
Fall 1996

Special Industry Report

Sick Building Syndrome

*"An indispensable reference for any professional involved in the
controversial debate over sick building syndrome"*



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Special Industry Report

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July 1996**Florida County Awarded \$11.5M In Third Sick Building Jury Verdict**

Martin County in southeast Florida was awarded an \$11.5 million verdict in the third sick building case to go to trial in the United States. The county filed suit in October 1992 against those it believed to be responsible for the design and construction of the courthouse and constitutional office building, as well as the construction manager's performance bond sureties.

The verdict, which was reached after 26 days of trial and a four-hour deliberation, was against all defendants named in the suit: Centex-Rooney Construction Co., the construction manager of the project, and its sureties, St. Paul Fire & Marine Insurance Co., Seaboard Surety Co., and The American Insurance Co.

The county originally named the project architect, mechanical engineer, structural contractor and mechanical contractor in the suit but settled those claims before the trial commenced.

"We are very pleased with the jury's verdict and feel that it should send a message about acceptable construction and design standards," said Leslie O'Neal, a partner with Holland & Knight, the law firm which represented the county. "The severity of problems in the Martin County Courthouse and Constitutional Office Building caused not just physical plant problems but county employee health problems that had to be addressed.

The suit stemmed from a series of continual problems leading to the eventual abandonment of the buildings, which were com-

pleted in December 1988. What started as minor problems with the air conditioning and leaks through the walls and windows when the building was first inhabited developed into more severe issues.

Over the next four-year period, the county consulted with the project's construction manager, designers and mechanical engineers, but the recommended actions to correct the situation were ineffective.

In addition, employees began reporting sinus and respiratory problems, skin rashes, and other symptoms as the buildings experienced mold growth on the walls and ceilings.

In early 1992, the county ordered a series of tests conducted by microbiologist Phil Morey who found two types of unusual mold — *stachybotrus atra* and *aspergillus versicolor* — both known to be potentially toxic and presented health problems in humans.

Further group testing by Michael Hodgson, an occupational medicine and public health specialist, found the building occupants had substantially higher levels of symptoms than the unexposed control group.

In December 1992, following those and other findings which supported the likelihood of building related illnesses, the inhabitants of the buildings were moved to temporary office space. Extensive renovations started immediately after the evacuations. The county anticipates reoccupying the buildings this month. ■

July 1996**Many SBS Illnesses In Adults Discovered To Involve *Stachybotrus*****Expert: Toxicity, Not Allergic Problems Are Key**

Stachybotrus, a black mold which grows in damp areas of buildings and homes in the presence of cellulose fibers, is increasingly being identified as a problem in the investigation of sick building syndrome (SBS) nationwide. *Stachybotrus* received a great deal of attention earlier this year when several infants in Cleveland were diagnosed with a severe lung disease believed to be caused by *stachybotrus* mold. Several infants died as a result of contracting lung disease which many doctors and experts at the Centers for Disease Control and Prevention (CDC) in Atlanta was directly related to inhalation of *stachybotrus*.

Now, *stachybotrus* is being examined as a potential suspect in reported cases of SBS where adult workers in buildings have become ill and are unable to return to the work environment.

Toxic Effects Observed

Dr. Eckardt Johanning, medical director of the Eastern New York Occupational Health Program in Latham, N.Y., and one of the foremost authorities on *stachybotrus*, told *Indoor Environment Review* that "a recent study I was involved in on adults in buildings where *stachybotrus* is found detected an increased prevalence of eye, skin, respiratory organ problems and neurological impairments. We found a relationship between neurological toxicity problems and the presence of toxigenic fungal materials, particularly *stachybotrus*.

"We now believe that the problems associated with *stachybotrus* are mainly associated with toxicity problems and not purely allergic reactions....While *stachybotrus* is not typically common, we are finding it more and more. I believe that this is because many experts are now aware of the potential for *stachybotrus* to be a problem in many buildings where damp, moist conditions are found and are better able to identify it during building investigations."

Chin Yang, president of P&K Microbiology in Cherry Hills, N.J.,

said that, "When *stachybotrus* grows, it is often found with a variety of other types of molds. So what the experts at CDC are looking at is that *stachybotrus* may be just one of several molds which is responsible for a variety of illnesses. Environmental investigators are looking at what other types of mold or fungi are found in the same environment in addition to *stachybotrus*. All I can say is that from my own experience is that *stachybotrus* is almost always accompanied by other molds and bacteria."

Prime Suspect?

Asked if *stachybotrus* is a prime suspect in many SBS cases, Yang said that "our company is biased in terms of what it observes, because when we go out to a job, it is in a building that already has problems. So we see *stachybotrus* present in many sites that we visit. This is true because many of the buildings that we visit are known to have many of the chronic conditions that allow *stachybotrus* to grow, especially those with chronic water problems. And *stachybotrus* is known to grow readily in a damp environment where cellulose materials is also present, many of the conditions that cause a building owners or manager to call us out in the first place."

Yang told *Indoor Environment Review* that "actually, *stachybotrus* is quite common in the natural environment, which is outdoors. It is not a new find. What is new is that many experts are now able to identify it during building investigations and other medical experts are now examining the potential health problems it may generate."

Yang said he is familiar with a documented case reported in Chicago in the mid-1980s where the hazards from *stachybotrus* were traced to a wide variety of illnesses in adults. "There have been several cases," he said, "where people have gotten sick from moldy buildings and where *stachybotrus* was at least a contributing factor. But you have to remember, *stachybotrus* rarely is found in isolation. There are other molds and

fungi present which together may be responsible for causing adverse health effects. We just do not know for certain at this time whether stachybotrus is the only factor causing harm to adults and children, especially since it is not found in isolation."

Expert Knowledge

Both Johanning and Yang emphasize that extreme caution must be taken when cleaning and removing stachybotrus from where it is found. "You have to be very, very careful when cleaning stachybotrus from the environment it is found in," said Yang, "this particular toxin can easily become airborne, and can spread throughout a wide area, and then can also be easily be breathed in through the lungs. This is why you must know how to clean up stachybotrus correctly. Not knowing what you are doing can spread stachybotrus throughout an entire building or home."

Yang emphasized that "there are very few people, outside the indoor air specialists, who are able to identify and remove stachybotrus properly. And from the samples that our company receives, we have seen an increase in stachybotrus in many buildings. So it is important to educate people to recognize stachybotrus and train them how to deal with it properly. But with some of the recent press attention, more indoor environmental specialists are looking for stachybotrus and are becoming more familiar with procedures for handling and removing it. But more must be done.

"But people who discover that they have a chronic water problem either in their home or in their building should be aware that stachybotrus may develop. And the key is to deal with the water or moisture problem when it is first detected." ■

July 1996

NIOSH Study Links Environmental Quality To Health Conditions

A recent analysis of indoor environmental quality has determined there is a measurable association between exposure and health conditions. The National Institute for Occupational Safety and Health (NIOSH) study also showed a high prevalence of sick building symptoms among occupants.

The study reported on the multiple symptoms of a maximum of 75 employees in 80 office buildings.

The questionnaires the occupants were required to completed asked 18 questions about their symptoms, physician diagnosed illnesses, comfort parameters and workplace stress factors.

The groups required at least three symptoms that improve when the participant was away from the worksite:

- multiple atopic symptoms (MAS) - eye irritation, stuffy/runny nose, sneezing;
- multiple lower respiratory symptoms (MLRS) - shortness of breath, cough, wheezing, chest tightness; and
- sick building syndrome — headache, fatigue, sore or dry throat, stuffy/runny nose or nasal congestion, or irritated eyes.

The survey determined that the occupants must experience the symptoms at work or one to three days per week in the previous four weeks (frequently) or one to three days per week in the previous four weeks and the condition improves when the employee is away from work.

The individual symptoms that were experienced "frequently" and

improved away from the worksite included irritated eyes (30 percent), fatigue (25 percent), headache (25 percent), nervousness (23 percent), and stuffy nose (21 percent).

Results from the multiple symptoms groups studies indicated the symptoms that are experienced "frequently" and improve away from the worksite also were the MAS (8 percent) and MLRS (2 percent).

Relative risks for MLRS were debris inside the HVAC air intake, poor or no drainage from drain pans and the air ductwork had never been cleaned. Relative risks for MAS included the presence of suspended ceiling panels and failure to clean the air duct.

Among the relative risks of asthma being diagnosed after the occupant began working in the building were recent renovations including drywall, dirty particulate filters and debris inside the HVAC air intake.

The researchers also questioned the participants on their environmental comfort parameters and found that 50 percent experienced "too little air" more than one day per week in the previous four weeks. Others complained of it being "too hot" (35 percent), "too cold" (32 percent), "too dry" (35 percent), and another 15 percent complained of "tobacco smoke odors."

The researchers also concluded that the symptom rates were similar to other NIOSH studies and those conducted by other researchers.

The results will prove useful for comparison with buildings with known indoor environment problems. ■

April 1996

Building Air Quality Investigations: A Systematic Response Model

Phase One: Personal Interview

After a complaint, the first action is for on-site personnel to go to the space and visit the complainant. This is called a phase one response. On-site personnel will discuss the symptoms with the occupant and check for obvious causes. It is preferable to speak directly to the person who is experiencing discomfort, but, in some cases, due to corporate policy, personnel issues or security concerns, this will not be possible and we instead speak with the person's supervisor or, for a larger tenant, the office manager or person assigned to be landlord liaison.

The landlord representative will look for obvious signs of a general ventilation problem or source of contamination. While the landlord often has control over the HVAC system, the tenant often retains control of the temperature and fan operation. Tenants have been known to block diffuses intentionally or carelessly or load spaces beyond their ventilation capacity. Most of all, the tenant controls the activities within the leased premises which can cause contamination of the air. Therefore,

the rep may look for obstructions to the flow of air, printing or other machinery, gluing operations or other unusual processes within the premises. The nose is a sensitive chemical detector and should be used along with the other senses and common sense.

A basic test for ventilation is to feel for air movement in the room, or better yet, at the diffuser. Signs of water or previous water damage, or anything which has changed recently or around the time the complaints started can be a clue. The occupants may have thoughts about what has caused the problem; they have spent considerable time observing their surroundings.

Phase Two: Low Tech Action

The next stage of response consists of low tech actions within the means of building managers, engineers or HVAC contractors, for example, investigations into the cleaning procedures for carpets and floors, type of filtration (see discussion under section above), condensate

pans, coils, air intake location, temperature and humidity in the space and a review of many of the relevant items found in the preventive maintenance discussion above.

A simple technique for confirming the presence of outdoor air to an air conditioner is to insert a thermometer into the outside air duct and see if the temperature is representative of the outside temperature.

The goal of phases one and two is to identify a cause of the problem which can be corrected, or, in the absence of a proximate cause, to make some change in the operation of the building or its ventilation systems which will be sensed and noticed by the occupants. Air quality is a very subjective matter and most complaints do not result from measurable deficiencies. Changing a fan switch from the auto to the on position (which will cause it to run continuously even when there is no call for heating or cooling) will result in more continuous ventilation; cleaning the dust tracks from an air diffuser will eliminate an unpleasant visual experience. Air economizer systems can be installed in older systems which do not already have them; these allow the interior to receive a good flushing with outside air when weather permits and often have satisfactory paybacks on energy for systems larger than five or ten tons of air conditioning.

Phase Three: Consultant

When all else fails, call in a consultant. The responsible ones will go through steps similar to those described above before beginning to test the air. We have found air testing useful only under very limited circumstances:

- there is a clearly identifiable source, such as a spill of dry cleaner fluid and the premises must be "cleared" prior to re-occupancy;
- the use of CO₂ sampling for use as a surrogate for ventilation rate and to calm fears;
- in high risk situations, culturing cooling tower water for bacteria; and
- nothing is wrong, but a tenant is not satisfied without independent testing — in these circumstances, the tenant should at least participate in, if not foot, the entire cost.

April 1996

Federal DOT Building Finally Labeled 'Sick'

A panel of indoor air quality experts has declared the Department of Transportation (DOT) headquarters in Washington a "sick building."

The announcement comes after a four-month investigation of medical exams, microbial and chemical testing and the gathering of baseline information on the HVAC system. The only new element found in the latest round of tests was an elevated level of hydrocarbons, but officials cannot pinpoint the source of the hydrocarbons.

Source or no source, though, the building is now officially "sick."

"All the consultants agree that cleaning the building ventilation system and improving the ventilation system and general cleaning of the building are necessary as soon as possible," according to a DOT official.

DOT and the General Services Administration have contacted the building's landlord, David Nassif Associates of Boston, to begin the cleanup.

New Spaces

Contracts with architects and engineers should be explicit in calling out indoor air quality as one of the criteria; this puts the burden on the designers and keeps them on the hook in the event of an unfortunate claim. The design stage is the best time to review placement of fresh air intakes and exhaust, taking into account not only present use, but possible future uses of the building and adjacent areas. With more efficient lighting and less commonly, ice HVAC systems, it is possible to reduce supply air quantities to levels which will cool the space but will not provide sufficient air movement for comfort. Therefore, a minimum of 0.6 cubic feet per minute per square foot or air conditioning supply air should be used.

Air conditioning designers are fond of interior duct lining because of its sound attenuating properties. But the potential for the introduction of fibers into the air, the moisture which may be trapped in the lining and thereby encourage microbial growth and our experience that the glue and fasteners often fail, sending pieces of the lining downstream where they may enter the room or clog the duct.

It is best in new buildings or newly constructed tenant spaces to flush the premises with fresh air. If there is no time to do this, the HVAC system can be operated at night and with greater than normal amounts of fresh air for the first few weeks of occupancy.

The first line of "defense" against indoor air quality problems is the on-site property management team. Their efforts can be strengthened by their knowledge and comfort with the issues and causes of the problems. The personnel consist of a professional engineer (P.E.) with experience in mechanical systems and environmental issues, legal counsel with a specialization in environmental law and a vice-president with overall responsibility and authority to direct environmental compliance. The test equipment is available for use by the P.E., and, where appropriate, he will assist with the selection of consultants and contractors. The P.E. is also available to speak and visit directly with tenants for investigatory purposes, but also for general education.

