By Megan Mazzocco, Associate Editor

Solving the Riddle of IAQ Through Evidence-Based Design

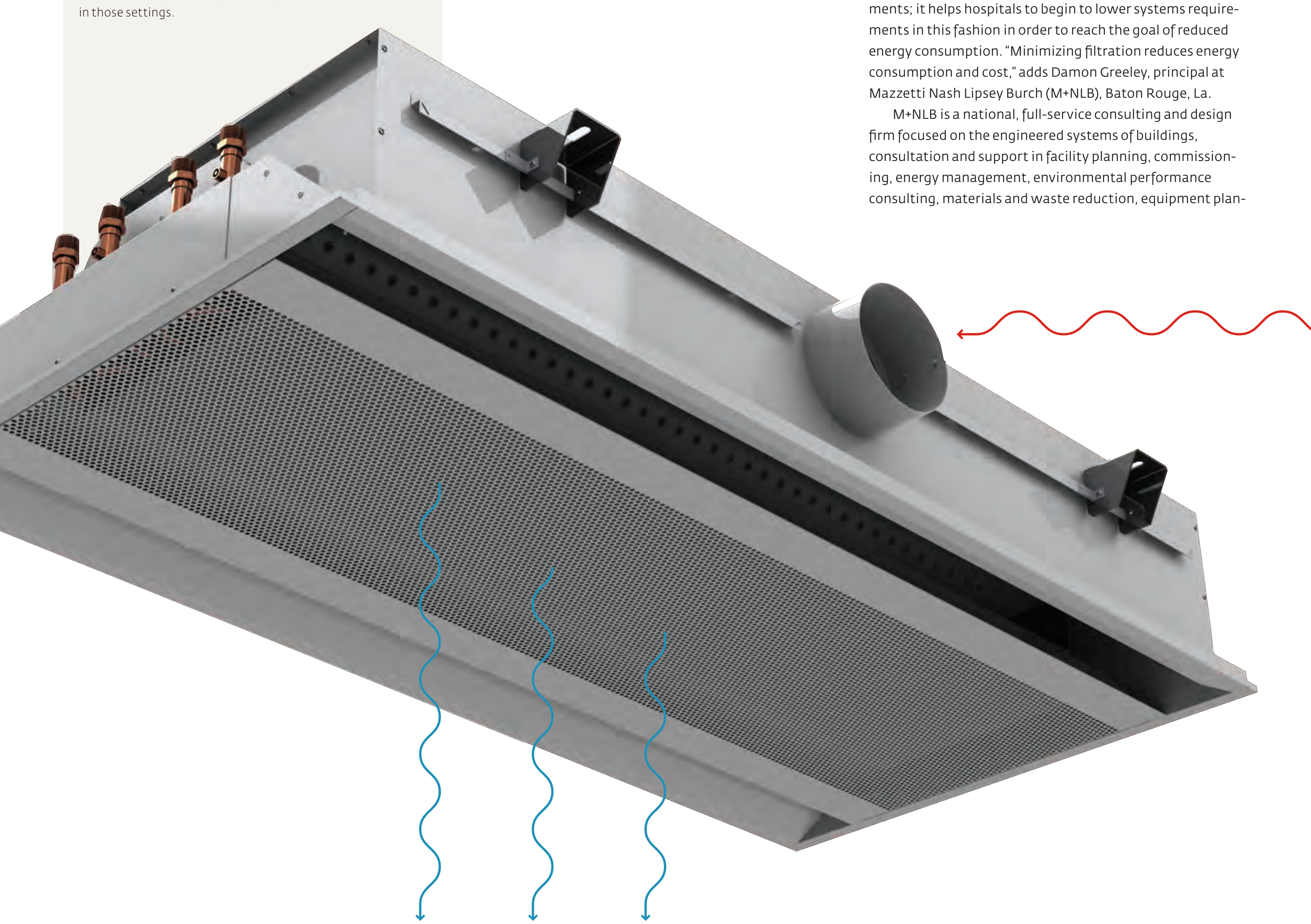
Quick Definitions

IAQ: Indoor Air Quality

ASHRAE 170: Ventilation of Health Care Facilities

ASHE: American Society of Healthcare Engineering. Changes passed by the two groups in June 2011 are helping reduce HVAC loads while preserving IAQ in patient rooms.

Addendum h: ASHRAE 170 allows healthcare systems to reduce filtration of patient room air supply that does not pass over a wet coil surface, thereby opening the door to introduce passive heating or cooling technologies in those settings.



