FEATURES

US Hotel with Good IAQ Leaves You Breathing Easy

Barry Dimson, president of Barry H. Dimson, Inc., set out to build the "first environmentally smart hotel in the continental US." The result is the Sheraton Rittenhouse Square Hotel at 18th and Locust Streets in Philadelphia, Pennsylvania; the hotel takes up the first seven floors of a renovated 17-story building. Dimson's high standards and thoughtful approach to the indoor environment provide an example that the hotel and other industries would do well to emulate, our investigation found.

Dimson built the hotel with support from Lubert-Adler Real Estate Opportunity Fund (a respected real estate investment group) for customers who want to stay in lodging that has a healthy indoor environment. The hotel faces the historic and now-upscale square named for William Rittenhouse who built the first paper mill in the US in 1690.

Given the need for healthier indoor environments, your ***IEQS*** editor spent a night at the Sheraton Rittenhouse in July to see if the hotel really was different from the moldy-smelling, volatile-organic-compound (VOC)-clogged, or stuffy air we find far too frequently at hotels. To provide a more rigorous test of the hotel's user-friendliness, we also contacted someone who suffers from respiratory problems who has stayed at the Sheraton Rittenhouse twice (see story on page 6).

Upon entering the hotel, I immediately noticed that the air wasn't stuffy, even in the hallways. The bedding was all cotton as advertised, and there wasn't any vinyl wallpaper. The hotel also featured many other differences that showed that Dimson put considerable thought into ensuring that the Sheraton Rittenhouse abides by its environmentally friendly claims.

When we later contacted Dimson, he launched into a description of the renovations he made to the building that left us convinced of the sincerity and efficacy of his efforts. (We're not the only ones. Clean Air Council, one of Pennsylvania's oldest and largest member-supported environmental organizations, holds its functions at the Sheraton Rittenhouse. Clean Air Council advocates and works for government enforcement of the US Clean Air Act in the Middle Atlantic states.) The Sheraton Rittenhouse represents Dimson's commitment to construct only "green" buildings for the rest of his life. His firm, located in New York City, offers consultation services to design and renovate or erect green buildings economically. Dimson tells ***IEQS*** that he consults worldwide on commercial, school, and other institutional developments as well as for contractors developing subdivisions of 20 or more homes.

Dimson's background includes earning a bachelor's degree in civil engineering from Rensselaer Polytechnic Institute in Troy, New York, and an MBA from Harvard University in Cambridge, Massachusetts, before becoming a real estate developer for more than 20 years. About eight years ago, Dimson's son began to tell his father what he was learning in college about the environmental impact of buildings. As a result, the real estate developer began to hit the books, too. "I studied environmental education at New York University in New York City for one-and-a-half years, and the timing was right to start a new career. I'll be in the environmental consulting business for the rest of my life. I want to right some of the wrongs inadvertently done to the planet by the building industry. People inside and outside the industry think it's much more expensive to build green. Well, it's not, and I want to educate people about that."

The Sheraton Rittenhouse Square Hotel, which Dimson points to as an example of economical green construction, is in a building originally designed as an athletic club in 1926. The club went bankrupt during the Great Depression and afterward had a series of owners and different uses. Dimson's family bought the 17-story structure from the US government in 1977. They immediately abated its asbestos insulation and converted it to offices and apartments. When Dimson began to envision it as a green building, the high ceilings of the seven lower floors made them ideal for conversion from offices to a healthy hotel with 193 guestrooms. The hotel opened its doors last year. Though the name above

the door is Sheraton, Dimson's family still owns the building.

"It's probably easier to control the indoor air quality [IAQ] in a hotel than in any other kind of building because you buy everything from the building materials to the cleaning products and can keep out stuff that off-gasses VOCs," he says. "The other key element that affects hotel IAQ is the fresh air you bring into the building." In addition, the hotel forbids tobacco use and won't book rooms to guests who insist on smoking.

