energydesignresources e-News Issue 45 ▸ February 2005

In This Issue:

Coming Soon

Keep an eye out in early March 2005 for news about how to submit projects for the Savings By Design Energy Efficiency Integration Awards, presented by Savings By Design and The American Institute of Architects, California Council.

Underfloor vs. Displacement Systems

People often confuse thermal displacement ventilation and underfloor air distribution (UFAD), but they're actually quite different strategies, according to Simon Turner of Healthy Buildings International.

"UFAD is really a conventional mixing system turned upside down," he says, "with the supply diffusers in the floor and the return air in the ceiling. UFAD mixes the air, so it doesn't provide the same level of indoor air quality benefits as thermal displacement ventilation."

Underfloor air systems also don't provide the same level of ventilation effectiveness as thermal displacement ventilation, observes Turner. While UFAD's overall ventilation efficiency is better than an overhead system, it is still not as efficient as displacement ventilation. Thermal displacement ventilation is more efficient at removing both indoor pollutants and heat from a room.

A displacement ventilation system can be combined with a raised floor that provides access for communications, computer, and utility cables. However, a raised floor isn't a requirement for a displacement ventilation system. The supply air ducts can be run inside partition walls, with flat diffusers mounted flush with the wall close to floor level. Furniture placement and space usage must be taken into account when determining the location of the supply air outlets. ■

Thermal Displacement Ventilation—The Time is Now!

The Cardiff-by-the-Sea Branch of the San Diego County Library is one of a handful of new buildings in California with a displacement ventilation system.
Photo by Frank Domin. Courtesy of Manuel Oncina Architects, Inc.

Imagine a ventilation and cooling system that's widely applicable to many building types and California climates, uses less energy than conventional systems, and provides excellent indoor air quality. Sound appealing? Perhaps the time has come to give thermal displacement ventilation a closer look. Simon Turner of Healthy Buildings International, an environmental consulting and engineering firm that designs innovative ventilation systems, thinks so.

How does thermal displacement ventilation work?

A conventional HVAC system pushes cold air at high velocity into a space. The supply air mixes with the room air to provide the desired space temperature. Thermal displacement ventilation works differently. Instead of pushing cold air, Turner explains, imagine pouring slightly cooled air into the space at a relatively low velocity, either through a raised floor system or via wall diffusers near floor level.

This cool air flows along the floor, and when it meets heat sources like people and office equipment, it is carried upward in thermal plumes. As this conditioned air moves slowly past people's bodies, it cools them. It also picks up contaminants in the air and carries the contaminants upward. The warm, stale air stratifies well above the heads of occupants, and is exhausted near the ceiling.

Benefits of thermal displacement ventilation

Benefits for building owners and occupants include significant energy savings and improved indoor air quality. "Too often we nickel and dime buildings to save energy through lighting retrofits and other measures," says Turner.

(continued on page 2)

Displacement Ventilation Resources

ASHRAE Publications

- *ASHRAE Standard 55–2004—Thermal Environmental Conditions for Human Occupancy*
- *System Performance Evaluation and Design Guidelines for Displacement Ventilation*, by Qingyan Chen and Leon Glicksman, ASHRAE, 2003.
- *Displacement Ventilation in Non-Industrial Premises*, ed. Håkon Skistad, REHVA, 2001 (available from ASHRAE).

Other Publications

- In 2005, Energy Design Resources plans to publish an in-depth *Design Brief* on displacement ventilation.

Classes

- San Diego Gas and Electric's Upcoming Class: Thermal Displacement Ventilation and Underfloor Air Distribution

  Instructor: Simon Turner
  Healthy Buildings International
  National University, San Diego,
  September 14, 2005

  This course provides architects and mechanical engineers with a compelling case for thermal displacement ventilation and underfloor air distribution technologies. ■

"There's some big low-hanging fruit that has been ignored in this country in the past. In fact, the energy savings for thermal displacement ventilation could be up to 30 percent of the HVAC energy costs," Turner says.

In the Cardiff-by-the-Sea branch library, the large duct at right provides supply air near floor level. Warm air is exhausted via the diffuser on the wall above the circulation desk.
Photo by Frank Domin. Courtesy of Manuel Oncina Architects, Inc.

"But there's some big low-hanging fruit that has been ignored in this country in the past. In fact, the energy savings for thermal displacement ventilation could be up to 30 percent of the HVAC energy costs," Turner says.

The ventilation efficiency of displacement ventilation is 15 percent greater than mixing systems, according to Turner, and as a result, displacement ventilation removes heat more efficiently. Moreover displacement ventilation can more frequently use 100 percent outside air when standard techniques such as an air economizer cycle are used. In addition, savings come from a lower velocity and volume of supply air. This translates into smaller duct work and a smaller fan system. Also, the supply air is typically delivered at 62°F to 67°F compared to 55°F for a conventional system.