Larry Schoen is the former mechanical engineering manager for The Rouse Co. He is currently president of Schoen Engineering in Columbia, Md. ■

DOT plans to relocate employees from portions of the building, but officials said total evacuation of all 5,500 occupants probably wouldn't be necessary.

The cleanup is scheduled to begin next month and last through the summer.

When contacted by *Indoor Air Review*, building manager Don Jenkins confirmed investigators hadn't found the source of worker's health complaints.

The building first began showing symptoms last October when 134 of the 200 employees on the eighth floor noticed a moldy smell in their Federal Railroad Administration offices. The employees were relocated to the ninth floor, but many complained that the symptoms, while diminished, were still present. ■

April 1996

Investigating Workpace Pollutants Must Include Search For Occupant, HVAC, Contaminant Sources

Whether a foul odor has permeated the sixth floor or microbials have contaminated the ductwork, it is critical the building manager follow a detailed process of investigation to ensure no clue is missed in the evaluation and mitigation of indoor pollutants. If one hazard escapes undetected or is improperly treated, it can recur and harm both the building and its occupants.

"The goal of the diagnostic building investigation is to identify and solve the environmental complaint in a way that prevents recurrence," according to the Environmental Protection Agency (EPA). "The investigation is a cycle of information-gathering, hypothesis formation and hypothesis testing."

The investigator, whether it is the building manager or an outside consultant, should first perform an initial walkthrough of the building that provides information about all four of the basic factors influencing indoor pollutants (occupants, HVAC system, pollutant pathways and contaminant sources).

For example, if the complaint concerns an odor from an easily identified source, the building manager may want to study pollutant pathways as a next step, rather than interviewing occupants about their patterns of discomfort.

A building manager who is already familiar with the layout and mechanical system in the building can begin identifying potential sources and pollutants in the HVAC system. Having a copy of mechanical and floor plans can be helpful at this stage, especially if they are reasonably current.

Looking For Obvious Problems

The manager can also ask facility staff to describe the operating schedule of equipment, and obvious problems like blocked diffusers and malfunctioning air handlers can be corrected to see if the complaints disappear.

An eye should be kept out for any odors, excessive dust or staining, as well as if sanitation problems like debris near the outdoor air intake, visible mold growth or major water damage could be introducing contaminants.

In addition, the building manager should check if there are any conditions or activities occurring in or near the building, for instance, construction, automobile exhaust from a loading dock, or a generally high pollen count or pollution count in the outside air, that could be related in timing, location and health effects to complaints.

A building manager investigating complaints should also be certain the thermostats, diffusers, fans, dampers and filters are operating, clean and in good condition.

If not, the building manager may want to pursue a series of questions to pinpoint the problem.

The questions should include:

- If operating procedures exist, has the staff been following them?
- Do records indicate the ventilation system was commissioned (set, tested and balanced) after construction?
- Do records indicate that system components are regularly inspected, calibrated and adjusted?

Symptom Patterns

Following symptom patterns can also aid the building manager in locating indoor pollutants.

If occupants are complaining of headache, lethargy, nausea, drowsiness or dizziness, and the onset was acute, sudden or severe, the pollutant may be carbon monoxide poisoning and the building

manager should arrange for medical evaluation.

Complaints of swelling, itching or irritation of eyes, nose or throat by occupants should prompt the building manager to suggest medical attention for allergies. Meanwhile, the building manager should check for dust or microbial contamination due to sanitation problems, water damage or a contaminated ventilation system. The manager should also check outdoor allergen levels and look closely for sources of irritating chemicals such as formaldehyde or those found in some solvents.

After gathering as much information on the potential causes of indoor pollutants, a building manager should develop one or more hypotheses that could explain the occupant complaints. The investigation can then be shaped to collect information that will either support or refute the hypothesis.

Collecting more information about the HVAC system may be necessary for the building manager to get an accurate fix on the problem and to support his hypothesis.

The building manager needs to make sure that the air distribution system is not introducing outdoor contaminants or transporting pollutants within the building.

An evaluation of the HVAC system may include limited measurements of temperature, humidity, air flow and carbon dioxide.

Engineering Study May Help

A detailed engineering study may be needed if the investigation discovers problems such as the following:

- airflows are low;
- HVAC controls are not working or are working according to inappropriate strategies; and
- building operators do not understand or are unfamiliar with the HVAC system.

If this is the case, the building manager should review documentation on the HVAC design, installation and operation to provide more information about the original design and later modifications.

If there is no documentation on the mechanical system design, much more onsite inspection will be required to understand the HVAC system. "The HVAC system may have been installed or modified without being commissioned, so that it may never have performed according to design," according to the EPA. "In such cases, good observations of airflow and pressure differentials are essential. In addition, load analyses may be required."

The manager can also seek additional information by interviewing the facility staff to identify conditions that may explain the complaints.

The discussion could reveal that the staff is not operating the building according to its design because they do not understand the design logic of the HVAC system, they have been asked to run the HVAC system at the lowest possible energy cost, they lack the proper manpower, or the HVAC system has not been modified to accommodate changes in the use of space or increases in the occupant population.

In addition to talking to staff, the building manager may have to perform an on-site investigation.

An on-site investigation involves checking the temperature and humidity to see whether the complaint area is in the comfort range. Building managers should check for indicators of inadequate ventilation. For instance, is ASHRAE Standard 62-89, Ventilation for

Acceptable Indoor Air Quality, being met. In addition, they should check that grilles, diffusers and fans serving the complaint are operating properly.

Sometimes, the HVAC system itself may be the source of contaminants. Building managers can check for corrosion, water damage or standing water, mold growth or excessive dust in ductwork and debris or damaged building materials in ceiling plenums.

In addition, if the mechanical room serves as a mixing plenum, the manager may want to check for stored solvents and deteriorated insulation.

What The Consultants Say

Building Environment Report contacted environmental consul-

ants across the country to ask how building managers can ensure that indoor pollutants will not return.

The majority conceded that building managers cannot totally prevent a recurrence, but they can greatly reduce risk simply by following a routine maintenance schedule and ensuring that all the equipment is working up to specifications.

As long as building managers stay on top of hazardous environmental conditions and potential indoor pollutant threats by using a preventative maintenance program, they can reduce risk of infiltration and contamination which can harm both the occupants and the facility. ■

April 1996

Workers' Perceptions May Be Core Element To SBS

A new study by Cornell University researchers has concluded that imagination, belief and job related stress, often neglected in sick building syndrome (SBS) investigations, may be important in determining if the source of illness in such cases is physical or psychological.

The study was undertaken to further investigate the relationship between atmospheric conditions, personal factors, occupational factors and self-reports of SBS symptoms in the workplace.

The researchers, Alan Hedge and William A. Erikson of Cornell's Department of Design and Environmental Analysis, said SBS is not solely an environmentally-induced disorder that arises as a consequence of exposure to air polluted by combustion gases, volatile organic compounds or dust and particulates, but it also reflects the outcome of the interaction between a person and his work environment.

A sample of 4,479 workers from 27 air conditioned office buildings, mostly occupied by private sector financial, insurance, sales and marketing companies completed a questionnaire on environmental conditions, sick building syndrome symptoms, job satisfaction, job stress and occupational and personal information while indoor air quality measures were taken. The indoor air quality met current ASHRAE Standard 62-89, Ventilation for Acceptable Indoor Air Quality, guidelines in all buildings.

The buildings surveyed were selected according to the type of organization, type of ventilation and office layout. Most of the buildings did not have known indoor air quality problems. Smoking was prohibited in six buildings, restricted to separately ventilated areas in five buildings and restricted to smoking areas without separate ventilation but with local air filtration devices in six buildings.

Main office spaces in all buildings were ventilated by either a variable air volume or constant air volume system with air recirculation. All buildings studied were located in the eastern United States. Each building was studied between January and June.

Explaining The Sensation

The results of the study show that 76 percent of workers in air conditioned buildings with acceptable indoor air quality, as defined by ASHRAE Standard 62-89, report at least one work-related SBS symptom per month.

Building occupants, however, often cannot accurately identify what is causing their sick building symptoms, the study con-

cluded. Symptoms like a headache, for example, can be caused by poor indoor air quality, inadequate lighting, job pressure, or noisy work conditions.

Hedge told *Indoor Air Review* that people use their beliefs and imagination to influence what they create or choose as a means to explain what they think is happening in their environment and inside their body.

"Once a building occupant believes that their air contains a colorless, odorless, yet noxious pollutant which causes eye irritation, they will focus on eye sensations for confirmation of exposure," Hedge said, adding that this may cause them to unconsciously create this information by rubbing their eyes more often and increasing irritation.

High job stress can also change a worker's perception of their mental, physical or environmental condition, by causing symptoms related to SBS including headache, nausea, dizziness and difficulty breathing.

In addition, significant associations between symptom reports and hours of computer use, level of job stress and amount of job dissatisfaction were found.

Workers who used their computers full-time reported more symptoms than infrequent users or non-users. According to the study, this is because environmental changes, such as the electrostatic field generated by a video display terminal screen, may attract more particulate contaminants into a worker's breathing zone, causing an increase of symptoms.

Hedge said that because an SBS investigation can cause SBS symptoms, a new method of research may be required to approach an investigation in such a way as to not alarm the occupants.

To better understand why stress, beliefs and imagination play a role in SBS symptoms, he believes studies that treat the whole building as a doctor would treat an individual patient need to be implemented so the approach to the symptoms is calm, orderly and calculated, not rash, haphazard and disorganized.

In addition, Hedge said a data base needs to be developed to provide appropriate background information of SBS complaints that may be expected in certain buildings to serve as a reference for treatment.

Controlled field studies, in which groups of people are subjected to a altered ventilation or cleaning and maintenance, and whose behavior is subsequently monitored to find a causal link between symptoms and environment, is also considered necessary information to better define future SBS investigations. ■

March 1996

Judge: Evidence Lacking In Sick Courthouse Suit

Workers' Claims Of Cover-Up Not Verified

Seven current or former workers at the Orange County Courthouse in Orlando, Fla., recently turned to a federal jury in hopes of proving they have become ill from working in the building, according to a report in the *Orlando Sentinel*. However, their efforts were denied by the judge before the case was able to reach the jury.

U.S. District Judge G. Kendall Sharp ruled against the plaintiffs after a motion for direct verdict by the defense. The case was dismissed on the basis that there was not enough evidence presented by the plaintiffs go to the jury.

The workers, who mostly suffer from respiratory troubles, contended the county privately acknowledged high levels of toxins and pursued a cover-up, especially when it hid a 1981 report warning of asbestos problems. There has also been testing done to classify the building as "sick" and the workers suffering from building related illness.

The workers, who alleged their civil rights were violated,

wanted more than \$4 million.

The plaintiffs were optimistic of winning because two times last year employees won workers' compensation claims based on similar accusations.

The employees suit was based on a civil rights claim covered under section 1983.

"What they [county officials] did is really an outrage," said Steven Mitchel, the lawyer for the plaintiffs. "This is a story of government out of control."

But according to the defense, section 1983 was not designed to be used for this type of case, especially in an employer and employee relationship because there are so many remedies out there such as workers' compensation.

Ron Webster, a lawyer who represented the county told *Indoor Air Review*, some of the plaintiffs were awarded worker's compensation but chose to follow through with a lawsuit as well.

"There are a lot of ways of getting redress other than a civil rights action," Webster said. ■

March 1996

On-Site Nurses May Be Right Prescription For Sick Buildings

In buildings where sick building syndrome (SBS) is suspected because employees have complained of coughs, sore throats, irritated eyes and headaches, the National Institute of Occupational Health and Safety (NIOSH) recommends, as an option, stationing a full-time occupational health nurse in the building to aid in determining the cause of the complaints.

The in-house nurse can help address employees' health concerns without interrupting the workplace. Workers feeling sick can visit the nurse, receive advice on their condition and find out if it is simply a virus or if it may be caused by on-site pollutants. When appropriate, the nurse would refer the worker to a physician who would visit the site once a week.

"One area where working with nurses has been of unbelievable help and value is in trying to evaluate indoor air problems, or SBS," said Suzanne Condon, director of the Massachusetts Department of Health's Bureau of Environmental Health Assessment (BEHA).

The bureau had a full-time nurse stationed at the Suffolk County Courthouse in Boston, where employees have complained of coughs, chest tightness, asthma, sore throats, headaches and other symptoms.

A NIOSH investigation linked the problems to waterproofing chemicals containing volatile organic compounds used in part of the building.

Scientists can measure airborne toxins, and epidemiologists can record people getting sick, but it takes someone who is part of the medical community to determine what is a real symptom. Condon said, adding that scientists and researchers don't have that expertise.

Information gathered by a nurse helped BEHA decide to close one of Boston's Registry of Motor Vehicles buildings.

In 1994, staff complained about problems such as skin rashes,

respiratory difficulties and eye, nose and throat irritations. In response, management encouraged sick-feeling employees to fill out health complaint forms and BEHA placed a full-time nurse at the site.

If BEHA had relied on the forms to assess the problems, the department would have underestimated them, Condon said.

Often workers would not fill out the forms because they did not want to be deemed "complainers." The nurse, however, spoke with staff and recognized that the skin rashes and other problems were far worse than reported. The source of the problem was mineral wool fibers from fire proofing material used in the building.

"Having a nurse on site made a tremendous difference," Condon said, but added that hiring a nurse is expensive, costing \$1,500 a week or \$60,000 for 10 months.

According to NIOSH, nurses can play a key role in helping companies and communities identify and solve occupational and environmental health problems.

However, to maximize this opportunity, workplace and environmental health issues should be more focused on nurse training.

Unless they pursue a master's degree focusing on occupational or environmental health, nurses are not well trained in these issues, said Moira Shannon, nursing consultant with the Department of Health and Human Services' Division of Nursing.

To help address the problem, the Division of Nursing spearheaded a multi-agency effort resulting in an Institute of Medicine report called "Nursing, Health and the Environment," Shannon told *Indoor Air Review*.