"I studied how they build green hotels in Denmark, Germany, Holland, Sweden, and Switzerland, adopted their standards, and added the concept of a fresh-air system that is separate from the HVAC system," Dimson says. "The renovations cost $20 million. It would've cost $19.2 million to build a standard hotel, so it only cost me another $800,000 to go green, and I made that back in the first year. During renovations, we monitored the subcontractors closely to ensure they used only the materials in our specifications. The worst thing that could've happened would've been to spend all that money and have someone sneak in something with VOCs either to save money or because he didn't know better. We used the lowest-gassing tape we could find on the wallboard and absolutely no vinyl, which gives off VOCs and can help promote mold growth. We used only water-based glues on the wallpaper, and the nontoxic paint was cheaper than regular paint. The only things that cost more were the organic linens, draperies, and bedspreads and having the separate fresh-air system. Normally, cotton is more heavily sprayed with pesticides than nearly any other crop. Does it stay in the cotton and off-gas later? Nobody really knows."

Fresh-Air System Is Unique

Every guestroom contains a booklet that explains the hotel's environmental materials and standards. Regarding the fresh-air system, it states, "We are the only hotel in the United States to provide filtered fresh air to each guestroom 24 hours a day." This system also serves the hotel meeting rooms, lobby, halls, ballroom, bar, and its two restaurants. It is separate from the water chiller that provides air conditioning and the boiler that supplies hot water heat to rooms via standard fan-coil units. The ventilation system provides a lot of fresh air — some 6,000 cubic feet (168 cubic meters) per hour to every guestroom every day. We further calculated that it provides 144,000 cubic feet (4,032 cubic meters) daily, or just over 1 million cubic feet (28,224 cubic meters) of fresh air per week *per room*. Here's how it works.

The fresh-air system draws air from the level of the ninth floor, avoiding a pitfall common to numerous urban buildings where outside air is pulled in at street level along with exhaust from vehicles. The Sheraton Rittenhouse air intake delivers outside air to a large, sound-insulated chamber where the air passes through a bank of filters that captures 30% of its particulate matter. The system then tempers the air to between 68°F-70°F (32°C-33°C) and dehumidifies it during warmer months. The system never adds humidity to safeguard against bacterial and mold growth.

"Next, a huge fan pulls the air through a 60% bag filter, which extracts particulate fibers as small as 5 microns. That means it even captures mold spores," Dimson says. "We pump the air through a duct shaft to horizontal ductwork on each floor. Baffles in the ducts ensure that every room gets 100 cubic feet [2.8 cubic meters] per minute of cubic air, 24 hours a day, 7 days a week whether or not a room is occupied. This supply air pushes against a full-room envelope of air and drives it through the return grill in the guest bathrooms. Each bathroom's grill is sized to return 100 cubic feet per minute [cfm]. We exhaust the return air from the building at the seventh floor, away from the air intake. We don't recycle or mix in any hotel indoor air because we want to get rid of it. Occupants in buildings give off airborne bacteria that are smaller than 5 microns, and we want to exhaust those bacteria from the building.

"We recycle our 30% filters every two to four weeks and the 60% filters twice a year. Even when it's as much as 90°F [42°C] outside, guests usually don't turn on their air conditioners because we've already tempered the air. We thought our electric bill would go up after we converted the offices to 193 hotel rooms. Instead, we pay 30% less in electricity because of the reduction in air conditioning. So, it's much more energy efficient to temper the

air centrally than it is to have individual fan-coil units do it," Dimson tells ***IEQS***.

Regarding the 60% filters, Dimson essentially is correct that they would filter out particulates as small as 5 microns, which includes mold spores. Mold spores can break, however, which means small amounts of their toxigenic particles could still invade guestrooms. On the other hand, the large air turnover in rooms combined with the filtering out of most spores and the hotel's other environmental precautions appear to make it fairly probable that mold levels inside Sheraton Rittenhouse guestrooms are lower than those outdoors. The hotel helps ensure this by inspecting guestroom fan-coil units weekly for leaks that might trigger mold growth. Asked why he didn't install 85% filters (as the developer did at the HBO building in New York City), Dimson tells ***IEQS***, "We looked into installing HEPA filters, but we couldn't have pulled the air through without a fan that created tremendous noise that would've been unacceptable for hotel guests."

Asked if the ducts are lined, Dimson replies, "No. They're wrapped around the outside with silver foil to prevent condensation. We didn't wrap them in fiberglass, which I'm convinced is a bad material to use in ductwork."

HVAC ducts are notoriously leaky due to design flaws; to the numerous turns ducts must make up, down, and sideways; and to poor installation. In fairness, many poor installations are partly caused by a contractor's need to wrestle in cramped, poorly lit spaces with rigid, cheap metal that arrives in 4-foot to 6-foot sections. We asked Dimson how he minimized leakage in his retrofitted ductwork.

