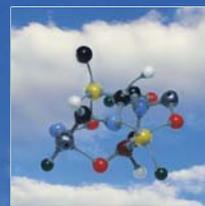
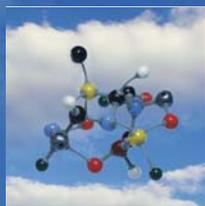
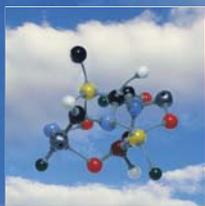
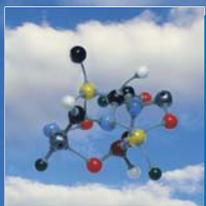
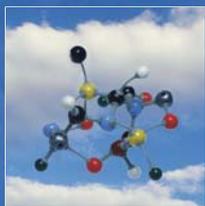
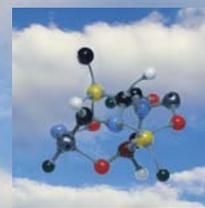
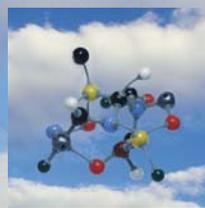
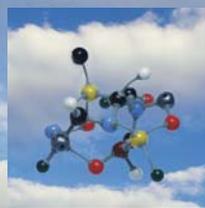
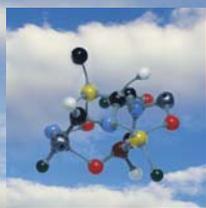
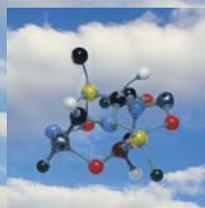


MANAGING THE RISK OF MOLD IN THE CONSTRUCTION OF BUILDINGS



Part I: Mold and Its Health Effects	12
Part II: What Mold Needs to Grow	13
Part III: Building Design, Materials, and Systems	18
Part IV: Construction Schedule and Sequence	22
Part V: Options to Consider	27
Part VI: Building Operation and Maintenance	28
Conclusion	31
References	31



GUIDANCE FOR BUILDING OWNERS, CONSTRUCTION CONTRACTORS AND OTHER PARTIES TO THE CONSTRUCTION PROCESS

Developed by the Mold Litigation Task Force of the
Associated General Contractors of America, Inc.

Chairman: Rick Poppe, The Weitz Company
Vice Chairman: Steven Charney, Peckar & Abramson

First Edition: March 2003

INTRODUCTION

Over the last few years, the discovery of mold in homes, schools, churches, courthouses and other public and private buildings has fueled a legal firestorm. Trial lawyers have started filing claims and cases at an alarming rate. The defendants include building owners, construction contractors, design professionals and other parties to the construction process.

One might think that mold is something new, or that today's mold is somehow different. The truth, however, is that molds are among the oldest forms of life on earth. The most obvious of the often-overlooked facts is that molds are naturally occurring organisms. There are thousands of different molds, and none of them are new.

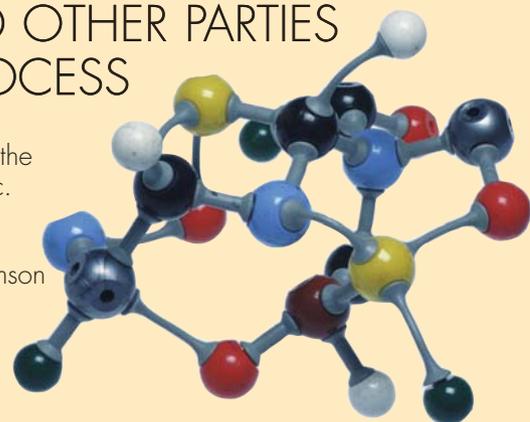
On the other hand, many questions about the potential health effects of various molds remain difficult to answer. The appropriate protocols and procedures for dealing with these molds are just as far from certain. Different molds affect different individuals in different ways, complicating any effort to set exposure limits. Certain molds can produce "mycotoxins," but the scientific community has yet to develop convincing evidence that these chemical compounds have toxic effects when inhaled in the relatively low concentrations being found in buildings.

Nevertheless, the claims and the litigation are real, and the costs of both are enormous. Moreover, it has become clear that neither building owners nor construction contractors can count on the insurance industry to cover those costs. Property insurance policies have long excluded any property damage or bodily injury resulting from building operation or maintenance. Going forward, builders risk and other property insurance policies are very likely to exclude mold arising from the perils that they do cover. Both

building owners and construction contractors are also likely to find mold excluded from their commercial general liability policies. For some period of time, building owners and construction contractors will need to find some other way to manage the risk of mold claims or litigation.