The report discusses environmental health as a core function of nursing, provides an overview of environmental health hazards and defines a nurses' scope of responsibilities. ■

2074050547

February 1996**New Insurance Policies Help Indemnify Building Owners From SBS Liability**

Because of increased indoor air pollution claims, building owners are seeking more extensive insurance coverage beyond comprehensive general liability (CGL) policies, which are intended to cover bodily injury and property damage faced by owners, to indemnify themselves.

"Building owners are not typically covered for sick building syndrome under CGL policies because there is usually an "absolute pollution exclusion" clause in the policy, which negates any such claim" said Scott Britt, managing underwriter for Environmental Compliance Services (ECS) in Exton, Pa. ECS is an underwriting manager for Reliance National's environmental accounts, and one of a few insurance companies, along with AIG and Zurich, willing to specifically underwrite sick building syndrome (SBS).

"In response to these claims, building owners are seeking more insurance protection," he said.

According to Britt, five years ago there was little interest from building owners to purchase any type of pollution insurance. But recently, 40 people to 50 people a month are having their building examined and underwritten specifically for pollution insurance by ECS.

Prior to 1985, building owners were usually covered for sick building syndrome under CGL policies, even though they contained pollution exclusion clauses.

But, in 1985, insurance companies added an absolute pollution exclusion attempting to shift liability of all indoor pollution claims to building owners.

An insurance industry expert told *Building Environment Report* insurance companies have been extremely reluctant to underwrite indoor air pollution problems such as SBS because "underwriters need to define the basis of what they are covering so the company will not be pulled into court on subjectivity."

When purchasing insurance, along with a CGL policy, building owners should purchase a straight pollution insurance policy, which effectively wraps around the CGL, filling in any ambiguities that could lead to liability.

"Buying a CGL policy in combination with a straight pollution insurance policy is the building owners best bet," Britt told *Building Environment Report*.

A pollution and remediation legal liability policy gives a combination of first and third party coverage, and covers both on-site pollution, such as a chemical spill in the basement of a building, and off-site pol-

lution, such as the tenants in the building who may be affected by the spill's fumes, Britt said.

Building owners without a separate straight pollution policy, however, may still be successful in transferring the financial risks associated with indoor air pollution to their insurers.

Irene C. Warshauer, a lawyer with Anderson, Kill, Olich & Oshinsky in New York, who specializes in obtaining insurance coverage for policyholders, said recent court decisions have substantially undermined reliance by insurance carriers on standard pollution exclusion clauses under CGL policies.

Warshauer contends the specific language in absolute pollution exclusions can be challenged.

"While it may seem obvious to most people that products such as carpets, paint and other substances used in a building and its units are not pollutants, insurance companies attempt to avoid their contractual obligations by arguing that the pollution exclusion bars coverage for SBS caused by such elements," she said.

Maryland's highest court, the Court of Appeals, in *Sullins vs. Allstate Insurance Co.*, rejected the exclusion argument, holding that an insurance company has a duty to defend and indemnify its policyholders in actions alleging injury from exposure to lead paint, even though the insurance policy contains one or more pollution exclusions.

Warshauer said the *Sullins* case exposed the insurance industry's intention to exclude only environmental pollution damage from coverage as evidenced by the use of the words "discharge," "dispersal," "release," "escape," "contaminant" and "pollutants."

The *Sullins* case also held that the terms "contaminants" and "pollutants," as contained in absolute pollution exclusion clauses are ambiguous when applied to product claims, she said.

Britt agrees that "in some cases depending on how the CGL policy is worded by certain carriers, courts are going to decide the insurance company is liable, but contends that the majority of courts still uphold the pollution exclusion."

Because some courts may uphold the "absolute pollution exclusion," locating and keeping pre-1985 policies is important, Warshauer said, adding that "owners may be able to look to old policies to provide coverage for sick building syndrome cases, so they should perform a diligent search for them while making sure that no policies are discarded in the course of document destruction." ■

February 1996**NIOSH Responds To Sole SBS Complaint In Kentucky Clinic**

When one of only four employees at the Leitchfield, Ky., clinic of Advanced Occupational Health Services Inc. (AOHS) feared sick building syndrome (SBS) because of dizziness, headaches, forgetfulness and a strange taste in his mouth, the National Institute for Occupational Safety and Health (NIOSH) in Cincinnati was called in to investigate.

NIOSH received the complaint last June and visited the Leitchfield office soon after to perform a health hazard evaluation.

The evaluation included measurements of carbon dioxide, temperature and relative humidity taken throughout the clinic's work day. In addition, general area air samples were collected using thermal desorption tubes and charcoal sorbent tubes to identify and quantitate any volatile organic compounds (VOCs) present.

Gregory A. Burr, the lead NIOSH investigator, discovered several problems in the clinic but no single cause for the employee's complaints of SBS.

High CO₂

The most obvious problem, the report stated, was the high level of carbon dioxide. The level measured June 15 gradually increased during the work day and generally exceeded 1,000 parts per million (ppm) throughout the facility, suggesting inadequate ventilation, Burr said. A level of 800 ppm should trigger an inspection of the HVAC system.

Even more surprising to the investigators was the higher than expected carbon dioxide concentrations at the beginning of the work day that averaged approximately 750 ppm. With the office empty overnight, combined with a low occupant density, concentrations would have been expected to register slightly above ambient concentrations of 300-350 ppm.

Burr said the concentrations measured in the office areas were remarkably high considering there are only four employees in a 3,000

square foot office space. This is significant because normally carbon dioxide levels are too low to get readings of this magnitude when there are less than seven employees per 1,000 sq. ft.

Burr also collected information on temperature and relative humidity because of their potential effect on occupants' perceptions of the indoor environment.

Several adjustments were made to the thermostat during the work day. The recorded indoor temperature levels fluctuated between 66 F and 78 F, a range of temperatures not within ASHRAE's summer comfort guideline of 73 F to 79 F. Relative humidity levels were from 38 percent to 50 percent, within the guideline.

The qualitative analysis of the thermal desorption air samples revealed the presence of a variety of chemicals, but only ethanol (ranging up to 2.2 ppm) and isopropanol (ranging up to 1.4 ppm) were present in quantifiable amounts (concentrations well below any applicable occupational exposure criteria).

In addition to making improvements to the HVAC system, investigators noted other problem areas.

The darkroom used for developing X-ray photographs lacked a ventilation exhaust system to reduce migration of chemical odors associated with the development process to the surrounding offices. Investigators also recommended keeping the door to the darkroom closed during X-ray development.

The exhaust from the two bathrooms adjacent to the nurses' station, currently venting into the space above the suspended ceiling, should be vented outside the building.

The amount of outside air provided by the HVAC system should be increased.

Although the clinic is reportedly in the process of making the necessary corrections, Pamela Hulsey, an AOHS administrator, refused to comment on the matter when contacted by *Indoor Air Review*. ■

February 1996

Proposed IAQ Rules Haven't Clarified SBS, BRI

The history of indoor air quality and related complaints coincides roughly with the institution of building energy conservation programs. As with any mandated program, there was a period of adjustment and confusion over the energy standards, which precipitated comfort complaints from building occupants. In many cases, building operators became overzealous in their desire to comply with the new standards, which exacerbated the indoor air quality issues. Complaints generally fell into two categories:

- those that represented a true health risk; Building-Related Illness (BRI), and
- those irritants that were perceived to be a risk, sick building syndrome (SBS).

These issues continued to generate interest through the 1980s, but it was not until the late 1980s and early 1990s that the indoor air quality issue generated serious attention. In 1994, the Occupational Safety and Health Administration (OSHA) introduced a performance based set of proposed regulations governing indoor air quality. The complete text of these regulations was published in the April 5, 1994, issue of the *Federal Register*, and public comments were solicited.

The comments received by OSHA exceeded 35,000; far more than any other single proposed regulation, and the debate extended well beyond the original projected period. These voluminous comments and protracted debate will likely result in modifications to these proposals, and perhaps a second round of public comment. It is generally accepted that some modified form of these proposed regulations will become law, but perhaps not until 1996 or 1997. This delay in implementation will allow building owners and managers to arm themselves with as much knowledge as possible in the next two years so these new laws can be integrated into work schedules, and more importantly, into operating budgets.

While the proposed OSHA regulation and the media attention around it has increased general awareness of the indoor air quality issues, it has not adequately clarified the SBS and BRI elements.

SBS Not A Health Risk

SBS is not a health risk, although it is widely perceived as such. The complaints cannot be clinically diagnosed or med-

ically verified, which adds to the frustration and discomfort. The fact that most people report feeling better after leaving the building only adds to the solution difficulty.

It is important to document the specific complaints so that a productive course of action can be taken. There are three general case complaint or symptom groups, and each relates to airborne pollutants in different ways.

The non-specific upper respiratory group includes congestion, coughing, sneezing, runny nose and general complaints associated with mucous membrane irritation. Additional symptoms may include eye irritation, headaches and general discomfort and lack of a feeling of well-being. This is the largest SBS category of complaints, and often one of the most difficult to solve.

Complaints of flu-like symptoms include nausea, chest tightness and pain, intestinal discomfort such as diarrhea, constipation and cramps, in addition to the upper respiratory symptoms.

People reporting flu-like symptoms often list dizziness, lethargy or weariness, and attention span deficit among their complaints. Some people in this category have what is known as multiple chemical sensitivity (MCS) and can react to cleaning products, personal hygiene products and fragrances, and environmental tobacco smoke.

Allergy-related symptoms are often difficult to differentiate from the upper respiratory complaints, since the two are so closely related. What tends to separate the two groups is that, in addition to the basic upper respiratory complaints, people in this group also report dizziness, lethargy or weariness, attention span deficit and skin rashes or itch. Where itchiness or rashes are noted, it is important to identify the source; is it a contact rash, or is it the result of an inhaled antigen?

Increasing Medical Claims

These questions and issues have caused the incidents of medical claims by employees to increase, along with medical treatment for a variety of allergic maladies including asthma. The National Center for Health Statistics (NCHS) has logged an increasing trend in the area of asthma incidence, morbidity and mortality on a national level. The current estimated cost for treating asthma is just over 1 percent of all health care costs.

The cumulative effects of the decreased ventilation rates on the SBS issue have been documented. The National Institute for Occupational Safety and Health (NIOSH) for example, concluded that 52 percent of all SBS-related complaints were the result of inadequate ventilation and dirty, contaminated air conditioning systems.

Dangerous Illnesses

BRI is the group that is truly dangerous to human health: Legionnaires' disease and Pontiac fever being the two most well-known. Of the two, Legionnaires' disease is the more serious, with fatality rates of about 15 percent. Fortunately, a Legionnaires' disease outbreak usually affects less than 5 percent of those exposed to it.

Pontiac fever has symptoms similar to flu and is not fatal, but nearly 95 percent of those exposed to it develop the disease, usually within two or three days. The Centers for Disease Control and Prevention (CDC) in Atlanta estimates that there are between 25,000 and 100,000 cases of legionellosis annually in the United States. One reason for the large range of values, is that in many cases of Pontiac fever, the patient either assumes that it is the flu, or it is misdiagnosed as the flu, and not reported.

Legionellosis is caused by the legionella pneumophila bacteria, of which there are 31 currently known species with 50 serogroups. Legionella is an ubiquitous marine organism present in nearly all water sources. Because low numbers of legionella can survive routine potable water treatment where insufficient chlorine is used, they can colonize in the system and be transmitted to homes and other structures.

There have been no documented cases from drinking water containing legionella. To contract legionellosis, the organism must become aerosolized and must be inhaled deeply into the lungs by a human host whose defenses are unable to stop the infection. The organism must also be virulent and in sufficient numbers to cause disease. Risk of infection is greater in older people and those who smoke, drink or are in an immunocompromised position.

The presence of legionella in water sources is not a guarantee of disease, since there have been cases of high bacteria counts with no incidents of disease. However, the studies have shown there is a reduction in the incidence of clinical Legionnaires' disease where there is a reduction of legionella in the environment. Most of the incidents associated with building system components such as cooling towers and evaporative condensers have shown high legionella counts.

Radon Poisoning

While not a disease per se, radon poisoning must fall into this category. It is necessary to understand what radon is and is not. Radon gas has recently been identified as a major indoor air quality problem primarily in the residential area, but can occur in commercial structures that are constructed with slab on grade design.

The United States Environmental Protection Agency (EPA) and the United States Public Health Agency announced that radon-induced lung cancer is one of today's most serious health hazards in areas where it can occur. The actual health risk resulting from radon is not from the gas itself, but from the decay products of gas, commonly referred to as radon progeny.

Like all radioactive elements, radon gas goes through a series of phase changes over time. Radon gas seeps into basements and turns into a series of charged atomic-sized decay progeny,

which easily attach to solid materials within the building, and to microscopic particles suspended within the air. It is these airborne particles that are inhaled into the lungs. Some of these particles radiate a large amount of alpha radiation over a relatively short period of time. If this rapid decay occurs in the lungs, damage to tissue and increased risk of lung cancer can result.

The greatest health danger is posed by the two radon decay products that release alpha energy (polonium 218 and 214). These small, atom-sized particles are low in penetrating power; they cannot penetrate the first layer of skin. However, if the radon decay products are inhaled, that same alpha energy can penetrate and damage the sensitive tissue inside the lungs. The tissue damage can eventually result in lung cancer. No other diseases or other health conditions have been directly related to radon at this time.

Radon is one of the most well documented indoor air contaminants. The relationship between exposure to radon and the occurrence of lung cancer has been clearly proven through long-term studies of underground miners. Many of the levels found in homes are similar to radon concentrations found in mines. The National Cancer Institute has estimated that 5,000 to 20,000 of the 130,000 annual lung cancer deaths in this country can be attributed to indoor radon. Recent research has also shown that lung cancer risks are increased for smokers exposed to radon. It is important to note that the health risk associated with radon is related to two factors:

- the concentration of radon gas and its decay products, and
- the length of time an individual is exposed.

Current research suggests that a significant risk of lung cancer only occurs when an individual is exposed to elevated levels of radon for an extended and sustained period of time, as might occur to a miner or house occupant (e.g. eight hours a day for a number of years). A short or periodic exposure to higher than normal radon levels probably has no significant effect on a person's health.