"There is always a certain amount of leakage no matter how good the tin knocker is. In our hotel, we probably have 10%-15% duct leakage. But our ductwork is wrapped on the outside, which reduces the leakage problem. With sloppy contractors on older jobs, the ducts are leaking 20%, even 25%. Today's ducts are better, but they still have leakage," he says.

Ducts also tend to build up dirt and debris inside, sometimes in as little time as six months. This can provide a ready substrate for mold and bacterial growth. How will the hotel keep its ducts clean?

"The constant stream of 100 cfm of fresh air should push the tiny particles out," Dimson says. "I'd be surprised if we have to clean or replace those ducts within 10 years, but we can use a technology to check them. It involves a little tractor that looks like a toy, and we'd put it on a track in the duct. The tractor has a camera that lets you see everything inside, and if dirt starts building up, we would clean it."

Dimson is also proud of the hotel lobby's seven-story atrium, with its grove of 40-foot bamboo trees. According to the booklet that describes the hotel's environmental amenities, bamboo "oxygenates the air 35% faster than any other plant or tree." Asked whether the trees can live up to that reputation inside, Dimson tells ***IEQS*** he installed special lighting that shines 10 hours daily to ensure it. Both the bamboo paneling in the lobby and the paint in public areas and guestrooms have "negligible" VOCs, he adds. Another environmental touch: 93% of the granite in the floor and waterfall tiles is recycled.

Asked how they stifle mold growth at the 30-foot waterfall, Dimson answers that the hotel maintains a relative humidity under 60%. "We also treat the water with chlorine, recycle it, clean it during the day, and replace it with fresh water each morning. We do that because I think closed-loop waterfalls pose health hazards."

(Editor's note: I neither saw nor smelled mold at the waterfall or anywhere else during my overnight stay at the hotel. Given the other precautions the hotel takes, a mold problem seems unlikely, barring an undetected water leak.)

Touring the Sheraton Rittenhouse

If you schedule it in advance through the hotel sales department, you can tour the hotel with a staff member who points out and describes the hotel's environmental features. (Note: The tour doesn't include a look at the hotel's ventilation system — an unfortunate omission.) During our tour, the guide tells me that manufacturers made the upholstered furniture from recycled "natural fibers." The environmental booklet notes that the carpeting is

recycled and "meets or exceeds all applicable industry and EPA [US Environmental Protection Agency] standards." (Upon examining the carpeting, I guessed it was nylon or a nylon blend. Dimson later confirms it is 100% nylon.) The booklet states that the padding under the carpet is made from recycled synthetic fibers and is "chemically inert, hypoallergenic, and resists mildew, odors, and off-gassing." The tour guide adds that the hotel's wallpaper is made from recycled newspapers. You can't visually tell that the wallpaper once featured articles about US presidential primaries, global warming, or the latest *Dilbert* installment, but it does feel a bit like newsprint.

The booklet continues, "Sleep easily knowing that your bed is an 'organic sleep system' comprised of 100% organic cotton and 100% pure wool for fire retardation." In fact, all the bedding, window treatments, and furniture upholstery are 100% organic cotton and emit no VOCs. The night tables are recycled shipping pallets. A manufacturer used a "catalyzed lacquer process that eliminates off-gassing of toxic chemicals" on the wooden parts of the other furniture.

Dimson explains more. "Each mattress has a top layer of organically grown wool, which means we didn't have to use a fire-retardant chemical on the mattress. Everything else is organic cotton that we got from Sally Fox, a businesswoman who studied the history of cotton and learned it naturally grows in green, beige, and brown colors. It contains no dyes, and it holds up very well. We launder it ourselves using an ozone process in cold water. The cold water saves 30% on our energy bill, which we've been able to document. Also, by washing everything ourselves, we needn't worry about some laundry service returning bedding and curtains that aren't organic anymore."