The critical if limited purpose of this document is to help the primary parties to the construction process manage that risk largely on their own, and without the benefit of the insurance coverage they have enjoyed in the past. This document proceeds from the basic premise that building owners, construction contractors and design professionals will all be more successful if they systematically sort through the major issues that mold raises. Construction contractors are responsible for the way they handle and store construction materials on the site of the work, and for ensuring that their employees and subcontractors perform in accordance with the plans, specifications and other contract documents. Design professionals are responsible for the design of a building's envelope and its HVAC and other mechanical systems, including design details that often have the potential to cause or prevent what some would consider a mold problem. Both design professionals and building owners are responsible for the building materials and systems that they specify. And, of course, owners are responsible for the operation and maintenance of a building following its completion.

This document explains the basic science of mold and how the construction process bears on the risk that the mold in a particular building will reach a level that some would consider unacceptable.¹ It seeks to identify most of the decisions that can significantly increase or decrease that risk. It also seeks to clarify the role that building owners should expect their construction contractors to play, and how



Note: This document is intended to help the various parties to the construction process understand the basic science of mold and how the construction process bears on the risk that the mold in a particular building will reach a level that some would consider unacceptable. This document is not intended to provide specific guidance on the "best" or even the "correct" way to construct, operate or maintain a particular building. Nor is it intended to create any obligations, or to establish any specific standards or guidelines, for managing the risk that mold will infest a particular building. Each construction project is unique. Each building is unique. The information included in this paper is necessarily general in nature.

This document is not a summary or statement of work or other business practices required by any government or other public body, or intended to provide legal, medical or other professional advice. This document is not an exhaustive treatment of the subjects that it covers.

Finally, this document should not be understood or construed as an undertaking to perform services on behalf of any party, either for that party's own protection, or for the protection of third parties. The Associated General Contractors of America, Inc. assumes no liability for reliance on the contents of this document.

design professionals fit into the picture. While building owners have to look elsewhere for expertise on the science of mold, they can and should expect their construction contractors and design professionals to support any special effort to manage the risk of a mold infestation.

As the reader will soon discover, neither the owner nor any of the other parties to the construction process can guarantee or warrant that a building will be free of mold. Mold spores are literally everywhere. They are microscopic in size and flow naturally through the air. Every existing building already has these spores in it, and every new building will surely have them. In addition, every building either has or will have the oxygen and organic matter that these spores need to grow. The only variable is water. And there is no simple or single way to control it.

If mold infests a new or renovated building, all of the parties to the construction process are, however, sure to lose. Tenants and other occupants will seek compensation from everyone

(continued)

involved in the construction process. By the time that property owners file their own lawsuits or insurance claims, these owners have already suffered losses. At the same time, it is clear that the only program that can effectively avoid either claims or litigation is a risk management program that all of the parties are prepared to implement. No one party can take all of the steps necessary to protect its interests. It is most important to get all of the parties to the process on the same page.

The keys to success are communication and collaboration.² Buildings owners, construction contractors and design professionals should discuss the subject of mold before the construction of any building begins, and as necessary, they should continue to talk and work together throughout the course of construction. Each party has an important role to play. Each one needs the others to succeed.

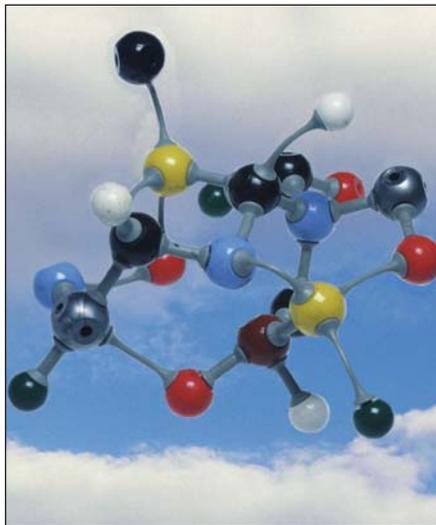
PART I

MOLD AND ITS HEALTH EFFECTS

Scientists classify living organisms several different ways, taking into account their genetic makeup, cellular structure, ecological niche, similarities and other factors. Most common schemes recognize anywhere from five to seven “kingdoms” of life. In addition to plants and animals, these schemes put viruses, bacteria, other microbes, and “true” fungi into their own kingdoms. While the classification schemes vary in their detail, all of the modern schemes consider fungi to be a kingdom of life—a separate and distinct component of life on earth.

The “true” fungi fall, in turn, into three major subgroups: the mushrooms, the yeasts, and the molds. Typically, mushrooms have a pulpy or woody structure and a mycelium base. Yeasts are unicellular organisms that do not normally form either woody structures or mycelia. Molds are a bit different from both. Molds do not have the stems, caps, or other structures that characterize mushrooms, but they are generally more complex than yeasts. Some molds are “dimorphic” organisms capable of taking more than one shape or form. At times, dimorphic organisms are single-celled organisms or simple clusters of cells. At other times, they are complex structures not very different from the simpler mushrooms.