Improving indoor air quality while simultaneously reducing energy consumption in a healthcare setting sounds like a riddle of a modern Sphinx.

However, with the latest addendum to ASHRAE 170 (Ventilation of Health Care Facilities) and revised practices approved by the American Society of Healthcare Engineering (ASHE), loads are being reduced while indoor air quality in patient rooms is being preserved, Addendum h allows healthcare systems to reduce filtration of patient room air supply that does not pass over a wet coil surface, thereby opening the door to introduce sensible heating or cooling technologies in those settings.

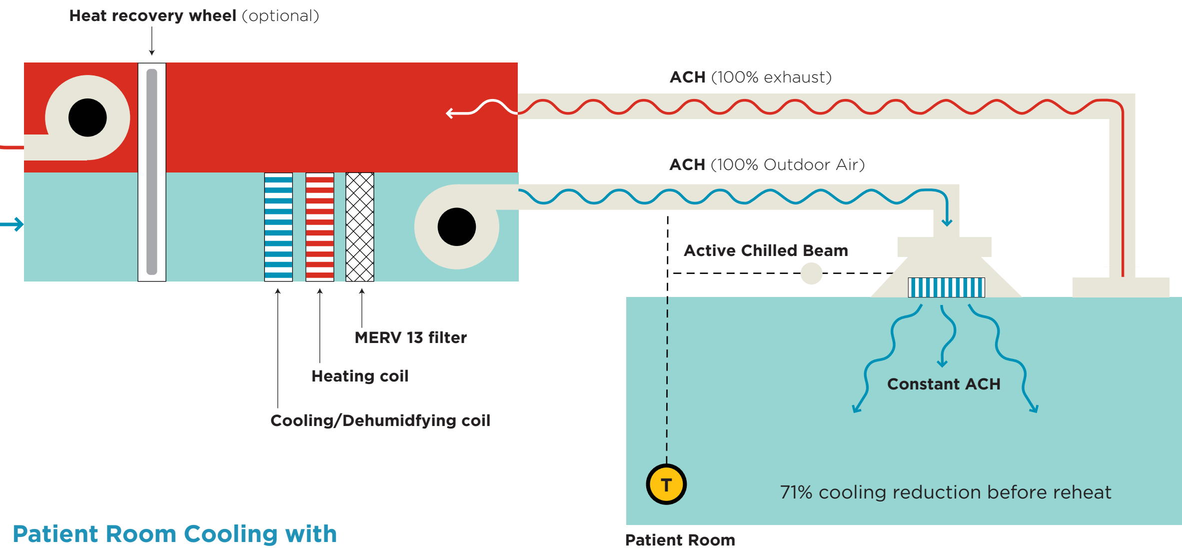
"The use of dedicated outdoor air systems (DOAS) coupled with radiant heating and cooling allows the air system to be reduced to the minimum size needed for ventilation," explains Adam Carlson, associate and senior mechanical engineer at Interface Engineering, Portland, Ore. "By using just the air needed for ventilation, the size of the duct system and air handlers can be reduced."

Addendum h to ASHRAE 170 is a major adjustment to the definition of air changes for spaces in healthcare environments; it helps hospitals to begin to lower systems requirements in this fashion in order to reach the goal of reduced energy consumption. "Minimizing filtration reduces energy consumption and cost," adds Damon Greeley, principal at Mazzetti Nash Lipsey Burch (M+NLB), Baton Rouge, La.

M+NLB is a national, full-service consulting and design firm focused on the engineered systems of buildings, consultation and support in facility planning, commissioning, energy management, environmental performance consulting, materials and waste reduction, equipment planning and procurement, and low-voltage and information technologies. The firm's pioneering research in the field of displacement ventilation air systems helped invoke a call for what was to become Addendum h and shaped the acceptance of new guidelines for the design and construction of healthcare facilities.

Press 'h' for Healthcare

As explained in a white paper by Trox USA, a supplier of chilled-beam technology, Addendum h dials down the ventilation requirements for spaces within healthcare facilities where recirculation of room air is allowable. Generally, these areas include diagnostic and treatment rooms, general patient nursing rooms, and labor/delivery and post-partum areas. Previous to the addendum, these areas required that six air changes per hour of conditioned and filtered air be delivered to each space, two of which were outside air. Addendum h revises the standard to allow re-circulation of room air to count toward the six total conditioned and filtered air changes provided:



Patient Room Cooling with Active Chilled-Beam System

In this space being supplied by an active chilled-beam system air is conditioned and filtered before delivering air at 55°F to a 6-ft. long chilled beam.