The toiletries in guestrooms are labeled "Natural Beginnings," which is a hotel-product line manufactured by the Hewitt Soap Company of Dayton, Ohio. A Natural Beginnings box describes its contents as "100% vegetable-based soap" made in a kettle from coconut and palm oils. The soap has no animal byproducts and is "lightly scented" with natural ingredients that include geranium oils, "enriched precious sandalwood," and a hint of ylang-ylang (a tree from the custard-apple family that is native to the Malay and Philippine islands). Likewise, the related items — Juniper Gentle Shampoo, Apricot Conditioner, and Green Apple Moisturizer — proclaim themselves au naturel, with no detergents, dyes, formaldehyde, phosphates, or wax. All are in recyclable plastic bottles. The bottle caps have no recycling symbol, which truly would have put Natural Beginnings ahead of the pack. A Hewitt spokesperson tells ***IEQS*** that Natural Beginnings' Spearmint Refreshing Mouthwash, which lists no ingredients, "is as natural as you can get and still be mouthwash." Hewitt imports the 100% bleached-white cotton shoe mitts from China. It is highly unlikely the mitts are organic, but we see this as trifling for all but persons who suffer from severe chemical sensitivity. No other US hotel we know of can match what Dimson has achieved and maintains at the Sheraton Rittenhouse in terms of nontoxic materials and indoor environmental quality.

In fact, Joseph Ruiz, general manager of the Sheraton Rittenhouse, tells ***IEQS*** that several guests with respiratory and other chronic conditions have remarked about how staying at the hotel didn't aggravate their ailments. "I have a guest who stays here 10 to 15 weeks a year for 3 to 4 days at a time who suffers from chemical sensitivities," Ruiz says. "We use nonphosphorus cleaning materials. I have no allergies or respiratory troubles, per se, but I'm healthier since I've been here and my staff says they are, too. We get sick less. I had a salesperson with allergies who worked here, left us, and is having allergy troubles at her new workplace."

Operating Expenses — Higher or Lower?

What about the operating cost of running a green hotel? Dimson says, "We project that our mattresses, which cost us $500 apiece [the same as standard hotel-industry mattresses], will last 15 years — double the industry norm. The carpeting should last twice as long, too. The nontoxic metal polish costs the same as the toxic stuff. The wallpaper will have a shorter life, but it's a safer material, and now there are more durable materials that breathe that we can assess when we need to replace what we have. We have to mop the lobby floor more often because we wouldn't use a toxic seal on it. We also pay more for maid service. Overall, my management service tells me, our costs are a bit higher — about $1 more per room than the normal

monthly cost at a four-star hotel — but our energy savings alone recoup that for us."

We asked Dimson the $800,000 question: How did he make back the extra development costs in the first year of operation? He replies, "Through a higher occupancy rate than expected for a hotel just breaking into the market. Normally, it takes three years of operation before a hotel makes money, and it loses a lot of money in its first year offering promotional room rates to build up clientele. Because of the fanfare and media exposure about our environmental building, however, our room income exceeded our original budget estimate by $800,000. Now, in our second year, we're already averaging or exceeding the income our peer group of established hotels averages."

We also asked if there are any other financial advantages beyond energy savings of having the only green hotel in town. Dimson notes that Philadelphia has five Sheraton hotels. "At the Sheraton Rittenhouse, we get 60% of our reservations through the national reservation system. Normally, a hotel gets 40% of its business that way. My management team is amazed because they've never seen a reservation percentage as high as ours, and the sole difference between our Sheraton and the others is that ours advertises that we're green."

Dimson says one of the best things about his hotel is its lack of chemical odors. He recalls one visit he made shortly after he opened the hotel, though, when he smelled lemon-scented furniture polish in his guestroom. "I went berserk," he admits. He learned that a maid bought the polish because she believed it made rooms smell "clean." This incident has two happy endings and also prompted a new program. First, the maid agreed to stop using the polish, which contains VOCs. Second, Dimson says, "Our fresh-air turnover cleared the odor from the room in two hours." Third, the hotel implemented an ongoing program that reemphasizes to hotel domestic staff that they must only use cleaning materials the hotel provides.

One final point. We asked Andrew Altman, deputy director of Clean Air Council, why his organization uses the Sheraton for its functions. Altman tells ***IEQS***, "We met with the hotel's officials, toured the hotel, and were impressed. Afterward, our indoor air expert gave what they'd done a thumbs up. By supporting the environmentally smart philosophy and business practices of the Sheraton Rittenhouse Square, we're putting our money where our mouth is, and we hope that will encourage other businesses to adopt such practices that help the environment and protect people's health."