Radon can seep into a structure through cracks in concrete floors and walls, floor drains, sumps, and through cracks and pores in hollow masonry blocks. This is why radon is more of a residential issue than it is a commercial issue. The lowest level of many commercial buildings is dedicated to parking or mechanical equipment. These areas are required by code to be power exhausted, so the airborne radon gas is evacuated. Homes, on the other hand, usually do not have exhaust in sufficient quantities to evacuate the gas.

Direct measurement is presently the only way of determining whether high levels of radon exist. The EPA recommends that corrective action should be undertaken if the long-term average level of measured radon equals or exceeds 4 picoCuries per liter (pCi/l). This does not imply that 4 pCi/l is a safe level, however. The EPA guideline of 4 pCi/l represents a level established several years ago, primarily as a technical guideline based on the knowledge at that time. Generally, any exposure to an ionizing radiation source like radon is considered a health risk.

Radon levels can vary greatly over the course of a day, week, season or year. The radon levels depend on inside/outside temperature differential, outside climactic conditions, moisture levels of the soil, how the building is constructed, localized geographical features and the operation of mechanical equipment.

EPA recommends a two step process for determining if a radon problem exists and if corrective action is necessary:

- taking a short-term screening test, and

- if warranted, undertaking further long-term follow-up testing.

EPA and a number of state governments are currently involved in assessing the effectiveness of a variety of radon techniques. Corrective measures, often referred to as radon mitigation, usually fall into one of three categories: source control, dilution and filtration. No single approach offers an effective control strategy. In most cases a combination of methods are used to reduce radon levels to an acceptable level.

Source control involves preventing the radon gas from entering. Common sources such as cracks, drains and sumps can be sealed with caulking or special covers. Another approach involves "sub-slab suction" where air (and radon) is drawn from below basement floors and behind below grade walls before it gets into the house. Source control is the most preferred method and should be the first approach used.

Dilution involves the removal of both radon gas and radon progeny from the indoor air. Natural and fan-forced ventilation (sometimes incorporating heat recovery) are the most common dilution approaches used.

Mycobacterium Tuberculosis

One last issue which has surfaced for consideration under general indoor air quality related topics is mycobacterium tuberculosis (MTB). The reason that this topic is considered here is that MTB is an airborne pathogen, and the CDC has reported a marked increase in the outbreak of MTB16. These outbreaks are traceable to two sources; AIDS patients, and some immigrant communities. In the first instance, the immunodepressed patient has lost the resistance to fight off the disease, and becomes both a victim and a carrier. In the second instance, there is a cultural problem that is reducing the effectiveness of treatment. Some immigrants equate real and perceived body temperature as a sign of illness or general wellness, and strive for "normal temperature." The treatment for TB of necessity raises the body temperature in the patient receiving treatment, and causes perspiration. When this symptom occurs in the patient, they stop taking the medication, and the disease progresses.

Health care givers are at risk from contracting TB from patients in all settings, from waiting room to treatment. Certain

treatments, such as sputum induction and aerosol treatment induce coughing, which causes the patient to eject infectious droplet nuclei (IDN) into the general atmosphere, increasing the risk of nosocomial infection.

Other methods of disease transmission control that are being studied includes the use of ultraviolet light (UV) sources. There is controversy surrounding the use of UV, but not because it cannot kill the bacterium; it can and does. The issue is how long does MTB need to be exposed to UV, and where is the UV placed for maximum effectiveness. If the room is under negative pressure, the logical place is at the inlet to the exhaust duct, to prevent the infection from contaminating the ducting, and the HVAC equipment. Some argue that placing the UV source over or around the door into the isolation area will kill bacteria escaping during door opening, or in vapor droplets. The issue here is the time duration that the MTB is exposed to UV.

There are also new treatment isolation chambers being tested that recirculate the air within the chamber for the duration of the treatment. These chambers incorporate absolute filters and UV light sources. There is some discussion surrounding the use of these chambers in that the chamber would have to be placed into a room that is under negative pressure to avoid any transmission of IDNs when the door is opened, and the patient removed.

Fortunately, the incidence of BRI and related issues is small, and we have learned a great deal about the conditions where the disease can occur, and mitigation of the situation.

Indoor air pollution (IAP) is often difficult to differentiate from SBS symptoms. In many cases of IAP, the irritants are brought into the space by the occupants. Inadequate ventilation rates and circulation rates prevent dilution or removal of these irritants rapidly enough to prevent discomfort.

Wayne Hansen is director of engineering at NIAQ/Mintie Corp. in Los Angeles. He has been active in the consulting engineering business for more than 20 years, and specializes in indoor air quality assessments relative to energy conservation oriented activities. This presentation was made at Indoor Environment '95 in Baltimore. ■

February 1996

Transportation Building Illnesses Still A Mystery

OSHA Investigators Can't Pinpoint Cause

U.S. Department of Transportation (DOT) officials are at a loss to locate the source causing workers' health complaints at the Federal Railroad Administration (FRA) offices in Washington, despite more than two months of investigations.

Investigators are perplexed because the complaints remain isolated to specific portions of the building. Last October, 134 of the approximately 200 FRA employees located on the eighth floor documented their symptoms in a workplace indoor air quality survey. More than 90 percent of the respondents reported at least one symptom: headaches (51 percent), odor (41 percent), scratchy or dry throat (38 percent), eye irritation (32 percent), dizziness or drowsiness (28 percent) and skin tingling or itching (22 percent).

Employees working on the eighth floor first noticed a moldy smell in their offices early in October and started complaining of feeling sick. The symptoms began growing progressively worse.

Initial Investigation

In initial investigations, one possible explanation was a banging inside the ceiling plenum coinciding with the onset of symptoms the employees also reported. However, investigators from the Occupational Safety and Health Administration (OSHA) later attributed the banging to hydraulic hammering of unsecured ethylene glycol coolant lines in the ceiling plenum as a result of a misinstalled coolant solenoid valve, and ruled it out as a possible source of illness.

Another possible cause, carpeting soaked during a lavatory pipe leak in August of last year and subsequently dried out, was checked out by investigators without significant results.

Employees Relocated

When the odor and the occupants' complaints did not ease, the agency relocated any employee who was suffering symptoms to temporary office spaces. After relocation, however, many of the employees maintained that the odor and symptoms, while diminished, had "followed"

them to the ninth floor.

"We [DOT] initially relocated 50 people, who were from two distinct organizational units of FRA located on the eighth floor," said Melissa Spillenkothen, assistant secretary of transportation in charge of the investigation. "Because employees continued to report symptoms, we decided to move the two units out of the building."

After initial investigations failed, a special OSHA investigative team—the same team that discovered Legionnaire's disease in a Philadelphia hotel 20 years ago this July—traveled from Salt Lake City to study the problem.

The OSHA team concluded, after a week long investigation, there was no serious problem with the building, but they did identify an unrelated air circulation problem.

"I don't think any of the experts investigating this problem have categorized it as sick building syndrome," Spillenkothen told *Indoor Air Review*.

Improvements Made

DOT officials, with the cooperation of building manager, Don Jenkins, and building owner, David Nassif Associates, have taken the necessary steps to improve the function of the air handling unit and to respond to problems as soon as they occur, Spillenkothen said.

Transportation officials and building management jointly responded to OSHA's suggestions, repairing two air handlers pumping fresh air into the sealed building and raising the water temperature in the department's hot water system to kill traces of Legionella bacteria.

"We are aggressively pursuing the problem," Jenkins said.

"Our [DOT's] reaction to the OSHA report was that the problem was not alarming," Spillenkothen said, but adding that when the FRA em-

ployees returned to their old offices, their symptoms recurred.

"It remains a puzzle because this particular problem has been so isolated."

New Investigation Launched

During mid-December, DOT moved the employees in the affected areas completely out of the building to rented offices, while a new investigative team, in coordination with OSHA, performed a round of extensive air sampling throughout the building.

The investigative team—Ken Chase of Washington Occupational Health Associates and HVAC expert Vincent Lee-Thorp of Summer Consultants—recently began a 60-day investigation.

"We are going to test the entire building to find if there is anything biologically, mechanically or anything else that might be contributing to the problem," Lee-Thorp told *Indoor Air Review*.

"It's an interesting problem because the occurrences have been insular within the building," Lee-Thorp said. "It has not been a building-wide problem. I am trying to find out if the problem is psychosomatic or physiological."

Lee-Thorp, commenting on the mystery involved with this case, said it was not unlike a detective novel where there is clearly a villain who has yet to be identified.

"The curious part is there is no evidence yet to suggest it [the source of illness] is the building," he said. "It would be premature to characterize this building as having sick building syndrome."

The investigative team is waiting for the results of the first round of medical and air sampling tests and then will form a plan of attack. DOT officials are also planning to do an employee survey of the entire building to see if something was missed. ■

January 1996

Building Owner, Manager Latest Winners In EPA Headquarters Case

In a reversal of a 1993 case that ruled in favor of five plaintiffs alleging injuries by sick building syndrome (SBS), multiple chemical sensitivities (MCS) and toxic diseases of the brain, District of Columbia Superior Court Judge Rufus G. King III recently granted the owner and property manager's motion for judgment notwithstanding the verdict, concluding that somatization is not a compensable injury in these circumstances.

The plaintiffs had claimed their injuries arose from exposure to volatile organic compounds at Environmental Protection Agency (EPA) Headquarters at Waterside Mall in Washington.

The 1993 jury had found that the plaintiffs, who filed a claim for loss of consortium, were not physically injured, but they suffer from somatization. Somatization means that the plaintiffs merely believed they were physically injured.

January 1996

Swedish Study: Half of Workers Report Sick Building Symptoms

A new study says approximately 50 percent of workers have complained of at least one symptom of sick building syndrome (SBS). The report also stated the prevalence of SBS symptoms is high in office environments and not as high in homes.

In preparing his report for Sweden's National Institute of Public Health, Jan Sundell reviewed more than 700 articles on indoor air quality and allergy/hypersensitivity reactions including SBS. He presented the report at ASHRAE's "IAQ 95" conference, held in Denver last October.

Approximately 40 percent of men and 60 percent of women have at

least one SBS symptom each week while at work during the last three months. Of these, two-thirds are said to be related to the indoor climate.

According to the law firm Carr, Goodson and Lee, this case is noteworthy nationally because it challenged the medical basis for MCS. It is important for building owners and property managers because MCS is often alleged as a disease by persons complaining of SBS and other indoor air quality problems.

Larry Kirsch of the Washington-based law firm Cadwalader, Wickersham & Taft said the 1993 case was interesting for a number of reasons.

"Unlike most SBS cases, it [the Waterside Mall case] actually went to trial and resulted in a jury verdict," he said. "Second, because of the scarcity of court rulings on indoor air cases, it was viewed as significant. Another reason is the small amount of the award. This fact may ultimately prove more significant than the fact the jury ruled in favor of the plaintiffs." ■

As to who will be affected by SBS symptoms depends on a number of personal, work-related and psycho-social factors besides building and room characteristics. One factor associated with a high prevalence of SBS is the age of the building. Most complaints occur in buildings constructed or remodeled after the middle of the 1970s.

"There is no clear-cut boundary between sick and healthy buildings," Sundell said. "Buildings are all more or less sick."

Factors Influencing SBS

Other factors influencing SBS include:

- The outdoor air flow rate;
- Dampness problems;
- The presence of photocopiers or humidifiers; and
- A low standard of cleaning.

"Much of the debate about sick buildings has been concerned with the significance of emissions from, especially, building materials or building constructions," Sundell said. "Generally speaking, in most cases it has not been proven that the materials or certain types of building constructions, as such, have given rise to problems, but rather incorrect handling of the materials."

The materials and the constructions themselves appear to perform satisfactorily if they are not exposed to the action of moisture, the report concluded.

Very little is known regarding the significance of the presence of individual chemical airborne pollutants or groups of volatile organic chemicals (VOCs); particulate pollutants or microbial agents. The difficul-

ties in measuring and characterizing such agents are so large that measurements at the present time should primarily be done within a research context and not in routine investigations, Sundell said.

Improved Ventilation

The report also stated that better indoor air through improved ventilation and HVAC can lead to a reduction in SBS.

"A well-maintained HVAC system contributes to good indoor air quality," said Air-Conditioning and Refrigeration Institute (ARI) spokesman John Nash. ARI found in some of its own research that pollutants, dampness, carpeting, paint, unfiltered outdoor air, and improperly maintained HVAC systems are all potential causes of SBS.

But many indoor air pollution problems are outside the control of the building industry, according to the Building Owners and Managers Association (BOMA) International. Office equipment pollution is listed among these problems. EPA is working to identify and measure gases emitted by office equipment. ■

January 1996

Teamwork Essential To Accommodating MCS, Related Illnesses

Each year the National Center for Environmental Health Strategies (NCEHS) assists thousands of individuals who report reactions to chemical exposures. A significant number of these people experience health problems caused or aggravated by workplace exposures. Without prompt action to minimize or eliminate problematic products and practices, these employees may find their health and employment options decline rapidly.

Multiple chemical sensitivity (MCS) and related environmental illnesses may be preventable disabilities. The key factors are recognition of chemically induced illnesses and a sensitivity on the part of management and co-workers toward the health imperatives of those affected by indoor pollutants.

To the unsuspecting employer, the complex health complaints associated with MCS may appear unusual and baffling. While the particulars of a specific situation may vary, there are actions that all employers should consider to create and sustain an accessible and healthful indoor environment.

Accommodations for sensitive populations are not just the right thing to do. They are the intent of disability laws including the Americans with Disabilities Act.

Specific recommendations may vary from one worksite to the next, but those that hold out the greatest possibility for successful employment include:

- An office with a window that opens. In some instances employers have installed an operable window for a hypersensitive employee.
- Maintaining a smoke, pesticide and fragrance-free work environment.
- Eliminating the routine use of air fresheners, deodorizers, disinfectants and similar products.
- Selecting alternative cleaning products and modifying the cleaning schedule as necessary to meet the health needs of sensitive populations. Some employers have turned over cleaning responsibilities for the private office or designated work area to the affected individual.
- Prenotification of building events such as construction, remodeling, floor waxing or pesticide applications with provisions for alternative workspace.
- Work schedule options so people affected by chemical exposures can work when fewer coworkers are present, when the ventilation is working at its peak or where the surroundings are least problematic.
- The option to work at home.

