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Student-Designed Facility Combines Underfloor Ventilation, Ventilated Façade

Program tests limits of sustainable construction

Progress rarely occurs without risk. Risk sometimes involves experimentation. In real-world construction, experimentation with new technologies in the name of improving energy efficiency is a risk few can afford, no matter how committed to sustainability they are. This simple reality may be the greatest obstacle green-building advocates face in trying to persuade the construction industry to embrace sustainable practices.

At the University of Kansas in Lawrence, Kan., the School of Architecture, Design & Planning is helping to loosen the industry's grip on "tried-and-true-but-not-so-sustainable" building practices by applying cutting-edge design, products, and technologies on real-life construction projects through Studio 804.

Studio 804 is a study program that for more than two decades has pushed the sustainability envelope, providing hands-on educational opportunities and real-world insights into the latest building techniques. Graduates entering their final year in the Master of Architecture program participate in a year-long educational project that sees them produce a building from design through completed construction. Past projects include homes in disadvantaged neighborhoods and LEED Platinum non-residential buildings. Perhaps most ambitious of all is The Forum at Marvin Hall.

An addition to Marvin Hall, home of the School of Architecture, Design & Planning, The Forum includes a lecture hall and meeting/exhibition space. It is unique in that the architectural design is deeply linked to the mechanical design, as an underfloor ventilation system works in concert with a highly energy-efficient ventilated façade.

Why a Ventilated Façade?

"Our goal was to prolong the need to turn on any A/C or heat as long as possible, meaning that the system takes advantage of swing periods during the fall and spring," Professor Dan Rockhill, executive director of Studio 804, explained. "If, during those periods, we can use natural ventilation without turning on any large-scale mechanical equipment to get the air changes we need, then everybody wins."

A ventilated façade was a bold choice.

"The complexity of the HVAC system we chose for this project is enormous," Rockhill said.

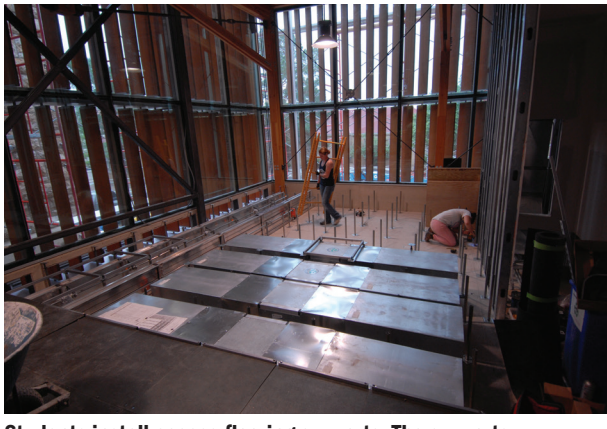
There were few, if any, good examples in the United States to look to, and the team would have an entire university to answer to if the design did not work.

The team consulted two expert firms—Henderson Engineers Inc. of Lenexa, Kan., and Transsolar Inc. of New York City—in designing the ventilated façade.

How the Natural-Ventilation System Works

While the primary means of controlling temperature and humidity are variable-refrigerant-volume heat pumps, the goal was to avoid mechanically tempered air. Ducted fan-coil units supply conditioned air via overhead diffusers; during natural-ventilation mode, fresh air is supplied to the lecture hall through an underfloor air system. Energy models demonstrated these systems working in concert would yield significant energy savings over the course of a year.

The ventilated façade is a wall composed of two layers of 1-in.-thick clear insulating glass running from floor to ceiling. These layers of low-emissivity coated glass are separated by a 3-ft, 5-in. ventilated space. In this space are 1-ft-wide vertical western-cedar louvers, which are turned to admit or block sunlight as required to modulate heat gain. On mild days, the system operates in natural-ventilation mode, meaning the primary HVAC system shuts down, and cross-ventilation is used to introduce fresh outdoor air. Air enters the floor plenum from the east façade and seeps into rooms through dozens of vents at low velocity. Stack effect—the natural movement of air into and out of a building via buoyancy—draws air from the interior through vents in the west façade's parapet.