Space Sensible Cooling Load BTU/ft²	Ducted Airflow Rate ACH⁻¹	Air Side Sensible Cooling BTU/ft²	Water Side Sensible Cooling BTU/ft²	Total Sensible Cooling BTU/ft²	Space Reheat Requirement BTU/ft²
25 (100%)	2.0	7.2	17.8	25	0
20 (80%)	2.0	7.2	12.8	20	0
15 (60%)	2.0	7.2	7.8	15	0
10 (40%)	2.0	7.2	2.8	10	0
5 (20%)	2.0	7.2	0	22	5.2

Active Chilled Beams

Chilled beam manufacturer **Trox USA** has a number of its systems installed in real-life applications, Here in this office, its DID632 unit uses a combination of primary air and chilled water, above room dew point, to provide sensible cooling to the space. The technology combines the airflow characteristics of ceiling diffusers with the energy-saving benefits of heat absorption. The design and positioning of the induction nozzles within the unit enhances the amount of secondary room air drawn across the internal heat exchanger, which achieves high cooling outputs with low amounts of primary air. The system is particularly suitable for perimeter zones with high sensible loads, as well as for use with dedicated outdoor air system (DOAS) designs. Other benefits include reduced ductwork and reduced plant room size. Visit www.troxusa.com or **Circle 520**

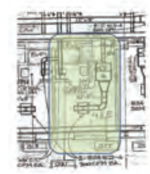
Quick Definitions

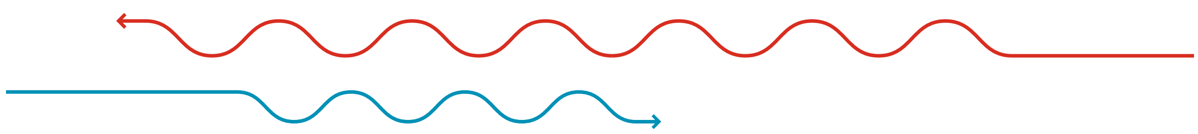
ASHRAE 55: Thermal Environmental Conditions for Human Occupancy

ASHRAE 62: Ventilation for Acceptable IAQ

General Medical Surgical Patient Care Room, Wellmont Health, Kingsport, Tenn.

A system schematic of the chilled-beam beta site at Kingsport, Tenn. The room temperature controls were configured to confirm compliance with ASHRAE/ANSI Standard 55 & 62.





- Re-circulation is acceptable in the type of space under consideration.
- The re-circulation is limited to the room itself and does not include any air from another space.
- Delivery of a minimum of two air changes (per hour) of outside air (filtered through a MERV 13) is maintained.

Hospitals Chill on Energy Usage

Of course, one of the reasons healthcare facilities are exploring chilled beams and other energy-savings technology is the fact that the Dept. of Energy and ASHRAE have adopted legislation that calls for a 20% energy reduction in existing healthcare facilities and 30% reduction in new construction by 2020. HVAC and lighting in a hospital consume more than 2.5 times that of a commercial office building. When it comes to LEED in healthcare, where can a system full of intentional redundancies possibly become more efficient in order to fit the constraints of energy legislation?

According to Trox' white paper chilled beams present an energy-saving opportunity where recirculation of room air is permitted. ASHRAE 170 Addendum h stipulates that no filtering of the re-circulation air is necessary provided it does not pass across a wet-coil surface. That said, "The addendum is clearly written to promote the use of fan coil units and chilled beams in patient areas in order to reduce the amount of supply air reheat," notes Ken Loudermilk, VP of technology and development, Trox USA.

Chilled Beams in Action

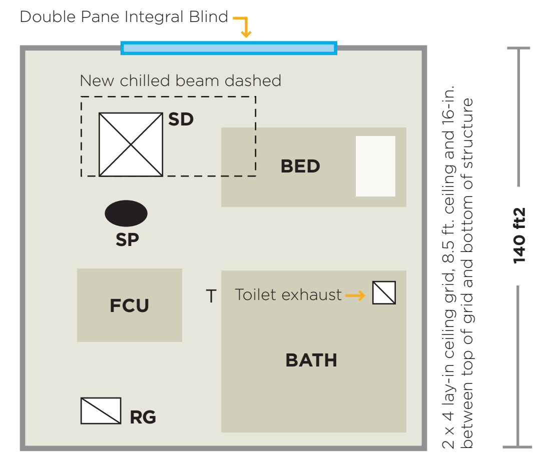
M+NLB is one firm that's taken up the chilled-beam gauntlet. When it comes to patient room design, the firm has demonstrated that displacement ventilation improves air flow and minimizes the mixing of room particles in the breathing zone—zero to 6 ft. "We are acutely aware of air movement within the space, being from clean to dirty, rather than filtering to 'fix' the problem," says Greeley.