Like animals, fungi consume organic compounds. Fungi depend on their external environment for the complex carbon-based molecules they need to survive and grow. Neither animals nor fungi can make their own food from the relatively



All molds require a certain amount of moisture. They need water to absorb nutrients into their cells and to release extra-cellular enzymes, metabolites and waste products. Molds also need water to maintain their form and shape.

simple compounds found in the soils. Neither animals nor fungi have chlorophyll, and for that reason, neither can perform photosynthesis. Animals, however, are self-propelling. They can seek out the nutrition that they need. Fungi cannot. Fungi have to depend on other organisms or on the forces of nature (such as the wind) to carry them to a food source, or to bring them food.

Molds live and grow in almost all terrestrial locations.³ Indeed, they are so common that they require significant effort to avoid. Mold spores and mold fragments are in the air we breathe every day. They literally float all around us. The only natural environments free of mold are underwater and in the deepest regions of the Arctic and the Antarctic. People living and working in our cities and towns are truly free of mold only in the clean rooms of our high-tech industries and similarly artificial environments.

In recent years, the television and print media have begun to portray mold as something often “toxic” and always to be feared. In the process, the media has also glossed over some fine but important points. Molds and other fungi can and do have serious health effects on certain peo-

ple. The number and nature of these effects are, however, far from certain. Indeed, they remain the subject of much study and debate. In addition, mold and other fungi are important, indeed critical, to the future of our environment. Without these organisms, we would literally drown in our waste. Mold and other fungi are the most important members of nature’s recycling crew.

Fungi also play an enormous role in the food and beverage industry. Consumers purchase an estimated one million tons of the common supermarket mushrooms every year. Among the world’s delicacies are a wide assortment of oyster, shiitake, paddy straw, velvet stem and other mushrooms. Truffles command astronomical prices, ranging up to \$50 per ounce. (Mushrooms also have a darker role in the history of the human diet, accounting for a large number of both intentional and accidental poisonings!) Yeasts provide the fermentation needed to make wine, beer and other alcoholic beverages. They are also responsible for the unique texture and flavor of most raised breads. Molds provide a wide range of foods and food intermediates, including shoyu (soy sauce), miso, and a variety of Asian food products. Molds also produce a wide range of medicines, ranging from antibiotics to anti-tumor drugs. One fungal metabolite even seems to hold promise in the treatment of diabetes.

Significantly, it is the media, and not the scientific community, which has coined the phrase “toxic mold.” Presumably, the media intends the phrase to refer to any mold that produces “toxic” compounds. Often included in the list are *Stachybotrys chartarum* and various species of *Aspergillus*, *Alternaria*, *Acremonium*, *Cladosporium*, *Fusarium* and *Penicillium*. The scientific community does not, however, consider all of these molds to cause the same or even equal problems.

Under certain conditions, these and other molds can produce chemical compounds called “mycotoxins.” Most of these chemical compounds are the normal byproducts of the metabolism of mold. One common and innocuous example of a mycotoxin is the alcohol that yeast produces during the fermentation of beer and wine. The scientific community has studied many of these compounds and it has well documented the health effects of ingesting them. The scientific community does not, however, have comparable evidence of the health effects of inhaling these compounds, particularly in the relatively low concentrations being found in buildings. Some scientists maintain that

inhaling these compounds in even these concentrations can have serious and even toxic health effects. On the other hand, several recent studies have found little evidence to support that conclusion.

The environmental conditions under which various molds will produce mycotoxins are also far from certain.⁴ When, how and even whether a particular species will actually produce mycotoxins all seem to depend on several things, including but not limited to the food source, the ambient temperature, and the amount of available moisture. Even the most suspect molds may or may not produce any mycotoxins at all, depending on the environmental conditions.

The Texas Medical Association has found that “[a]dverse health effects from inhalation of *Stachybotrys* spores in water-damaged buildings is not supported by available peer-reviewed reports in medical literature.”⁵ The American College of Occupational and Environmental Medicine (ACOEM) has similarly found:

Molds growing indoors are believed by some to cause building-related symptoms. Despite a voluminous literature on the subject, the causal association remains weak and unproven, particularly with respect to causation by mycotoxins.⁶

In its position paper on mold, the ACOEM adds:

Levels of exposure in the indoor environment, dose-response data in animals, and dose-rate considerations suggest that delivery by the inhalation route of a toxic dose of mycotoxins in the indoor environment is highly unlikely at best, even for the hypothetically most vulnerable subpopulations.⁷

In addition, peer-reviewed studies in the scientific literature have shown that *Stachybotrys* is frequently found in the outdoor air in certain geographic areas, and further, that this mold is found at levels that may generally exceed the levels found in the indoor air of some of the buildings of current concern.⁸

The bottom line is that the scientific community has yet to reach anything approaching a consensus on the health effects of inhaling mycotoxins in the relatively low concentrations found in some buildings. Different researchers have come to different conclusions.

