusers, Kyle Schultz, engineering manager, Air Products Equipment, an Elk Grove Village-based ventilation manufacturer's representative, suggested fabric based diffusers typically used in laboratory settings. LabSox™ is a new series of laboratory air dispersion solutions by DuctSox®. Schultz, who had recently sold cylindrically-shaped LabSox as a retrofit to the University of Chicago's new Gordon Center for Integrative Science as the only solution to providing very low fpm specifications and tight temperature tolerances required for laser experiments, felt the product's low profile and superior airflow performance versus metal diffusers were perfect for the EGHS kitchen. "We think fabric lab diffusers might be a good application for our future foodservice area air diffusion specification because of the low air velocity they provide," said Schafer, whose firm has engineered multiple school cafeterias/kitchens and restaurant renovations—both as retrofits and new construction. "One hidden benefit with fabric diffusers is the ability to be easily taken down and laundered, which is a big sanitation advantage in a food prep area."

The LabSox All-Fabric Surround Flow diffuser has a flat fabric back panel with a flexible fabric connection that eased connections within the restricted space between the joists and suspended ceiling. They're also available with metal backpans in conventional sizes of 2x2-foot, 2x4-foot, and larger voids when replacing metal diffusers. "The fabric diffusers went into the ceiling very nicely and took about one man-hour each of installation time," said Lenny Hart, foreman, Air-Con Refrigeration & Heating, Waukegan, Ill., which was the installing contractor. "The clearances and space constraints above the ceiling were really difficult for running the ductwork through the joists, so the flexibility and the low profile of the product were a big help."

Make-up air flows through LabSox's RX-200 factory-engineered fabric at a low velocity of 70 to 95-fpm. The end result is a slower, more even airflow distribution that allows the kitchen exhaust hoods and other exhaust outlets to perform correctly.

Due to the fact the truss clearances would only allow air distribution via 10-inch-round ductwork, the 2x4-foot diffusers were custom-designed by DuctSox so that each diffuser receives two 10-inch-round duct supplies delivering 425-cfm each for a total of 850-cfm.

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Laboratory and foodservice exhaust hoods are very similar in that both need non-turbulent and consistent inlet air velocities, according to Schafer. Therefore, Schafer believes fabric lab diffusers might serve a performance purpose in CS2 Design Group's future foodservice kitchen designs. Aside from performance, the new system creates no drafts, which contributes to improved indoor air comfort and indoor air quality for kitchen employees. "When you're dealing with the quantity of air we had on this project, this type of diffuser design is a good solution for retrofits and new construction," said Schafer.

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