Now that ASHRAE 170 will permit active chilled beams for the secondary air movement in patient rooms, M+NLB continues championing displacement ventilation air

HVMC Chilled Beam Beta Site

Proposed Room: A Building, 4th Floor, Room 43E

Wellmont Health in Kingsport, Tenn.
Room chosen for its southeastern exposure



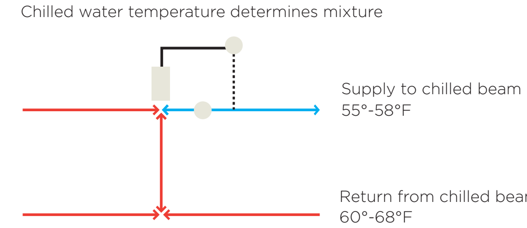
Corridor side: Lay-in ceiling with primary air, CHWS/R and HHWS/R mains with branch piping to FCU, 2-way control valve

Chilled Beam scope of work:

1. Remove Fan Coil Unit (FCU), Smoke Dampener (SD) and RG
2. Provide new 4-pipe chilled beam in approximate local of SD
3. Extend chilled water supply/return (CHWS/R) and heating hot water supply/return (HHWS/R) branch piping to new 4-pipe chilled beam
4. Provide CHWS/R piping bridge with circulator
5. Replace pneumatic stat with E/P transducer and new DDC wireless control. On call for cooling modulate CHW CV to maintain 52F supply (adj.) to chilled beam and run pump to maintain room temp. On call for heating modulate HHW CV to maintain room temp.

HVMC Chilled Beam Beta Site

Proposed Room: A Building, 4th Floor, Room 43E

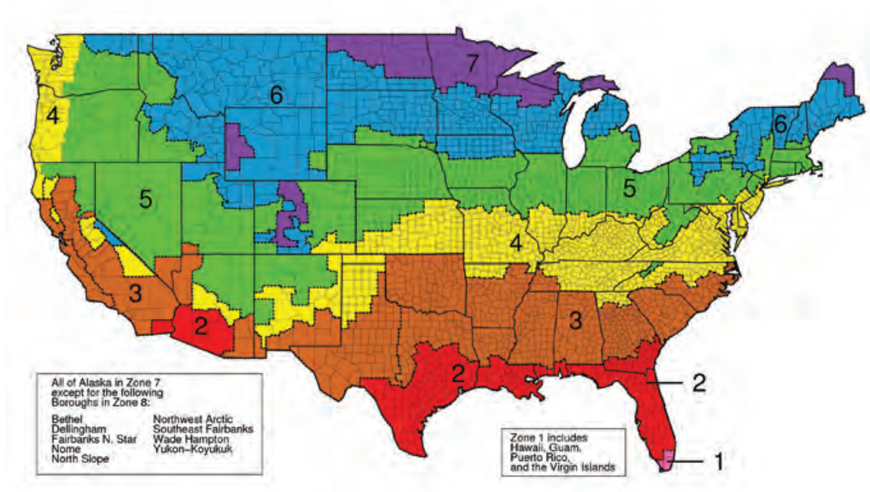


Proposed Piping Diagram

3-way control valve and circulation pump to either 2-pipe (change over between heating and cooling or 4-pipe beam. Heating connection doesn't require mixing valve/pump arrangement.

Map: The U.S. Energy Dept. has divided the continental United States and Alaska into eight climate zones based on temperature—CDD-cooling degree days, or HDD-heating degree days—precipitation and general humidity levels—marine, dry and moist.

- Zone 1: 9000 CDD
- Zone 2: 6300-9000 CDD
- Zone 3: 4500-6300 CDD
- Zone 4: <4500 CDD; <5400 HDD
- Zone 5: 5400-7200 HDD
- Zone 6: 7200-9000 HDD
- Zone 7: 9000-12600 HDD

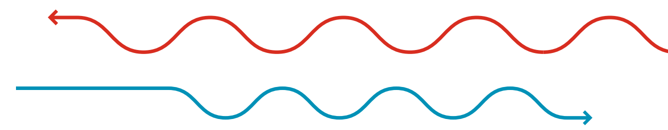


U.S. Climate Zones

M+NLB continues championing displacement ventilation air systems research by studying IAQ in patient rooms with chilled-beam technology in order to prove the validity of the concept within U.S. Climate Zones 1, 2, 3, 6 and 7. (Two previously existing installations being studied at University of California Davis School of Medicine, Davis, Calif., and the Yale University Hospital Expansion, New Haven, Conn., are located in U.S. Dept. of Energy Zones 4 and 5.)