Students install access-flooring supports. The supports conceal four variable-speed fans with silencers on each end that will draw outside air into the positive-displacement system when temperatures permit. A row of smoke dampers standing to the inside of the control dampers will permit air from the exterior of the vented wall cavity to enter the space.

Underfloor Fans Aid Stack Effect

While stack effect may achieve sufficient air movement many days of the year, depending on both outdoor conditions and indoor conditions, some mechanical assistance is needed to ensure optimum comfort. That is where underfloor ventilation fans come in.

"If the temperature and humidity are right for natural ventilation,

dampers will open to bring in outside air, but if the space temperature creeps above 72 degrees, then that is a sign the stack effect is not adequate, so the fans come on to enhance that process," Carl Holden, PE, of Henderson Engineers said.

The student design team knew little about the types of fans available or how best to apply them. A chance encounter with Systemair at the 2013 Greenbuild International Conference and Expo in Philadelphia changed that.

"We were lucky to hook up with Systemair," Benjamin Peek, a graduate of the Master of Architecture program and a member of the 2013-2014 Studio 804 design team, said. "They had so many different options that they could share with us. They started to tell us what we could use to get the right amount of CFM, the proper sizes, location options, etc."

Systemair experts helped the students choose four Systemair MUB-EC centrifugal ventilation fans for the underfloor application and advised them as to where to locate the fans to keep noise and vibration to a minimum.

"Originally, we had the fans on the west wall, but Systemair came up with the solution to put them under the auditorium floor, which we had never even talked about before," Peek said.

The fans are designed with electronically commutated motors, which consume 30- to 50-percent less energy than conventional alternating-current motors, even at low speed. The MUB-EC motors are controlled with a 0-to-10-V signal, so additional variable-speed drives are not necessary. The fans are extremely quiet thanks in part to the electronically commutated technology, which provides a smoother rotation and, thus, less vibration. Low noise also is the result of double-skin, galvanized-steel panels and 7/9-in. mineral-wool insulation.

"We were not specifically looking to apply EC (electronically commutated) motors in this project," Holden said, "but once we got into it and learned about the fans, we understood that the technology was a really nice fit for what we were doing here."

A Lesson in Collaboration

Systemair was a good fit for the Studio 804 project in more ways than one, Holden said.

"Systemair was very supportive," Holden explained. "Their willingness

Continued on Page 30

Continued from Page 8

to meet with the Studio 804 team and us has been a great advantage. It showed they were really invested in the project. Our conceptual-design approach is to get involved early in our projects so we can work through the concepts early on. The application of these fans is a perfect example. Between all of us, we could talk about the best place to locate the fans. But if you don't have everyone around the table to share their particular perspective, you can't do that."

It is a lesson in collaboration few architectural students get, and it is one of many experiences that distinguish Studio 804 graduates. Few, if any, other architectural programs offer students such exposure to real-world construction. Rather than sitting in a classroom discussing concepts, Studio 804 students are on a job site every day, working alongside contractors. They are meeting face to face with manufacturers in the presence of professional engineers solving actual problems. By the completion of a project, each student has directly participated in every level of design and construction.

"The public in general would be surprised to learn that that part of an architect's education does not normally include any kind of hands-on opportunities," Rockhill said.

A seasoned architect and construction veteran himself, Rockhill understands that integrated experiences like these have the potential to improve the overall success of construction projects.

"I have seen so many architects just trying to save face," Rockhill said. "It's the trade industry—the reps, the installers—these people really know what they are doing."

It is among these experts Studio 804 students get to test the limits of sustainable construction, make mistakes, solve problems, and experience the pressures of a real-life project. The projects are well-documented, and Studio 804 is transparent about the ups and downs of each journey, which benefits not just the students, but the construction industry as a whole.

"Studio 804 brings untold value to our industry," Pablo Varela, product manager, fans, Systemair, said. "As a first-time contributor to a Studio 804 project, we've seen the positive dynamics. It's been enormously exciting and gratifying to work with these design students."

Information and photograph courtesy of Trish Holder, a writer and marketing consultant for the HVAC industry and the creator and publisher of www.greenspirationhome.com.