Another major benefit of thermal displacement ventilation is improved indoor air quality. A conventional system mixes all the air — and indoor air contaminants — and distributes them throughout the space. With displacement ventilation, the rising air picks up pollutants and discharges them at a high level instead of circulating them in the breathing zone.

Ceiling heights must be at least nine feet, Turner says, to allow for stratification of the warm air. Another architectural consideration is the diffuser locations; they can be mounted in the floor as part of a raised floor system, on walls near the floor, or in columns, an option that is particularly effective for large open-plan spaces.

CARDIFF-BY-THE-SEA BRANCH LIBRARY

Although thermal displacement ventilation is still relatively new in California, a few projects have been completed and more are in the pipeline. At the Cardiff-by-the-Sea Branch of the San Diego County Library, which opened in 2003, a displacement ventilation system provides ventilation and cooling for the 6,242-square-foot space. The project participated in Savings By Design, a non-residential new construction energy efficiency program administered by California's four investor-owned utilities.

Mark Bender, PE, principal of E/C Engineering of San Diego, the project's mechanical engineer, notes that choosing a displacement ventilation system was a team decision, and that the owner, engineer and architect (Manuel Oncina Architects of La Jolla) were all on board. He also points out that

(continued on page 3)

"Nobody wants to be the first one to do it," Bender says. "Having a project to show people makes a difference."

About *e-News*

Don't miss future issues—to sign up for a free email subscription, please visit www.energydesignresources.com/enews.php. Send letters to the editor, suggestions on topics for future issues, or other comments to admin@energydesignresources.com.

e-News is published by Energy Design Resources (www.energydesignresources.com), an online resource center for information on energy efficiency design practices in California.

Savings By Design (www.savingsbydesign.com) offers design assistance and incentives to design teams and building owners in California to encourage high-performance nonresidential building design and construction.

Energy Design Resources and Savings By Design are funded by California utility customers and administered by Pacific Gas and Electric Company, San Diego Gas and Electric, Southern California Edison and Southern California Gas Company, under the auspices of the California Public Utilities Commission.

Energy Design Resources
Your Guide to Energy Efficient Design Practices

Savings By Design
Resources for Energy Efficient New Construction

"the Cardiff area is known for environmentalism, so we were looking at doing a project that was cutting-edge environmentally."

Cardiff-by-the-Sea's mild coastal climate "lent itself well to the DV system," says Bender, "especially when it's in the economizer mode. The system is designed around 65°F to 68°F supply air. If you look at the times during the year when the outdoor temperature in the Cardiff area is in that range, it's an incredible number of hours."

"This system takes care of all the cooling loads," Bender says. The library's 17.7-ton, variable-air-volume cooling unit has an enthalpy-integrated economizer, with ten large diffusers distributed throughout the space.

Bender notes that "the library has north-facing glass with reading areas and people close to the glass. So I decided to use baseboard radiant heating to supplement the displacement ventilation system. Due to the glass exposure, we put the radiant tubes below the windows so we were washing the windows with warm air to offset the cold glazing." The baseboard radiators are served by an 82 percent efficient hot-water boiler.

"There really weren't any significant barriers" to implementing the displacement ventilation system, Bender says. "The system we used was not much different than a conventional system. The biggest cost difference was the cost of the DV diffusers." Low-velocity distribution calls for relatively large diffusers, "so whereas you might have been able to use a $100 register to supply an area with a conventional mixing system, you may spend $600 on the register instead" for a displacement ventilation system. "Overall, I don't think it was a significant cost over a conventional system," Bender says. "It took some different engineering and different controls but we were able to do it using conventional HVAC components."

Bender kids that a lot of people, including engineers, still think displacement ventilation is a bit mysterious. He recommends that engineers pay careful attention to ASHRAE's publication, *System Performance Evaluation and Design Guidelines for Displacement Ventilation*, and consult thermal displacement ventilation manufacturers' literature. "Do your research on diffuser location and coverage," he recommends.

It's also critical to invest adequate design time in determining how you will supply the 65°F to 68°F supply air, which is significantly warmer than the 55°F supply temperature that standard HVAC systems are designed to provide. For the Cardiff library, Bender could not use an off-the-shelf package unit for the required supply temperature. "We had to use an engineered coil and condenser system," he says.