- Education of management and coworkers to the nature of this disability to avert stigma and harassment.

People sick from workplace exposures want accommodation and remediation, not litigation. They want to remain productive. Those experiencing more severe symptoms require immediate removal from triggering exposures to minimize reactions and to avert permanent disability.

Many individuals can be accommodated with a little creativity and common sense at minimal expense. NCEHS has assisted management and affected individuals in such modifications.

Affected individuals are frequently the best judge of what needs to be done. We encourage employers to seek input from employees in determining acceptable practices and policies. Indeed, some employers in the public and private sector are taking a proactive approach by adopting strategies to address the needs of sensitive populations before a problem arises. In far too many instances, a problem can turn into a crisis before management has taken the time to assess the situation. Indoor air committees are generating recommendations that include input from sensitive individuals and their representatives.

Corrective actions, such as the elimination of synthetic pesticides, indoors and outdoors (lawn care pesticides are pulled into buildings and circulated through the ventilation system), or the selection of least-toxic cleaning products, need not be based on sophisticated scientific evaluations, but on intuitive, practical solutions.

Building managers should be wary of the "quick fix" to indoor air problems. The use of fragrances and deodorizing agents to mask odors or to cover poor air quality is a misguided effort that intensifies indoor contaminant levels. These products are complex and potentially harmful volatile compounds. The pesticide paradichlorobenzene is the primary chemical emitted by room air fresheners and deodorizers.

Personal fragrance products, such as perfumes and colognes, can also be a serious problem. Some perfume wearers get incensed that such minute quantities of seemingly "harmless" aromas could cause reactions. But these synthetic compounds include neurotoxic and allergenic substances. Exposure to these chemicals can totally incapacitate an individual with chemical sensitivities.

While some employers have adopted policies which call for a scent-free workplace or recommend minimization of fragrance use in the work environment, a greater number of employers and managers have ignored this increasingly distressing health issue. In our experience, when management abandons the hypersensitive employee, by permitting products and practices that cause debilitating reactions such as with the use of fra-

grances and fragranced products, it sanctions an atmosphere of harassment and retaliation.

Public education and sensitivity to the issue can go a long way toward environmental improvement. Efforts to improve air quality for the hypersensitive improve air quality for all employees.

For this month's report on accommodating the environmentally sen-

December 1995

SBS Effects Orange Co. Tax Office

Ongoing Problems Force Movement of 350 Workers

The Orange County, Fla. Commissioners moved the tax assessor's offices on Pine Street in Orlando, along with 350 employees, to another location, declaring the original office building afflicted with sick building syndrome (SBS).

The move came after the county settled claims with two employees who suffered long-term disability from exposure to mold in the building. Another 20 employees have filed claims.

The tax assessor's office closed Oct. 20 and reopened on Oct. 24th at the new location in the SunBank Tower.

Venetta Denis, the county's assistant to the director of administrative support, recommended the offices be moved. She said the problems are with some of the building's systems—problems that have been happening in buildings long before the term SBS was invented.

November 1995

Nurses Aggravated Over SBS at Famous Boston Hospital

Indoor air quality remediation at Boston's Brigham and Women's Hospital has been extended from an intended two-year deep cleaning to an ongoing project of eradicating exposure sources.

A nurses union said building conditions and unfinished remediation in the hospital, built during the 1970s, are still causing more cases of occupational asthma and other illness related to Sick Building Syndrome (SBS).

Indoor air consultants started work in the spring of 1993 after the Massachusetts Nurses Association (MNA) made a concerted push to stem SBS-related illness in the 1,000 bed hospital, which employs about 10,000 people.

"We are taking a wait-and-see attitude to what is a complicated problem," said MNA spokesman David Schidmeier. However, nurses in his union are still getting sick and several have filed lawsuits.

Schidmeier added that clean-up operations came too late. Slow action has left more than 300 people injured from exposure to volatile organic compounds (VOCs) in cleaning products, allergens from latex gloves and often highly toxic medications and aerosols. He added that the building's poor ventilation was also a prime contributor.

Among the injured are about 80 nurses that have been placed on indefinite leave, most of them after contracting occupational asthma.

The association blames the hospital for not acting in an aggressive manner, he said. "Their efforts have been to minimize, control, deny and diffuse the situation," said Schidmeier.

Hospital Responds

A hospital spokeswoman said that stringent cleaning methods were used to rid its 17 patient-care floors of sources of occupational exposures.

In addition to other facility renovations, she said the HVAC and ventilation systems have undergone some "serious tweaking."

John McCarthy, president of Environmental Health and Engineering (EHE) Inc. of Newton, Mass., the lead contractor for the HVAC remediation, would not say whether they have completed their original

sitive, we asked Mary Lamielle, director of the National Center for Environmental Health Strategies in Voorhees, N.J., and editor and publisher of The Delicate Balance newsletter, to provide her insights on this growing problem. She is a member of the President's Committee on Employment of People with Disabilities. She also was named the Indoor Environment '95 Public Interest Advocate of the Year. ■

"It is not such a horrible building," Denis said. "All the health and engineering experts said this building could be occupied.

However, a person that had allergies or had sensitivities might have problems."

One of the problems with the old building included negative pressurization drawing outside moisture in. Work crews found mold on dry-wall behind the wallpaper and the building lacked a vapor barrier.

The commissioners had to make a decision to continue putting money into the building or move the employees out.

"They were talking \$4 million in renovations," Denis said.

There is apparently no rush to correct the problems in the old building. The county positively ventilated one office there so the data collection center can still operate until a new location can be built. Denis said there is no date set yet for starting renovations. ■

mission to rid the facility of the causes of SBS. Rather, he said, his company's role there is evolving.

McCarthy said he has developed a comprehensive program of indoor air quality investigation and remediation that requires six members of his team in full-time residence at the hospital. They manage the newly created Department of Environmental Affairs.

Employees can report indoor air quality problems to a pager number and the EHE team will respond by beginning an investigation with interviews and air sampling.

McCarthy said the areas they cover are the exhaustion of contaminants, allergens and offgassing of materials and re-engineering processes that might contribute to poor indoor air. The last function includes having all medications produced in the central pharmacy and strictly controlling the administration of aerosol medications.

To cover these three complex areas, McCarthy's team has instituted full-time surveys and control methods that no short-term remediation could fulfill. He calls this plan his early warning system. Some features are:

- The team has an automated phone survey that allows anyone in the hospital to answer questions using the phone key pad.
- Safety committees in every department.
- When EHE does remediation work, they form floor committees that serve as conduits for questions and answers.
- Any modifications must go through a design review and performance testing. The team tries to catch problems in the design and building phase of new renovations or installations. For example, new x-ray machines installed with dedicated ventilation must pass performance tests to ensure that no indoor air quality problems are created.

Schidmeier, however, believes that their attempts to improve communications have not lived up to the program that was sold to MNA. Nurses are still getting sick, he said.

As the remediation efforts continue, McCarthy admits that, "there is always something" more to do at Brigham and Women's Hospital. ■

November 1995

Sampling Techniques Used in Sick Building Analysis

The investigation of problem buildings involves both physical and biological factors that may contribute to unhealthy living conditions. Aside from design features, factors that relate to building operational inadequacies are often implicated with deficiencies in ventilation and maintenance, at rates of up to 75 percent.

As a result, indoor biocontamination may reflect in many instances unsuspected short-comings in building operations, leading to a high risk of microbial-associated illnesses such as hyper-sensitivity reactions and respiratory diseases.

Biocontamination hazards, appearing mainly as bacterial or fungal organisms, have been reported in 20-25 percent of problem buildings studies). Other studies have also presented evidence of an association between a "sick building symptoms" and microbial agents in air tight buildings. While microbial contaminants may jeopardize the health of the occupants of a building, they also add to the deterioration of internal structures through extensive colonization of wood, insulation and sheathing.

Saprophytic organisms are capable of growing on many interior surfaces, in environments where the relative humidity is as low as 10 percent, and spores of bacteria and fungi can remain dormant on surfaces for several years. Adding to the biocontamination burden is the dissemination of microbes by occupants, especially if there is a high density flow of people throughout the structures. When extensive human shedding occurs in poorly ventilated environments, bioaerosol levels may endanger susceptible individuals throughout the enclosed area.

Complaints of discomfort by individuals within a building are not the only criteria for conducting an evaluation of total microbial contamination, both airborne and surface laden. Knowledge of biocontamination levels from routine sampling assays can provide insight into potential hazards that may affect both the health of the occupants and the integrity of the structure.

In these studies, biocontamination profiles were compiled for four problem buildings as part of a total indoor quality assessment, irrespective of the current state of health of the occupants. Tandem aerosol and surface sampling provided comparison data for in-depth interpretation, vis-a-vis operational inadequacies and human transmission of bioagents within the buildings.

Material and Methods

Biocontamination studies were conducted on four buildings in August, September, and November of 1994; and January 1995. Surface Samples were taken of 5 cm² area using sterile cotton swabs pre-moistened in sterile water. Surface areas most often surveyed were walls, ceilings and floors. Although three of the four buildings were public schools, all sampling was conducted during period of non-occupancy.

Trypticase soy agar plates were inoculated with these swabs immediately after sampling. As recommended by ACGIH, surface swab analyses were reinforced with indoor/outdoor air sampling.

Bioaerosol samples were collected with a Graseby/Anderson N6 Single Stage Microbial Air Sampler which employs a 400-hole sieve plate. Samples were collected on to Trypticase soy agar for three minutes at a flow rate of 0.028 m³/min. All sample plates were incubated

at 38°C from four to six days prior to the analysis for bacterial and fungal colonies.

Discussion

Within a problem building, biocontamination arises from either structural materials or human traffic. A good appraisal of contamination levels involves aerosol sampling for suspended biologicals along with surface sampling for settled particles. Sampling surfaces can provide information on operational efficiency and the potential for eventual exposure to microbes, since dust is an important reservoir of dormant organisms which become viable once moisture is introduced. Several studies have indicated that microbes in dust are periodically dispersed into the air and contribute to indoor bioaerosol levels. Swab samples of surfaces were taken in this study in order to ascertain the latent microbial level and not necessarily substitute for air evaluations.

Although surface analyses are not qualitative, relative profiles of bacteria and fungi can be determined, and related to overall indoor contamination. As indicated in the results, estimates of microbial populations on various indoor surfaces favored bacterial agents over fungal. In particularly dry areas, bacterial spores will be the predominant contaminant, increasing as dust accumulates.

Bioaerosol studies have focused more on fungal contaminants because of their association with many human afflictions and their ability to degrade practically all building materials. While air sampling provides information on microbials that most likely will be encountered within a room, this alone will not determine whether an extensive contamination problem exists, or identify the underlying cause. Indoor air sampling and concurrent sampling of HVAC insulation and fiber material allows better evaluation of the source of biocontamination.

A ratio of surface microbial counts to aerosol counts (S/A) as an index of total indoor biocontamination was employed. Aerosol counts were adjusted to reflect a sampling area similar to that used in surface sampling (25 cm² vs. 30 cm³).

Although this index permits a rapid analysis of the source of contamination, is not a suitable bench mark for remediation, like the airborne count of 104 CFU/M³ recommended by ACGIH. However, air sampling procedures alone may not be reliable due to variations in spore emissions as well as poorly defined normal background levels, even in well maintained buildings.

Conclusion

The role of biocontamination in assessment of problem buildings requires sampling and assay techniques that can efficiently present an overall profile of the indoor microbial burden. By evaluating surface and aerosol populations in tandem, an index of biocontamination can be computed, as an indicator of the relative viable microbial levels. Diagnostically, this index can be used to determine defects in building operations or potentially hazardous health situations.

Charles Erlanger is principal of North Atlantic Labs in Ronkonkoma, N.Y. This presentation was made at the Indoor Environment '95 Conference in Baltimore. ■

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November 1995**Sick Building Syndrome Causes Southwest Airlines Employees to Bring EEOC Action in San Antonio****Failure to Take Proper Action May Have Worsened the Situation**

A Southwest Airlines Co. reservation center, housing up to 600 employees, mostly airline ticket reservationists, was named in a sick building syndrome (SBS) action before the Equal Employment Opportunity Commission (EEOC).

Houston attorney Damien Capps said six of his clients have contracted multiple chemical sensitivity (MCS) from exposure to airborne contaminants in the Southwest office building.

MCS symptoms the women are experiencing include sinus problems, bronchitis, colon and bladder problems, fatigue, speech problems, nervous disorders and skin rashes. One client, who asked that her name be withheld, said she first experienced the symptoms in 1989. She later went on disability and after three years, her position was terminated in 1994. She said she did not think Southwest could terminate her while on disability and workmen's compensation.

Capps said his clients are asking that Southwest allow them to work their old jobs outside the office by installing reservation and phone equipment in their homes.

EEOC will investigate the complaint, Capps said. Southwest will then be given a chance to take action to remedy the problem. If EEOC finds cause and Southwest does not respond, a right-to-sue letter will be issued from EEOC to the six plaintiffs.

One Southwest employee who is not part of the suit and did not want to be named said she too was suffering from MCS symptoms. She believed her symptoms were caused by fungi growing on the interior walls of the building, dust and environmental tobacco smoke. She also said the ventilation system just recirculated the same contaminated air and the ducts were dirty.

Southwest started to do some renovations, she said. They pulled down the carpet that lined the walls and found mold growing on the walls. However, they just covered it back up again without destroying the mold.

A total of 11 female employees (which include Capp's six clients) who have worked, or are working at the reservation center, are being treated by Houston physician Andrew Campbell.

Other employees at the Southwest reservation center are experiencing similar kinds of chronic illness, said the unnamed employee. A number of them were starting to meet openly and are complaining about the working conditions.