The following two articles offer related information about the person-friendly indoor environmental quality at the Sheraton Rittenhouse and how to contact the companies that provided its nontoxic furnishings, paint, wallpaper, and other products.

For more information, contact Barry Dimson, President, Barry H. Dimson, Inc., 23 Leonard Street, 4th floor, New York City, NY 10013. Tel: (212) 334-7762; Fax: (212) 334-3508; E-mail: barrydimson@aol.com.

Guest Describes Impact of Sheraton Rittenhouse IEQ Versus Other Hotels' IEQ on Her Asthma

As noted in the previous article, I found the indoor environmental quality (IEQ) at the Sheraton Rittenhouse Square Hotel in Philadelphia, Pennsylvania, comfortable and with fresher-smelling indoor air than at any other hotel in recent memory. We were curious, however, to see if someone with a history of respiratory problems would fare as well. We asked long-time asthma sufferer Sylvia Rodman about her recent stays at the Sheraton Rittenhouse.

Rodman, a retired teacher who is over 70, has had asthma since childhood. According to her doctor, Rodman's asthma is "moderately severe," and it has caused considerable lung damage, which involves fibrosis with an accompanying loss of lung elasticity. Despite this, Rodman travels several times a year to visit family or attend bridge tournaments. (She's one major tournament win away from becoming a Life Master, we know from reading the *New York Times*.) How does a typical hotel affect her health, we asked?

"My asthma tends to worsen in hotels," Rodman tells ***IEQS***. "I'm particularly affected by dog, cat, and tobacco allergens. In hotels, I always wake up wheezing or with difficulty breathing about three to four hours after going to bed. I have to use my inhaler, or, if it's really bad, a small breathing machine I take along. In the morning, I usually must use my inhaler for at least an hour to clear my breathing passages. Mornings are hard." She recalled a two-day stay at a bed-and-breakfast lodge where exposure to another guest's dogs landed her in the hospital with a severe asthma attack.

Rodman stayed at the Sheraton Rittenhouse Square Hotel twice this year, for two nights each stay. The results?

"I slept through the night each time, which is most unusual," she says. "I don't even usually sleep through the night at home, and I have the best electronic filter available," which is installed on her home HVAC system. Rodman says that, while she still had to use her inhaler after awakening at the Sheraton Rittenhouse, "it wasn't much, and I was ready to go in a lot less than an hour." She adds, "I also can walk the halls there without feeling uncomfortable, which again is unusual and is really wonderful. I'm staying there again soon, and I recommend it to anyone I know who might visit Philadelphia. I wish other US hotels would do what the Sheraton Rittenhouse has, but I know it would be expensive for them."

A total conversion might strain the budgets of many hotels, especially those in buildings that lack the needed space for a fresh-air system similar to the one at the Sheraton Rittenhouse. But why couldn't most at least afford to replace toxic building and other materials with environmentally friendly alternatives? We asked Barry Dimson, who renovated the Sheraton Rittenhouse building and whose expertise in real estate development and the hotel industry position him to know.

"Any hotel could convert a block of rooms with the organic materials I used," he tells ***IEQS***. "They could do it in 5 rooms, 50 rooms, or all the rooms in a 500-room hotel. The furniture part you could do anywhere, anytime to get rid of the chemicals. To do a fresh-air system on a partial basis, you could do it, say, on the top two floors of a hotel, but that depends on the structure. It depends on whether you can get ducts into the rooms, which could mean having to drill down from the top to install it, but in most cases, you could," Dimson concludes.

Hotel owners who follow the Sheraton Rittenhouse's lead could achieve two desirable benefits. First, they would begin to rid their industry of the generally substandard indoor air quality that troubles many hotels. Second, for the one-time capital expense, they would probably gain legions of loyal customers who happily return and eagerly recommend these hotels to friends and acquaintances, like Rodman.

Vendors That Supply Green Products, Services to Sheraton Rittenhouse

You can contact the following vendors to learn more about the organic and environmentally friendly furnishings, building materials, or other products and services they provide to the Sheraton Rittenhouse Square Hotel in Philadelphia, Pennsylvania:

Beds, bed covers, and upholstered furniture: Furnature, Inc., 319 Washington Street, Brighton, MA 02135-3395. Tel: (877) 877-8020 (toll free in US) or (617) 783-4343 (outside US); Web site: www.furnature.com.

