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EXHAUST STACKS

Low chimneys for UQAM's laboratory

At the University of Quebec at Montreal (UQAM) the design team evaluated many HVAC products while planning a new 37,160-m2 (400,000-s.f.) laboratory building for the university's science campus. Teaching and research activities there include mathematics, computer sciences, physics, earth and environmental sciences.

By any standards this was a huge project. The 10-storey building accommodates over 4,000 students and incorporates over 150 individual laboratory work stations for research and education. The building also houses classrooms, teachers' offices and a library.

One of the many HVAC considerations was managing the work station fume hood exhaust for the 150 laboratories. As is typical of university laboratories, a wide variety of chemicals and materials is used at the work stations and as a result some fume hood exhaust effluents are highly corrosive, and noxious.

"The issue of laboratory work station exhaust was a major consideration in planning the entire HVAC system for the building," says André Couture, an architect at the university. Couture's department was responsible for overseeing the design and development of the technical/mechanical systems of the entire building, and he served as the link between the architects, the engineering consultants, the future occupants and UQAM's maintenance department.

Chimney systems mounted on the roof.

"For my part I was concerned about laboratory security, the building environment, neighbours' fears (with regard to work station exhaust), aesthetics, meeting city regulations and expansion possibilities," Couture says when discussing his role.

As it turned out aesthetics — particularly the building's roof line — were a main consideration since, according to Couture, "one of the worst prescriptions" came from the City of Montreal. "The total height of the building—including roof equipment — was limited, and we were concerned for the neighbours," he says. "There is a row of houses just on the other side of the street and we wanted the roof chimneys as short as possible so as not to be seen by people in those houses. ... On the other hand, we were concerned about the possibility that work station exhaust fumes would be re-entrained back into the building or into other buildings on the campus and elsewhere in the neighbourhood."

To eliminate these problems the university commissioned an environmental study. Its findings concluded that there indeed could be possible problems on warm days without wind. To eliminate these concerns they needed a high chimney or higher velocity to blow the fumes high enough so they would not fall at street level or on the campus ground (cold air from the building has a higher density than warm outside air).

Pageau, Morel & Associés, consulting engineers of Montreal, were on the team for the project, with Marc Schuler of the firm responsible for its HVAC and controls engineering.

The new building on UQAM's science campus.

Specifically, Schuler was involved in the design of the air handling systems, including laboratory work station exhaust. Schuler had solved a similar exhaust problem for the Canadian Space Agency which won a technology award from ASHRAE in 1996. According to Schuler, Pageau Morel suggested that the university use Tri-Stack laboratory fume hood exhaust systems on the building. Based on his experience, Schuler thought they would meet both the performance and aesthetic requirements.

Three Model BS4/30 Tri-Stack systems were mounted on the building's roof, connected to a common exhaust manifold designed for general room exhaust. This arrangement helped reduce installation costs while enhancing the HVAC's efficiency. The Tri-Stack systems mix outside air with primary air to dilute the laboratory work station fume hood exhaust, sending skyward a converging plume about 18 metres above the top of the building (in a 16 km/h, or 10 m.p.h., wind).

Schuler says that the HVAC system incorporates a number of different fans. For example, some laboratory work station fume hoods are served by dedicated exhaust fans. "These were used for highly corrosive fume hood

exhaust," he says. There were two reasons: first, the highly corrosive nature of the exhaust precluded it from mixing into the general exhaust manifold system. Second, the cost of each fan was also a factor. The individually dedicated fans are belt-driven and mounted in a penthouse. Schuler says they are bifurcated and designed to operate at low speed to minimize noise and vibration.

The third type of fan is to supply clean air for the building. There are seven 200-HP supply fans using variable pitch blades, and eight 50-HP variable pitch return air fans providing 420,000 cfm of conditioned air. The entire system is combined for maximum efficiency. The air supplied to the laboratories is exhausted via the fume hoods, but the air supply to the library and non-laboratory spaces is returned and recirculated.

The key for the laboratories was the Tri-Stack system, one of which is typically about 3.6 metres (12 ft.) high. Schuler says that after testing with a scale model of the building and surrounding neighbourhood it was determined there would not be any re-entrainment problems into the building through the fresh air intake louvers. "For the volume of air we had it would have taken a very high chimney for the exhaust (to eliminate re-entrainment)," says Schuler. "But with the Tri-Stack fans we were able to avoid an ugly chimney on the roof."

The Tri-Stack systems at UQAM have been exhausting about 75,000 cfm from the common laboratory work station manifold. Now the university is adding one more Tri-Stack BS-4/30 fan, with provision for a fifth in the future. That would bring the capability of the exhaust systems to 125,000 cfm, divided between the dedicated exhausts and the Tri-Stack systems.

By Victor A. Neuman, PE, Technical Systems Manager, Strobic Air Corp./Met-Pro Corp, Harleysville, PA. manufacturers of Tri-Stack Systems, tel. (215) 723-4700.

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