In the past, the employee said, when they complained, the management just turned up the air conditioning. It got colder but the air quality problems persisted.

Melanie Jones, a public relations representative at Southwest's Dallas headquarters, said the company has voluntarily started conducting air quality tests and is correcting indoor air quality problems that they find.

Southwest is proactively responding by having an indoor air quality consultant perform air monitoring tests, she said. Some contaminant levels are not up to air quality standards and will be mitigated. She would not say what contaminants were at unsatisfactory levels.

The reservation center was divided into four quadrants, she said, with one quadrant set aside for employees who smoked. The smoking quadrant had clean air filtration devices and added ventilation, however, that section was among the areas where the indoor air quality is being reassessed.

Jones said she did not know what prompted the volunteer efforts, but added that Southwest was named one of the top 10 companies in the nation to work for by Robert Levering and Milton Moskowitz, authors of a book listing the 500 best companies to work for. Southwest values the health of its employees, she added.

Jones said she could not verify why the six women were out on disability or why some or all had been terminated.

Out of the workplace for more than three years, the unnamed employee was excited to hear that Southwest had been contacted by EEOC and that Southwest said they were making some changes.

"Maybe now something is going to happen," she said. ■

October 1995**Chemical Interactions Responsible for NOAA SBS****Pre-installation Testing Could Have Prevented Problem**

Tests reveal that Phenol, a volatile organic compound (VOC), is responsible for the sick building syndrome (SBS) symptoms that plagued one of the buildings at the National Oceanographic and Atmospheric Administration's Silver Spring, Md headquarters.

The building had been troubled by a hard to locate SBS problem that affected more than 20 percent of the occupants. Complaints of headaches, burning eyes and fatigue began shortly after the building was occupied in 1990.

Six indoor air surveys were ordered by the General Service's Administration (GSA), the federal government's landlord. The tests revealed that phenol was present in the indoor air and that it came from a floor-leveling compound used on four floors of the nine story, pre-cast concrete building.

The epoxy-based compound was spread over surface deflections on those floors. The floors sagged because insufficient reinforcing steel was used in constructing the concrete floors.

GSA and NOAA asked the National Institute for Standards and

Technology (NIST) to confirm the presence of phenol or other VOCs and to recommend remedial action.

After random sampling with gas chromatography-mass spectroscopy revealed phenol to be present in up to .52 percent of the compound's mass, NIST recommended removing the compound.

Compound Removal

Interim mitigation steps, such as heating the building to 92 degrees for five days and installing charcoal filters were unsuccessful. NIST then urged that the compound be removed and replaced with another floor leveling product — portland cement.

The leveling compound was removed and the HVAC systems were also updated. New carpeting, partitions and furniture was installed. Shortly before reoccupancy, however, construction workers began to complain of a musty, sweet odor and watery eyes.

The building was superheated again, but the odor remained. Air Quality Services of Atlanta was called in as a consultant.

The consultant found that the odor was a chemical reaction between the floor leveling compound and the polyvinyl chloride (PVC) backing of the carpet tiles, producing the airborne VOC contamination. The main contaminants were 2-phenoxyethanol and long-chain alco-

hols.

Air Quality Services suggested removing and replacing the ceiling and floor tiles using low-emitting adhesive and low-emitting replacement products. These products were chamber tested separately before installation.

The carpet and tile was removed and the process started all over again. Windows were removed and the building was thoroughly

aired out. Total costs now exceed \$1.6 million.

GSA has filed an intent to sue against the general contractor of the building and some of the product manufacturers, including the maker of the initial leveling compound. Reconstruction is expected to be completed in March of 1996. ■

October 1995

Damage Costs for Polk County Courthouse Keep Mounting

While waiting for an appeal, compounding interest continues to build on the \$35.3 million judgment against a New York insurance company that underwrote the faulty construction of the Polk County Courthouse.

The courthouse in Bartow, Fla. has become a textbook case of Sick Building Syndrome (SBS). Mold growth caused by building leaks and faulty HVAC in the 8-year-old courthouse was blamed for causing a variety of ills among 580 employees. The ten-story building was evacuated in 1992 and has not reopened.

Reliance Insurance Company was the underwriter for the contractors who did the faulty construction in the Bartow, Fla. building. Originally, Reliance underwrote the contractors for \$29 million, however, building renovations topped \$40 million.

The original judgment for \$25.9 million was handed down in Pinellas Circuit Court on April 25. Then on June 30, the court turned down a motion for a new trial and granted the county another \$8.8 million in

interest earned since the county filed the claim in 1992.

To date, interest, fees and other court costs have pushed the total up to about \$39 million, said Robert Trohn, the county's attorney.

Trohn said Reliance posted a \$40.3 million bond with the appellate court, which will cover the suit plus two years interest. But with the costs and interest compounding, he said, the county may have to ask the courts for a larger bond.

The county, in separate court actions, has already collected \$12.8 million from out-of-court settlements with some of the contractors. Reliance made a motion to get this amount removed from their judgment.

However, Trohn said by appealing the original suit, Reliance has wiped out all previous motions.

"I thought they would have paid a long time ago," Trohn said. "We'll take the money when they want to give it." ■

October 1995

Virginia Beach School District Starts SBS-Mitigation in 2 Schools

School officials initiated a host of studies and two pilot projects to mitigate problems in eight Virginia schools where students and staff suffered health problems related to sick building syndrome (SBS).

The \$2 million pilot projects started this summer after officials with the Virginia Beach School District finally acknowledged that Birdneck, Glenwood, Red Mill, Rosemont and Strawbridge elementary schools; Salem Middle School; Ocean Lakes and Salem high schools had SBS-related symptoms.

Nancy Ferguson, spokesperson for the Parent Teacher Association (PTA) and a member of the district's Indoor Air Quality Committee, said the organization is hoping to finally see some action with the release of the district's comprehensive plan Oct. 15. It will contain a review of the problems and offer solutions proposed by indoor air consultants hired by the district.

After an initial walk-through by consultants school officials did report that all schools had adequate HVAC systems, but did not control humidity well.

School officials refuse to acknowledge that the health complaints — headaches, shortness of breath, sinus conditions and skin irritations — were related to molds and fungi growing in the buildings, as has been asserted by PTA members.

Ferguson said the review will most likely recommend starting six pilot projects in six of the eight schools.

Meanwhile, according to a newspaper report, the school district has sued six architectural firms that designed the schools, and those firms

have sued the mechanical contractors for designing the HVAC equipment.

Ferguson said the whole mess came to light when a member of the PTA obtained an indoor air quality study performed by Virginia Tech University. She said the school system reportedly covered up a study that included allegations that ventilation fans intended for the schools were never installed, even though the money was appropriated.

"The study was done five years ago and the school district just sat on it," Ferguson said.

Since the acknowledgment of the problem in January, all eight schools have installed dehumidifiers and air cleaners, and an additional custodian was assigned to each school to insure proper operation of the equipment.

Operable windows were added at Salem High School, and will be installed at Birdneck and Glenwood elementary schools, and at Salem Middle School.

Part of the pilot programs' objectives is to develop an improved ventilation system to be tested in selected classrooms at Birdneck and Glenwood.

The trial ventilation systems will give occupants direct control over humidity in the classrooms. The amounts of outside air will also be adjustable.

If that works, the programs will be expanded to the rest of the schools, school officials said. ■

September 1995**Boston's RMV Evacuated to Begin SBS Cure**

Officials at the Registry of Motor Vehicles have decided to close its headquarters in the 19-month-old Ruddle's Center in Boston.

Because of the undisputed causality of sick building syndrome (SBS), the center has been the scene of an ongoing battle between the private owners, the state and an employee union over how to implement renovations costing \$5 million.

No one has disputed that the building occupants are suffering health problems stemming from insulating and fireproofing materials in the ductwork that have been breaking off and were blowing into the work areas, said Steve Schrag, the New England Regional Safety and Health Specialist with the National Association of Employees. More than 640 state employees have reported SBS-related illnesses.

The problem has always been whether to keep the building open and renovate floor by floor, or follow recommendations by the employee's union to evacuate the building until the renovations are completed.

In June, a state court ordered the building stay open and the renovations be completed quickly. Employees were to be shuffled from floor to floor.

However, Schrag said the union took the state back to court, and a ruling to close the building was made.

He said there were too many unanswered questions about the health and safety of the state employees to keep the building open during renovations.

In addition to the insulation breaking off and blowing around the work area, Schrag said there also has never been enough fresh air in building.

Officials tried to treat the problem by raising the ventilation rate to 25 cfm, but people were still getting sick, he said.

The union has recommended that in addition to the planned renovations, the building owner encapsulate the duct insulation and install direct ductwork to all work areas. ■

July 1995**Boston Courthouse Closed Due to SBS**

The ventilation system of a Boston courthouse will undergo an \$800,000 upgrade in hopes that it will dissipate the fumes from a waterproofing chemical improperly applied last summer, according to state officials.

A judge at the Suffolk County Courthouse said employees could not work in four of the eight courtrooms for a full day without developing health problems associated with the sick building syndrome (SBS).

Court proceedings had to be moved to neighboring localities after court employees complained of eye discomfort, headaches, dizziness,

light headedness, congestion, fatigue, skin problems, coughs, respiratory problems, unusual stress symptoms and nausea.

State officials said the original courthouse ventilation system was unable to remove enough of the fumes from the waterproofing material, Duramen V-500.

About 200 employees were temporarily relocated, and court officials said that if the ventilation upgrade does not work, the state will continue to hold its trials in other courthouses. ■

June 1995**Danish Study Links Dust Quality to SBS Symptoms****Symptoms Increase Proportionally With Ratio of Dust Types to Other Components**

Fatigue, headache, dizziness and poor concentration—symptoms people frequently exhibit in workplaces diagnosed with sick building syndrome (SBS)—may be due as much to the quality of dust in the building as the quantity.

Pinn Gynzelberg and a team of Danish researchers working for the Danish Indoor Climate Study Group found that different types of dust, and bacteria dust may harbor, cause different maladies. Certain Gram-negative bacteria (determined by laboratory analysis) and volatile organic compounds (VOCs) were shown to significantly induce mucous-membrane symptoms.

The findings of concurrent dust analyses from 12 town halls and surveys of tenants in those buildings were published last year in the journal *Indoor Air*.

The researchers surveyed 870 people around Copenhagen, Denmark, asking questions about indoor climate, symptoms they had experienced, allergy history and psychological work factors.

A building expert collected data on the indoor climate, coverage of carpet, and the order and condition of the building. Researchers also collected dust samples using specially equipped vacuum cleaners.

Dust is More Than Just Dirt

Based on physical properties, the researchers divided the dust into three categories. One group was composed of human fragments, such as hair, nail clippings and skin scales. The second group contained fibers from textiles, paper, plants, glass and rockwool, a mineral wool used for insulation. The third category included organic particles such as wood,

pollen and seed coats, and inorganic particles such as mineral and rust.

Each category of dust was tested for VOCs and biological properties such as microfungi, bacteria, endotoxins, macromolecular organic dust (MOD), mite allergens and histamine liberation. (Histamine is produced by the human body during an allergic reaction and is released in mucous.)

Reactions to Different Dusts

Using statistical analysis, physical and chemical properties of the dust were compared to symptoms reported by the tenants.

The researchers reported a strong correlation between general symptoms—fatigue, heavy-headedness, headache and dizziness—and the prevalence of bacteria, MOD and histamine liberation. Furthermore, as the ratio of those compounds to other components in the dust increased, the symptoms increased proportionally.

The correlation of Gram-negative bacteria to those symptoms and mucous-membrane complaints was especially strong. The researchers also tied mucous-membrane symptoms strongly to particle-to-dust ratio and VOCs.

The study says amounts of MOD correlate specifically to headache and dizziness, and histamine liberation correlates with dizziness and lack of concentration.

The correlations in the study are strong, and although the researchers cautioned they do not necessarily indicate causality, they support that hypothesis.

The analysis did not account for the influence of confounders such as temperature. Dust was collected from floors only, but researchers assume the quality of the dust in the air was similar. ■

June 1995**Sick Courthouse Wins \$26 Million From Insurance Company**

In an April jury trial, Polk County, Fla., was awarded \$26 million from a builder's insurance company to correct shoddy construction and design flaws in its courthouse, some of which may have contributed to sick building syndrome (SBS) complaints from tenants.

The Polk County Courthouse in Bartow, Fla., has become a textbook case of sick building syndrome (SBS), with a large portion of its 8-year life spent unoccupied. In 1992, all 580 workers were evacuated and the building was closed.

Currently, 80 risk-to-health lawsuits are pending by courthouse workers alleging SBS-related illnesses, including respiratory problems from mildew. Additionally, 200 workers have filed workmen's compensation claims, some of which are permanent, total disability cases.

However, the April case was based on poor workmanship and was

not an SBS suit, said Robert L. Trohn, Polk County's attorney.

As an example, Trohn cited 900 holes in masonry around windows and doors that made it impossible to properly air-condition the building.

The jury based its decision against Reliance Insurance Co. of Philadelphia, on an all-risk builder insurance policy. Although Reliance had originally denied coverage, citing a number of policy exclusions, the jury found that the policy did cover construction problems.

The \$26 million verdict could reach \$38.5 million when interest, court fees, and other costs are added, said Trohn, adding that he expects Reliance to appeal later this year.

The courthouse may re-open in November, said optimistic county officials. ■

May 1995**Hunting for an SBS Remedy With UV Light**

Could applications of ultraviolet light and a common ingredient found in toothpaste be an inexpensive and effective cure for sick building syndrome (SBS)?

If University of Florida engineering professor Yogi Goswami is correct, the answer could be yes.

A research team lead by Goswami rid ductwork of microorganisms — often the culprits in outbreaks of SBS — by forcing air through specialty-coated filters and a bank of ultraviolet "black lights."

The filter was coated with powdered titanium dioxide, which acts as a catalyst to increase the ultraviolet light's effectiveness.

Scientists and engineers have been studying the successful sterilizing effects of ultraviolet rays. But Goswami said it was the combination of light and titanium dioxide that killed most of the airborne fungi, which had been released from mold and mildew in ductwork used in the test.