Sheets and pillowcases: Natural Cotton Colours, Inc., P.O. Box 66, Wickenburg, AZ 85358. Tel/Fax: (520) 684-7199; Web site: www.foxfibre.com.

Night tables: Safe Solutions, LLC, 21638 Hwy 160 West, Durango, CO 81303. Tel: (970) 247-3333.

Other wooden furniture: Fleetwood Fine Furniture, represented by John Taylor & Associates, 131 Stedman Street, Chelmsford, MA 01824. Tel: (978) 459-5544; Web site: www.fleetwoodfinefurniture.com.

Paint: EcoSpec/Pristine Paint, Benjamin Moore & Company, 51 Chestnut Ridge Road, Montvale, NJ 07645. Tel: (201) 573-9600.

Wallpaper: Brewster Wallcovering, 67 Pacella Park Drive, Randolph, MA 02368. Tel: (800) 366-1700 (toll free in US) or (781) 963-4800 (outside US).

Bamboo wall panels: Mintec Corporation, 100 East Pennsylvania Avenue, Towson, MD 21286. Tel: (888) 964-6832 (toll free in US) or (410) 296-6688 (outside US).

Window treatments: Fabtex, Inc., 111 Woodbine Lane, Danville, PA 17821. Tel: (800) 778-2791 (in US and Canada) or (570) 275-7500; Web site: www.fabtex.com.

Room carpeting: Mannington Commercial, 200 Lexington Avenue, New York, NY 10016. Tel: (800) 241-2262 (in US and Canada) or (212) 251-0290; Web site: www.mannington.com.

Hallway carpeting: Shaw Contract Group, 900 South Harris Street, 072-42, P.O. Drawer 2128, Dalton, GA 30722-2128. Tel: (706) 278-3812. (Commercial contact: Steve Bradfield.)

Carpet padding: Norman D. Lifton Co., 315 East 3rd Street, Mount Vernon, NY 10553. Tel: (800) 431-1808 (toll free in US) or (914) 667-7400 (outside US).

Cleaning products: Envirosafe Cleaning Products, P.O. Box 620356, Woodside, CA 94062. Tel: (650) 369-3711.

Hotel industry Natural Beginnings personal care products: The Hewitt Soap Company, Inc., 333 Linden Avenue, Dayton, OH 45403. Tel: (800) 543-2245 (US and Canada) or (937) 253-1151. Web site: www.hewittsoap.com.

Environmental interior design: Floss Barber, Inc., Architects Building Penthouse, 117 South 17th Street, Philadelphia, PA 19103. Tel: (215) 557-0700; Web site: www.flossbarber.com.

PRACTICAL RESEARCH BRIEFS

CEN Used Results from European Studies to Set Realistic Target Value for Low-Polluting Buildings

Four research studies of more than 80 schools, kindergartens, and office buildings in nine countries produced data that CEN (European Committee for Standardization) used to establish requirements for low-polluting buildings in terms of maximum indoor emissions from materials. Pawel Wargocki and P. Ole Fanger were involved in the studies, and they discuss their findings in *European Data for Building Related Pollution Load and Building-Related Required Ventilation.*

Wargocki and Fanger write that in three of the studies, researchers visited buildings when the occupants were absent during a weekend with the mechanical ventilation system operating normally. A panel of 54 people judged the quality of room air immediately after entering the office buildings, following the procedure specified by the American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE) Standard 62.1 *Ventilation for Acceptable Indoor Air Quality*, Appendix C. Meanwhile, a panel of 13-15 trained judges rated perceived air quality immediately after entering classrooms at several schools and spaces in kindergartens using procedures specified by Bluyssen et al. (1989). Researchers used tracer gas to measure outdoor ventilation rates in these spaces. Based on these measurements, the researchers calculated the sensory pollution load from the building including the HVAC system as "the equivalent number of standard persons which would cause the same percentage acceptance of indoor air as the pollution caused by the actual unoccupied building." When they calculated pollution loads, they converted the judgments of trained panels to ratings by untrained panels using the transfer function established by Wargocki and Fanger (1999). Table 1 shows the pollution loads they determined.

The fourth study took place in 56 office buildings. A trained panel of 12-15 people visited each building once when occupants were there and measured the outdoor supply rate using tracer gas. They again converted the judgments by the trained panel to those of an untrained panel using the same