By JOHN DIXON, PORTLAND OR

Active or passive, chilled beams yield cool customers

If designed and constructed properly, chilled beams can offer several advantages over traditional VAV systems, the primary one being energy efficiency.

When engineers first began designing the new Bill and Melinda Gates Hall at Cornell University, they reviewed a variety of HVAC strategies. They knew that with the name Gates on the entranceway of its new computer science building, the structure had to perform flawlessly. After careful analysis they designed an HVAC system that incorporated an assortment of innovations headed by active (ACB) and passive (PCB) chilled beam technology.

Chilled beam systems use cold water circulating through pipes to cool the surrounding air. With the unit installed in or around the ceiling, the air it cools becomes dense and falls towards the floor. The vacuum created by the falling cool air is replaced by rising warmer air, which comes in contact with the chilled beams, and the process continues over and over, causing a constant airflow.

"There are two basic types of chilled beam systems in use today; active and passive – the primary differentiator being that active systems introduce fresh outside air into the equation via ventilation ductwork connected to the unit," said Aeroseal's **Neal Walsh**. "The outside air allows for additional cooling capabilities and eliminates many of the IAQ issues associated with using recirculating air. Through the use of dampers and other mechanisms, the introduction of outside air also allows for easier system adjustments."

The Bill and Melinda Gates Hall incorporated multiple ACB and PCB units throughout the building with active chilled beams placed in classrooms, small conference rooms and computer labs, passive chilled beams used in perimeter and interior offices, and a combination of the two used in rooms with high cooling loads.

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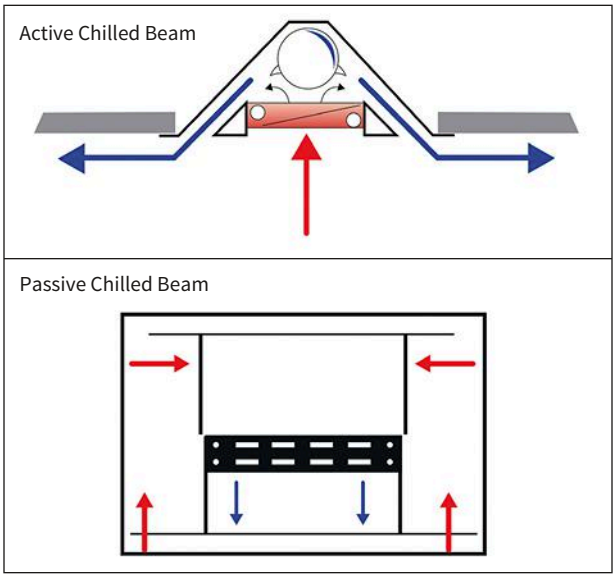
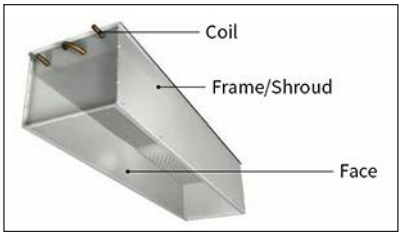
In order for treated air in a VAV system to arrive at the proper temperature, it must first be over-cooled. This allows for any temperature dissipation while traveling through the ducts to the intended destinations. Since chilled beam systems treat the air in and around the location where it is being used, there is no need for delivery ducts, no temperature dissipation, no over-cooling – all of which adds up to reduced energy use.

Also, without the need for large fans to circulate the treated air, chilled beam systems require even less energy to operate. The amount of energy saved through minimizing fan power far exceeds any increased energy associated with pumping water though the system. And since the temperature of cooled water is higher than the temperature of cooled air, chilled beam systems are able to deliver the same cooling ability at a much lower cost.



Active systems (top) introduce fresh outside air via ductwork, while passive systems need ventilation air to be delivered by a separate air-handling unit.



Components of a typical passive chilled beam.

Chilled Beams vs. Humidity

At the same time, chilled beam systems have their drawbacks, primary of which is their sensitivity to humid environments. To avoid condensation forming and dripping from the chilled beams, the surrounding air must sustain a proper low level of humidity. Maintaining the dew point of the indoor air below the surface temperature of the chilled beam is critical – and requires the careful calculation of various factors.

"It really is a balancing act," said **Rod Lord**, managing director of SEED Engineering in Brisbane, Australia. "The temperature of the space, the number of occupants, air humidity and the amount of outside air being delivered to the system, all play a role in the proper functioning of a chilled beam system. Changing one of these calculations can make the difference between a highly effective HVAC system that provides a comfortable, high air quality environment, or one that creates an untenable mess."

Unfortunately for the owners of a luxury high-rise in the heart of North Sydney, Australia's business district, the latter was the case. The 23-story building's VAV / chilled beam hybrid system never provided the energy efficiency it was designed to deliver. Tenants of the state-of-the-art building were never happy with the AC, and energy costs were well beyond initial design levels. Any adjustments to the system pushed it beyond safe dew point levels where condensation threatened to create a disastrous effect.

After conducting an analysis of the building, Lord and his team at SEED concluded that duct leakage was at the root of the problem. Leaks throughout the 20 vertical shafts and hundreds of square feet of horizontal ductwork prevented the required amount of air from reaching the chilled beam units.

Gates Hall at Cornell University uses both active and chilled beams.

"Chilled beam systems are particularly sensitive to external factors, and since leaks in the duct system were preventing sufficient air from reaching the beams, they were unable to provide effective cooling and worse, there was condensation dripping from the various units," said