Best Results

The best test results came when the relative humidity was about 50 percent. Under those conditions, Goswami's team reported "complete

inactivation of the organisms."

At higher humidities, 10 percent of the test organisms lived. The addition of the titanium dioxide had no effect when the relative humidities were 30 percent and below.

Goswami said higher ventilation rates retarded the kill rate because such rates lessened the amount of time the fungi were retained by the filter.

The researchers said they were pleased to see the fungi destroyed, but added that the time needed to kill the fungi was not satisfactory.

As a possible remedy, the team's report suggests using a honey-combed reactor to slow the flow of air and airborne fungi across the filter and to increase the filter's retention time.

After reviewing the report, Dave Wassman of Halliwell Engineering Associates Inc. said Goswami's approach was "highly experimental."

He was not familiar with the potential health hazards of introducing titanium dioxide into an office building's HVAC.

For that reason, he wondered if Goswami's process would have a practical application. ■

March 1995**DuPage County Courthouse Trials End in Split Decision Employees Award-**

After a four-year battle, separate trials assessing fault in DuPage County, Ill.'s sick courthouse debacle finally ended with a split decision.

In one case, the county employees settled out of court with the defendants who designed and helped build the new courthouse in suburban Chicago. The other went to a jury, who found the defendants not guilty and said the building's owner — DuPage County — was at fault.

Symptoms of sick building syndrome (SBS) struck down 125 DuPage County employees in 1992 after only two months in the new courthouse. Plaintiffs' attorney Terry Ekl of Connolly, Ekl & Williams in Clarendon Hills, Ill., said that the employees experienced flu-like symptoms and cases of immune system and neurological disorders.

The county, which owns the 340,000 square-foot complex, stopped the final payment on the building. The county then sued the architects and HVAC contractors for \$6 million, alleging breach of contract.

Among the defendants named in the suit were Hellmuth, Obata & Kassabaum, a St. Louis architecture and design firm; Wight & Co. of Glen Ellyn, Ill.; Johnson Controls, Inc.; and J.A. Jones Construction

Co. of Charlotte, N.C.

Split Decision

Originally the county and employees were joint plaintiffs, but because of the complexity of the original case, the presiding judge split the two cases last September.

A trial jury found DuPage County at fault Dec. 30 for causing the ailments by using anti-oxidant and anti-scalant chemicals to clean and treat the building's HVAC system.

The anti-oxidants were added to inhibit rust and extend the system's working life and an anti-scalant polymer was used to prevent sediment build-up. The manufacturer of the courthouse's HVAC system maintained it told the county not to use the chemicals, as they could become unstable in the dry-steam humidification system.

The jury noted that the builders had aired the courthouse out for two months prior to occupancy, and that the first SBS complaints did not come until nearly three months later — facts which convinced the jurors that the building was properly designed and it was the county's operation which made the plaintiffs sick.

The court found that the county was at fault for not maintaining and operating the HVAC system properly, and ordered the county to make the final payments they had withheld.

Ekl, who was not involved in the county's case, said the court barred the testimony of courthouse employees in the trial, adding that with such testimony, the county would have won.

Also not allowed by the court was testimony from seven doctors supporting claims of volatile organic chemical exposure, which Ekl said the defendants could have never defended themselves against.

Ekl added that the county's errors in maintaining and operating the HVAC system would only have caused eye irritation and skin rashes, whereas many of his clients suffered neurological disorders and immune disease that he said were caused by exposure to building materials used by the defendants in the courthouse.

"Particle board is everywhere" in the courthouse, Ekl said, adding that it emitted formaldehyde, one of the chemicals that he said caused his clients' sickness.

Ekl disputed that the building had been aired out by the time it was occupied.

Design problems in the courthouse, Ekl said, reduced the percentage of outside air to the building to about 5 percent when it was first occupied.

Ekl said the county may appeal.

The 125 employees settled their case out of court Jan. 5 for an undisclosed amount. Attorneys for the defendants said the settlement was a business decision—it was cheaper to pay than to continue the trial.

"No one came out of this a winner," said engineering consultant Jack L. Halliwell of Halliwell Engineering Associates in East Providence, R.I., who has followed the trials from the beginning.

Maybe the doctor bills got paid, maybe the indoor air issues in the courthouse were straightened out, but no one won, he said, "except for the attorneys." ■

March 1995

Spatial Spectroscopy May Help Study Eye Irritation From SBS

Thanks to the flawed pictures sent back from NASA's Hubble Space Telescope, the Environmental Protection Agency (EPA) could have a new technology to study irritated eyes, a common symptom of people working in sick buildings.

A University of North Carolina (UNC) researcher developed the method, known as spatial spectroscopy, originally to improve blurred photos from outer space using computers and photography.

UNC's James Coggins said he has shifted the focus of his work to measuring precisely the degree of eye redness, or hyperemia. EPA wants to use the method to gauge irritation from indoor pollution and has backed the project with hopes that it will help set indoor air pollution standards for examining sick building syndrome (SBS).

Yale University is also working on three additional methods for gauging indoor air pollution.

Swimming Pool Study

Coggins said his method was still five years from actual field use.

He has been measuring the redness of graduate students' eyes after they spent time in chlorinated swimming pools.

The ophthalmology department at the UNC School of Medicine photographs the students' irritated eyes. Coggins then uses a computer algorithm he developed that automatically assesses hyperemia in photographs of the eye.

"The computer measures how bloodshot the eyes are quickly, automatically, and far more objectively than human observers," he said.

Spatial spectroscopy is also used in analyzing microscope images, satellite images of the Earth, and x-rays. Coggins said the method might even be used to map blood vessels in the eye and find signs of glaucoma earlier.

"Most people in computer vision work don't know about this yet," he said.

"It's so new, we haven't had time to publish much on it." ■

January 1995

AIHA Addresses Fears, Formulae for Sick Buildings

Warnings About Air Testing, Choosing a Consultant

The American Industrial Hygiene Association (AIHA) has released a free booklet designed to provide building occupants with accurate information about indoor air quality in the workplace.

Do I Work in a Sick Building? offers examples of good and poor indoor air quality, illustrates symptoms associated with poor indoor air, and lists common roots of such problems. The object is to help occupants make wise decisions about their building.

AIHA's Jeff Seckler said the association had determined that "there's a need for something someone can walk around with." The booklet, he said, is "real basic stuff" that can fit in a pocket, yet offers references to more in-depth information, if needed.

AIHA noted that while "sick building syndrome" and other indoor air buzzwords are increasingly popping up in the press, such stories "have generally raised fears without offering solutions."

Advice for Complaints

When faced with an indoor air complaint, the booklet calls for determining the who's, what's, when's, and where's of the complaint

before taking a stab at the why's and how's.

Information should be gathered on who is affected, where concerns are found in the building, when the problem occurred, what health effects and complaints are reported, and if those complaints cease after leaving the building.

Also of potential import are any diagnoses offered by physicians, evaluations from the building engineers or HVAC contractor, and any environmental conditions or activities (such as copier use, remodeling, or pesticide applications) apparently associated with the problem.

After gathering such information, an attempt can be made to evaluate the situation.

The Air Testing Question

The AIHA booklet sounds a warning about air testing, observing that "shotgun" air testing for a broad spectrum of potential contaminants is generally misleading and seldom helps to identify a problem.

Nor are measurements of chemical levels necessarily helpful—AIHA notes that such levels are set for exposure to individual chemicals in an industrial setting, not for "the complex contaminant 'soup' often found in office building air." Such standards were also devel-

oped for men without pre-existing health problems, instead of for the more diverse office building population.

"The greatest value of air testing is in the comparison of the results of testing in different locations or at different times," AIHA said, adding that "the data generated often yield very valuable information about the origin of the problem and possible solutions."

The booklet recommends that outside assistance be considered:

- if the problem persists after obvious sources of indoor air contaminants have been identified and rectified;
- if the problem demands immediate and concerted attention, yet resources are limited; or
- if the preliminary investigation reveals little of significance and the next move seems unclear.

Such outside assistance, AIHA warns, may have to include specialists in medicine, lighting, acoustic design, or psychology.

Know Your Consultant

And, the association adds, "particular attention" should be paid to

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Sick Building Case in Schools Divides Ohio Town

Pam Dittner remembers Sept. 11, 1992 as the day she lost a battle against the indoor air pollution she believes plagues Tri-County North Schools in Lewisburg, Ohio.

That was the day Dittner, who said she had been suffering increasingly severe health problems, became disoriented in her second-grade classroom.

"I toughed it out," she said, but "I didn't know what it was — it was a strange feeling."

She became disoriented again at the end of the school day, however. And the next day. Then the following Monday. She said she tried to teach classes with the door and windows open and the fan running but found her lungs burning and coughed up blood. In the fall of 1992, she stopped teaching, used up her sick days and went on unpaid medical leave.

Two years later, Dittner is teaching again but still battling health problems. And she and a group of parents and students are suing Tri-County North Local School District, the Ohio Department of Education and architects and contractors connected with an addition to the school built in 1988 and 1989.

The school district maintains it modified the building's HVAC system to bring in more outside air, and numerous health investigators, including the National Institute for Occupational Safety and Health (NIOSH), have examined the building without finding anything they deem a potential health hazard.

Health Problems in Addition

Dittner said she entered the new addition in the fall of 1990 and soon suffered fatigue, heart arrhythmia, headaches, eye irritation, laryngitis, cramps, asthma and allergies.

"My head felt like it had been blown up with a bicycle pump," she said.

Dittner said other teachers were having health problems, while children were suffering from nosebleeds, rashes, headaches and gastrointestinal problems.

Reports of health problems had reached parents and the media by late 1992. Dittner recalled about 50 children had been taken out of school by their parents and tutored or sent to private schools. Meanwhile, the local Department of Health and regional health experts were testing the school for levels of carbon dioxide, carbon monoxide and other contaminants.

consultants' background and demonstrated successes in resolving similar situations.

"Hiring someone to perform a poorly conceived study is worse than a waste of money and time; it may lead to erroneous conclusions and costly remedial efforts of no intrinsic worth," the booklet says. "If a consultant proposes elaborate and expensive air monitoring without demonstrating to your satisfaction that the resulting data will be meaningful, look elsewhere for assistance."

AIHA's Seckler said that when the association released a booklet about residential indoor air last year, some companies requested "thousands" of them to be passed out to their employees.

He said AIHA was considering sending copies of the booklet to the Occupational Safety and Health Administration (OSHA)'s regional offices.

To obtain a copy of the booklet, contact AIHA Support Services at 703/849-8888. ■

The school's HVAC system was modified after NIOSH and other experts said insufficient outdoor air was coming into the building.

NIOSH has performed sampling and investigations four times at Tri-County North. The agency's initial investigation, conducted Oct. 16, 1992, measured temperature, relative humidity and carbon dioxide at various locations in the school.

Investigations in October 1992 and February 1993 found low levels of volatile organic compounds and formaldehyde but high levels of carbon dioxide in some locations. Carbon dioxide levels averaged 1289 parts per million during the 1992-93 investigations.

NIOSH recommended outside air be increased; the district added \$800,000 worth of additional air handlers.

Sampling conducted this January showed carbon dioxide levels averaged less than 700 parts per million, and formaldehyde levels had dropped by some 80 percent. And a comparison of questionnaires issued to the staff in 1992 and 1994 showed the percentage of employees reporting work-related symptoms dropped from 26 percent to 10 percent.

New Beginning, Old Problems

Dittner, who returned to work in January, said problems persist — and the school has increased the ventilation before NIOSH inspections. She said she wears a breathing mask in the hall and keeps air cleaners in her classroom, and children are still having problems, too.

"I still see kids going into the office with breathing problems, cramps, headaches," she said. "We have all these kids who are hypersensitive."

That category, she said, now includes herself. She said now she can't read a newspaper without using a respirator.

Dittner and a group of parents and students filed suit Sept. 30. Her workers' compensation case is pending, she said.

Dittner said other teachers have had health problems, but she is the only one who has come forward.

"They think if they're quiet, it'll go away, or that I'll take care of it for them," she said.

Dittner said she does not know what exactly caused her health problems. It may be Dursban, a pesticide used in the school until late 1993, or volatile organic compounds, or insulation. She said she has had antibody testing for formaldehyde and the results were "way out

of kilter."

District Defends Conduct

Michael J. Burdge, an attorney with Dayton, Ohio's Young, Pryor, Lynn & Gerardi, represents the defendants in the case. Burdge paints a different picture of what has happened at Tri-County North.

NIOSH, he said, did note formaldehyde in the building from the school's copiers. But their recommendation was merely that the school consider switching toners when the current copiers were due for replacement, he said.

Of all the health investigators who have examined the building, he said, none believe anything in the building is causing health problems.

"The most that they would say is there was insufficient outside air being brought in," Burdge said.

Burdge said the case probably would take more than a year to come

to trial, but that a welter of motions to dismiss and other legal maneuvers would occur before then.

He said the plaintiffs' attempt to make the case a class action is "ludicrous," and said no other employees besides Dittner have made claims.

Certifying the case as a class action, he said, would mean that the plaintiff class comprises everyone who has entered the school — a category which would include the defendants and Burdge himself.

Burdge said "inaccurate" reports in the media have hurt both school attendance and housing sales in Lewisburg — fueling an anger Dittner said she is well-aware of.

"A lot of people are really angry at me," she said. "They think I'm out to make a huge sum of money for my retirement, or they think I've manufactured this." ■

November 1994

What's Gone Wrong?

'Sick Courthouse Syndrome' Continues To Plague Counties in Sunshine State

If its current woes continue, Florida might consider changing its name from "the Sunshine State" to "the Moldy Courthouse State."

Martin County. Broward County. Palm Beach County. And, topping the scales as the biggest nightmare of all, the Polk County courthouse.

Fixing Florida courthouses has become a thriving industry in its own right, supporting legions of engineers, construction companies, indoor air contractors and mitigators, and lawyers.

What's gone wrong in Florida? The answer is a combination of three factors. The first is relatively esoteric for those not conversant with indoor air. It's what building expert Joseph W. Lstiburek calls "regional chauvinism": the failure of building design to adapt to the indoor air quality needs of different parts of the country.