Chilled Beam Installation

One of the country's few chilled beam installations in a healthcare setting, the patient care room at Wellmont Health, Kingsport, Tenn., is a test site. Since a chilled beam is a non-condensing device, the room does not require filtration, only filtration from the dedicated outdoor air system (DOAS), which is MERV 14.



systems research by studying IAQ in patient rooms with chilled-beam technology in order to prove the validity of the concept within U.S. Climate Zones 1, 2, 3, 6 and 7—Two existing installations in zones 4 and 5 were previously studied at University of California Davis School of Medicine, and at Yale University's Hospital Expansion in New Haven, Conn.

In August 2011, the research team of M+NLB, ASHE and ASHRAE/ANSI began examining its first test site, a chilled-beam installation in a general medical surgical patient care room at Wellmont Health in Kingsport, Tenn. Wellmont chose Room 43E for its southeastern exposure, relates Greeley. The traditional six-room air-change ventilation air system was reduced to two. In testing the project, the research team set out to measure outcomes and IAQ through compliance with ASHRAE 55: Thermal Environmental Conditions for Human Occupancy; ASHRAE 62: Ventilation for Acceptable Indoor Air Quality; and, of course, ASHRAE 170: Ventilation of Health Care Facilities. What they found was not only improved IAQ, but greatly reduced energy consumption.

WHY DO HVAC DESIGNS WITH HIGHLY FILTERED, BUT RE-CIRCULATED AIR CONTINUE? "IF THE ONLY TOOL YOU HAVE IS A HAMMER, THE WHOLE WORLD LOOKS LIKE A NAIL." —DAMON GREELEY, M+NLB

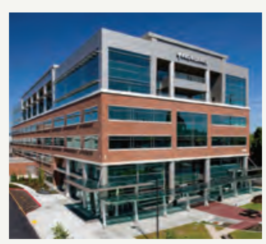
"The goal was comfort and ventilation satisfactory for healthcare delivery; energy savings was icing on the cake," says Greeley.

Conclusion: Hit the Books

With the dawn of Addendum h and chilled beam technology coming to the forefront of patient room design, why are there still designs featuring highly filtered re-circulated air? "If the only tool you have is a hammer, the whole world looks like a nail," says Greeley. In other words, too often specs are influenced by manufacturers and product vendors pushing their solutions on an audience of code-making bodies.

In order to solve the IAQ and efficiencies dilemma and equip specifiers and code-making bodies with an entire evidence-based toolbox, M+NLB makes their findings and information accessible to engineers, designers, medical equipment planners, architects, energy sustainability consultants and other equipment vendors serving the healthcare sector "for the betterment of healthcare in the U.S. and around the world," says a draft prospectus of the Wellmont Health Chilled Beam Study.

"Advocacy is part of our mission," confirms Greeley. The firm's results will be shared with ASHE in an effort to share knowledge and coordinate efforts. Additionally, individuals from M+NLB currently serve on committees to contribute their knowledge for the creation of new IAQ guidelines for in-home hospital care situations—the next frontier of modern healthcare settings. □



Open to Good Air

The LEED Gold Providence Office Park II six-story office building in Portland, Ore., is praised for creating open green space on a tight urban site; it carries that same theme inside with an open floor plan and fresh air throughout.

According to Tom Wesel, architect at Jon R. Jurgens & Assocs. Inc., Beaverton, Ore., a **Tate** access floor system incorporated in five of the building's six floors "allowed us to eliminate any cross bracing throughout the building, and the raised access floor eliminated the need for overhead ductwork. As a result, when you step out of the core area, you always have access to natural light and an unobstructed view to the outside."

The underfloor air distribution (UFAD) system provides employees with IAQ because air is delivered directly to the occupied space—the space from floor level up to six feet. In the process, older, warmer air is carried to the ceiling by natural convection and removed through return outlets, keeping it out of the occupied zone. The Tate access floor system that Wesel references consists of an understructure and 24-in. square welded steel floor panels filled with lightweight cement. The understructure that supports the panels provides positive positioning, lateral retention and leveling adjustments to ensure that the floor is soundly supported on all contact points. Visit www.tateinc.com or **Circle 519**