Displacement ventilation systems are still relatively new in California, and "Nobody wants to be the first one to do it," Bender says. "Having a project to show people makes a difference." ■

Events and Conferences

February 18, 2005
Facilities Management · Eugene, OR
University of Oregon Sustainability Leadership Academy

One-day seminar in the principles and practices of applying sustainable measures to built facilities.

http://center.uoregon.edu/course_desc.php?CourseKey=461679

February 28–March 3, 2005
C.A.S.H. 26th Annual Conference
Sacramento, CA
California's Coalition for Adequate School Housing

Includes roundtables and workshops on school design and construction, energy efficiency and green design.

www.cashnet.org

April 29–30, 2005
Parade of Green Building
Santa Barbara, CA

This fifth annual event includes a self-guided tour highlighting 15 environmentally sustainable buildings and gardens.

www.sustainabilityproject.org

February and March Training Schedule

Partial list of classes. For a complete list, visit each energy center's website.

Date	Course	Time	Location	Units
17 Feb	*Outdoor Lighting*	8AM–12:30PM	San Diego	4
17 Feb	*Design Strategies for High Performance Glass*	9AM–12PM	CTAC	3
18 Feb	*Title 24 Requirements for Certifying Site-Built Fenestration*	9AM–11AM	PEC	1.75
23 Feb	*Calculating Energy Savings*	9AM–4:30PM	PEC	6
23 Feb	*Lighting for the Electronic Office*	8:30AM–12:30PM	CTAC	4
24 Feb	*Restaurant and Foodservice Energy Strategies*	9AM–12PM	CTAC	
24 Feb	*Implementing Energy Efficiency Projects*	8:30AM–4PM	CTAC	
25 Feb	*Evaporative Cooling for Commercial & Industrial Facilities*	8:30AM–12PM	Hesperia	
2 Mar	*Premium Efficiency Motors and Adjustable Speed Drives*	8:30AM–4PM	CTAC	
2 Mar	*Fundamentals of Compressed Air*	9AM–4PM	Stockton	
2 Mar	*Lighting Fundamentals*	9AM–4:30PM	PEC	6
3 Mar	*Underfloor Air Systems*	9AM–4:30PM	PEC	6
3 Mar	*Fundamentals of Compressed Air*	9AM–4PM	San Ramon	
8 Mar	*Building Commissioning*	8:30AM–4PM	San Diego	6
9 Mar	*Advanced Lighting Technologies*	8:30AM–12:30PM	CTAC	4
16 Mar	*Lighting for Architecture and Interiors*	8:30AM–12:30PM	CTAC	4
16 Mar	*Prime Movers—Engines or Motors*	9AM–4PM	Bakersfield	
18 Mar	*Basic Heating, Ventilation & Air Conditioning (HVAC)*	8:30AM–12PM	CTAC	
18 Mar	*LEED NC Technical Review**	8:30AM–5PM	PEC	7.5
22 Mar	*Package Unit Heating, Ventilation & Air Conditioning (HVAC)*	8:30AM–4PM	CTAC	
22 Mar	*Cool Roofs*	9AM–12PM	ERC	3
24 Mar	*Compressed Air System Efficiency*	8:30AM–4PM	CTAC	
25 Mar	*Package Unit Heating, Ventilation & Air Conditioning (HVAC)*	8:30AM–12PM	Temecula	
29 Mar	*Prime Movers—Engines or Motors*	9AM–4PM	Salinas	
29 Mar	*How to Specify Environmentally Preferable Lighting Equipment*	1-4PM	PEC	2.5
30 Mar	*LEED NC Technical Review**	8:30AM–5PM	CTAC	7.5
30 Mar	*Prime Movers—Engines or Motors*	9AM–4PM	Stockton	
31 Mar	*Direct Digital Control Sequences for Demand Reduction and Energy Savings*	9AM-4:30PM	PEC	6
31 Mar	*How to Specify Environmentally Preferable Lighting Equipment*	1-4PM	San Jose	2.5

Training Locations

Location	Explanation	Phone	Website
Bakersfield	Hodel's	(415) 973-2277	**www.pge.com/pec**
CTAC	SCE's Customer Technology Application Center, Irwindale	(626) 812-7537	**www.sce.com/ctac**
ERC	Southern California Gas Company's Energy Resource Center, Downey	(562) 803-7500	**www.socalgas.com/business/resource_center/erc_seminar_info.shtml**
Hesperia		(626) 812-7537	**www.sce.com/ctac**
PEC	PG&E's Pacific Energy Center, San Francisco	(415) 973-2277	**www.pge.com/pec**
Salinas	Community Center Rodeo Fairgrounds	(800) 244-9912	**www.pge.com/pec**
San Diego		(858) 636-5726	**www.sdge.com/construction/ee_commercial_newconst_training.shtml**
San Jose	San Jose Chamber of Commerce	(415) 973-2277	**www.pge.com/pec**
San Ramon		(800) 244-9912	**www.pge.com/pec**
Stockton	PG&E's Energy Training Center	(800) 244- 9912	**www.pge.com/stocktonclasses**
Temecula		(626) 812-7537	**www.sce.com/ctac**

*** Register at: www.usgbc.org/events/events_training_calendar.asp**