The other two factors in the Florida courthouse mess are more common: incompetence and opportunism.

The West Palm Beach courthouse had problems even before the first mention of "sick building syndrome" (SBS). Construction on the \$125 million building is running a year behind schedule. The roof needs to be replaced because it leaks and consultants warn it could blow off.

But in late July, an Orlando air expert dropped another bombshell on Palm Beach County — it seems the building's vapor-retardant barrier was installed backwards.

That may sound unlikely, but it's an example of Lstiburek's "regional chauvinism": what's right for the temperate northeastern U.S. may not be right for other regions, yet builders — and some designers — act as if one set of rules applies.

Special Needs

The problem with Florida buildings, Lstiburek said, is that "they suck." Literally.

Outside Florida buildings, it's generally hot and humid. Inside, people want it to be cool and dry. Moisture travels from warm areas to cold ones — by any means it can find. If a building exterior has cracks or holes (as nearly all of them do), the building will act as a sponge, sucking moisture into the interior.

Another problem comes from the interaction of sun and rain. First Florida's violent afternoon storms wet building exteriors. Then the sun comes out and heats the wet surfaces, creating an even larger temperature differential between the warm exterior and the cool interior.

This temperature differential drives moisture into the building cavity.

Moisture in buildings is a fact of life wherever you are — that's why there are vapor-retardant barriers. But how you use them is important.

In the northeast, vapor-retardant barriers are installed abutting the interior wall of the building cavity. That's because in the northeast, most moisture problems arise from people's activities such as cooking and showering.

In the southeast, the moisture threat comes not from within but from without. So vapor-retardant barriers are supposed to be installed abutting the exterior wall.

In the West Palm Beach courthouse, the barrier, in this case insulation with an aluminum foil seal, was installed according to northern design specifications. But before criticizing George Hyman Construction Co., consider this: they were just following instructions printed on the insulation itself by Owens/Corning. Those instructions directed that the foil barrier face the interior wall.

The architect's specifications had the barrier facing the correct way. But after county officials consulted with the architects, the decision was made to install the barrier according to northern specifications.

Band-Aid Repairs

That decision, an Orlando indoor air consultant noted, places the courthouse at risk of sick building syndrome (SBS) from mold growth. Moisture will enter the building cavity through cracks in the exterior and collect against the foil seal — in the insulation. To any indoor air consultant who has seen moldy duct lining, that spells trouble.

Instead of tearing down the walls, the consultant recommended that Palm Beach County make certain the HVAC system continues to work properly. By keeping the building at a positive pressure, moisture problems should be averted. To ensure positive pressure, the consultant recommended that the county conduct some \$20,000 worth of pressure tests in the courthouse each year.

Meanwhile, officials are fuming that somebody will pay for the extra maintenance — and that somebody won't be Palm Beach County.

The insulation debacle in West Palm Beach makes the extent of Lstiburek's regional chauvinism clear: apparently neither a major insulation company nor a builder on a Florida project knew a fundamental tenet of building design in the southeastern United States.

"Florida barriers have to be better," Lstiburek said. "They aren't doing any worse than we are, but there's no forgiveness there."

Polk County Tops List

When it comes to the champion of Florida courthouse nightmares, the title belongs to Polk County.

The Polk County courthouse, which opened in Bartow seven years ago, has become a colossus looming over local politics. Not one member of 1987's Polk County Commission remains in office. One member retired, while the other four were defeated in re-election bids. Their opponents hammered away at the courthouse debacle.

In July 1987, a gala affair celebrated the opening of the \$32.4 million building. Guests admired the courthouse's roof of Portuguese orange tile, but unbeknownst to them, the bricks in the building's exterior were already cracking.

Today, the courthouse has not been used since 1992. The county remains embroiled in a lawsuit with the building's designer, contractor, and subcontractors. Former employees suffering from SBS continue to wage their own legal battle against the builders and the county.

The orange tile roof is gone; all 800,000 bricks have been replaced. Estimates of the building's repair costs have climbed from \$17.7 million in July 1992 to \$33.2 million in July 1994. The original date for completing repairs, late 1993, is long past, with summer 1995 the newest target date.

Polk County officials refer to the courthouse, when their responses can be printed, with words like "atrocious" and "boondoggle." Polk County Public Information Office Director Gene O'Dell calls it "the mother of all sick buildings."

Within a year of the building's opening, mildew and mold were appearing on the courthouse's vinyl wallpaper and old records books. During the summer rains, ceiling tiles and carpets were soaked.

The county filed suit against Lakeland, Fla. architect Wade Setliff, contractor Barton-Malow Co. of Michigan, and various subcontractors in 1988. O'Dell said the county has recovered some \$7.5 million in settlements to date.

The first complaints of illness in the courthouse came in early 1990. That October, the county surveyed the building's employees. Three hundred-sixteen of 367 employees said they had complained about the courthouse's air quality. Two-thirds reported allergy-like symptoms, and nearly half of those respondents said their symptoms cleared up after work. Complaints reported included headaches, lethargy, irritated nose and throat, eye problems, skin irritation and nausea — classic symptoms of SBS.

In 1992, Joseph Jarvis of Denver's National Jewish Center for Immunology and Respiratory Medicine was brought in as a consultant to the county.

Jarvis noted that 440 of 564 employees had SBS symptoms. He said 160 of the 440 "definitely" had SBS problems, and that 56 employees' symptoms had symptoms that might point to allergic reactions in the lungs — a hallmark of hypersensitivity pneumonitis.

Based on Jarvis' findings, in April 1992 the County Commission unanimously agreed to evacuate the courthouse over the next two months. Repair work began in July 1992.

'Worst Construction Job'

The list of repairs, and the problems found, are staggering.

Polk County's SBS problems began in classic Florida style, with a negatively pressured building interior and cracks in the exterior. Windows and expansion joints were improperly installed. The building's flashings were installed backwards, directing water into the building. Borings discovered missing or improperly installed steel reinforcement bars, anchors connecting bricks with the concrete walls under-

neath, and waterproofing and fire-resistant materials.

Palm Beach County had its vapor-retardant barrier installed backwards; the builders of the Polk County courthouse never even installed one.

Hill International, the contractor for the courthouse repairs, called it the worst construction job they'd ever seen — an assessment O'Dell concurred with.

"As they got into it and tore those bricks off, they found outrageous things," he said. "They had no way of knowing what was behind those walls."

Every brick was removed, a vapor-retardant barrier installed, and every brick replaced. The orange tile roof was replaced with a copper one that wouldn't leak. New flashing and sealing materials were placed around the windows. The HVAC system was reworked to create positive pressure in the building and reduce humidity.

Before repairs began, some suggested the county simply tear the courthouse down and start over. County officials rejected the idea, noting that such a course of action would have demanded moving the courthouse to a new site outside the Bartow city limits, for a price tag of around \$50 million.

Repair costs, originally estimated at \$17.7 million, are currently estimated at \$33.2 million, nearly twice that.

Problems Throughout Building

The construction work soon began to fall behind schedule and climb over budget as the extent of the courthouse's flaws became apparent.

In January 1993 it was discovered that the courthouse's tower suffered from far worse mildew problems than had been expected. More drywall had to be removed than the county had budgeted for.

In March an environmental consultant nixed the county's plan to clean up parts of the building while construction continued elsewhere, recommending that cleanup wait until all renovations are complete. That delayed the building's reopening an additional six months and added some \$720,000 to the price tag.

Then in May, consultants tested the air in a cleaned temperature-control box in the courthouse's HVAC system and found more mold spores than had been recorded in 1992. The problem, they concluded, was that humidity got into the building in the summer of 1993, when windows were removed for repairs.

The commissioners voted unanimously July 15 to replace the ductwork in the HVAC system. That's another \$3.2 million and six to nine months more construction.

Ironically, the county has benefited from one aspect of the disaster. O'Dell and Randy Oliver, the County Courthouse Coordinator, decided that some good could come of Polk County's misery if the lessons learned there were applied elsewhere.

O'Dell and Oliver, by now unwitting experts on sick building syndrome, formed the Institute for Sick Buildings and sponsored a seminar on SBS in the summer of 1993.

The Institute's seminar attracted some 175 construction, legal and medical professionals and turned a \$19,000 profit, which was put back into the repairs contingency fund.

O'Dell said he hoped the institute might sponsor another seminar next year — one that would feature a reopened courthouse.

More than one person has wondered why so many courthouses seem to be riddled with indoor air problems. What's so special about courthouses, anyway?

For Joseph Lstiburek, the answer is: nothing. The key is not courthouses, but who's inside them — lawyers, judges, legal clerks and assistants. People who are up-to-date on current issues and on prospects for litigation. And their concerns, he added, are fueled by "a lot of consulting firms blowing things out of proportion."

"Courthouses aren't experiencing any worse problems than other buildings down there," he said. "But then you superimpose a litigious atmosphere and a feeding frenzy from consultants."

Lstiburek noted that another common venue for indoor air quality fears is schools. Are schools' indoor air problems so much worse than other buildings? Or, like courthouses, is it that more concern is focused on schools than on other places?

The laws of physics, Lstiburek noted, "are the same. How does the mold know it's a courthouse? That's the question. [The mold] does-

n't — but the consultants sure do."

With "regional chauvinism" so prevalent, the final lesson from Florida's courthouse debacles may be a grim one indeed. Unless the lessons of regional design reach insulation manufacturers and builders, courthouses and schools may soon have lots of company as more and more types of buildings become the object of fear, litigation, and costly repairs.

"If the money spent on testing was spent on mitigation," Lstiburek said, "we wouldn't be having these problems." ■

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Frequent Symptoms of SBS Found to Be Real

This editorial appeared in the March issue of *American Journal of Public Health*.

In the past two decades, increasingly frequent episodes of symptoms—headache; lethargy; eye, nose and throat irritation; breathing difficulties; and dry skin—among occupants of large, mechanically ventilated buildings have aroused public concern.

Although explanations have sometimes been found for symptoms reported in individual buildings, in many buildings neither specific diseases nor evident causes have been identified. The lack of environmental explanations, along with evident psychological distress in the workers, has to some suggested "mass psychogenic illness"; however, such illness has specific diagnostic criteria that the health complaints in these episodes rarely fit. Furthermore, available studies suggest some of these occupant symptoms involve physiological responses to environmental exposures.

The role of building ventilation in this phenomenon is not well understood. Inadequate ventilation is a suspect in many symptom episodes, yet this suspicion is based on little actual knowledge about the relationship between ventilation and health.

Building ventilation is the movement of outdoor air into a building, either mechanically or by infiltration. An important aspect of ventilation is the volumetric rate of outdoor air per person brought into a building—that is, the outdoor air ventilation rate.

Before the energy crisis of the 1970s, the minimum recommended outdoor air ventilation rate in the United States was 20 cfm/p (cubic feet of air per minute per person); this rate was based primarily on the need to control odors produced by the occupants themselves. In the 1970s, this recommended minimum was lowered to 5 cfm/p to reduce energy costs. Later in the decade, the phenomenon of symptom complaint episodes, sometimes referred to as sick building syndrome, first appeared. As this syndrome was thought to be related to inadequate ventilation, the minimum ventilation guidelines were raised over time back to 20 cfm/p, the current minimum for offices.

Historically, these guidelines, produced through consensus by organizations such as the American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE), have been incorporated into building codes and other regulations as standards, setting the minimum outdoor air ventilation rate that the ventilation system in a new building must be designed to provide. In theory, a building should then actually provide the prescribed amount of outdoor air, but in practice, building codes have not been used for this kind of enforcement. In effect, practically enforceable standards for the delivery of outside air into occupied buildings have been rare. Only recently have proposed or established indoor air quality statutes in several states (such as California, New Jersey and Washington) defined such explicit standards for outdoor air ventilation.

Current Knowledge

Since we do not yet understand the nature, distribution or toxicity of the many sources of indoor exposures, we have a limited scientific basis for considering current buildingwide outdoor air ventilation

guidelines to be health protective. Given the impracticality of collecting toxicity information on all indoor pollutants of concern (including odorants, toxicants, allergens and infectious agents), empirical data on worker symptoms at different outdoor air ventilation rates may be useful in setting guidelines that will reduce occupant symptoms in most buildings.

Studies are needed in a greater variety of buildings, over longer periods of time, and with improved measurements of the outdoor air ventilation rate, various indoor exposures and health outcomes. Measurements should assess ventilation rate variation within buildings. Experimental studies will allow the strongest inference, but observational studies of many buildings can also contribute.

Research on office worker symptoms must also consider more than outdoor air ventilation, because even buildings with high levels of outdoor air ventilation can have large proportions of workers with non-specific symptoms. These symptoms are clearly of multifactorial origin; epidemiologic studies have found their substantial occurrence in every large building, workspace, job and personal/psychological factors.

Examples of implicated factors include air-conditioning systems, temperature, humidity, carpets, poor office cleaning, work stress and female gender. Increasing the ventilation per person may help reduce symptoms caused by indoor-generated pollutants; however, increased ventilation would not eliminate symptoms related to psychological stressors, temperature or humidity, outdoor air contaminants, or contaminants produced within ventilation systems.

Existing scientific findings suggest that standards for outdoor air ventilation rates in occupied buildings may be reasonable, particularly if bolstered by additional research. But as ventilation standards alone cannot be sufficient to guarantee adequate indoor air quality, we must look beyond minimum ventilation requirements to consider the proper design, construction, operation and maintenance of buildings and their ventilation systems. More research is necessary here as well; however, based on current knowledge, EPA and the National Institute for Occupational Safety and Health have compiled some practical approaches to the prevention and resolution of health and comfort concerns related to indoor environmental quality.

We should not ignore these health problems of office workers simply because they involve nonspecific symptoms and multifactorial causes and because we have generally failed to identify simple solutions. Even nonspecific symptoms, when commonly experienced in the large population of indoor workers, are of public health importance and probably of economic importance as well. We will be able to minimize these symptoms only when we more fully understand the requirements for truly healthy indoor environments.

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