That molds play a significant role in human health is, however, well documented. The U.S. Environmental Protection Agency has accurately reported that many and perhaps all molds can have

health effects. Molds can trigger a wide range of allergic reactions in sensitive individuals, including eye, nose and throat irritation, dermatitis, and a generalized worsening of asthma or respiratory distress. In recent years, the country has also seen an increase in the number of opportunistic infections, primarily among people with compromised immune systems.

Several species of mold can also cause infections to the surface of the skin. Ringworm (tinea) and athlete’s foot are common examples. Thrush (oral candidiasis) is another example, common among newborn infants. Molds can also cause subcutaneous infections, such as sporotrichosis, particularly in tropical and near-tropical climates, where higher humidity levels may encourage fungi and fungal growth.

Fungi can also cause systemic infections, such as histoplasmosis, a pulmonary infection endemic to the Mississippi and Ohio valleys, where as many as 40 million people may have had the disease—most without even knowing it. Other and often more serious examples include coccidioidomycosis (Valley Fever), cryptococcosis, blastomycosis, aspergillosis, and systemic candidiasis. Rarely, more severe conditions, such as Organic Dust Toxic Syndrome, or hypersensitivity pneumonitis, can develop.

The broader scientific community associates many of these infections with the dimorphic organisms noted earlier, but not with mycotoxins. This is significant, at least in part, because several of the dimorphic organisms normally and commonly live in the human gut or on mucus membranes. For example, *Candida albicans* is a yeast that commonly grows in the mouth, gut or vagina of as much as half of the healthy population. While it can have serious health effects, it is normally kept in check by a combination of bacterial competition and natural defenses.

In sum, molds and other “true” fungi are an important component of life on earth. They depend on their external environment for their nutrition. They do not contain chlorophyll, and they cannot perform photosynthesis. While they have to depend on other organisms or the wind to carry them from one location to another, they live and grow in almost all terrestrial locations.

In recent years, the media has begun to portray them as something inherently dangerous. The scientific evidence does not, however, support that proposition. Certainly, molds can trigger allergic reactions in sensitive individuals, and the country has seen an increase in the number of opportunistic infections among

people with compromised immune systems. At the same time, molds appear to have only minor effects on the healthy adult population, and those effects seem to end with the exposure. In the future, the scientific community may conclude that mold can and does have more than minor health effects on most healthy adults, but today, the scientific community does not seem prepared to go that far.

As for mycotoxins, the scientific community has yet to reach anything approaching a consensus on the health effects of inhaling these chemical compounds in the relatively low concentrations being found in some buildings.

PART II

WHAT MOLD NEEDS TO GROW

Molds are resilient organisms that need only oxygen, organic material, water and a safe place to grow. Indeed, they are amazingly tolerant of environmental extremes. Some species can tolerate temperatures that range from 23° to 140° Fahrenheit. Many species can also tolerate extreme acidity or alkalinity. If mold has the opportunity to grow, it will do so. Moreover, it will grow exponentially.

The problem, of course, is that our schools, churches, courthouses and other public and private buildings always meet at least three of these four needs. Indeed, the ideal environment for growing most molds is close to, if not the same as, the environment in which humans are most comfortable. Both humans and molds require oxygen, food and water, and at least some protection from the elements.

Some molds can tolerate extremely low oxygen levels, but even these molds are not anaerobic. It follows that completely eliminating oxygen from our buildings would eliminate the risk of a mold infestation. That would, however, defeat the very purpose of any building intended to provide a place for humans to live, work, play, pray or do anything else. Not only molds but also humans need oxygen, and a school, hospital or office or apartment building that failed to maintain adequate levels of oxygen would be useless.

Like other fungi, molds normally get the nutrients they need from the various materials to which they attach. Molds can be cultivated on most organic substrates. It follows that finding substitutes for all of the many building materials that contain organic compounds would reduce the risk of a mold infestation, but even that strategy would not reduce the risk to zero. Several species can even grow on non-organic substrates, either

(continued on page 16)

feeding off organic matter that the wind carries to them or capturing the food they need in other ways. Some risk of a mold infestation would still exist.⁹

The point, however, may be little more than academic. In the vast majority of cases, it would be impossible to find cost-effective substitutes for all organic building materials. Common examples of such materials include the paper that clads dry-wall, all lumber and acoustic tiles, and all of the many other materials that contain some form of cellulose. In the past, the manufacturers and suppliers of these materials often treated them with formaldehyde or other chemicals that would inhibit the growth of mold. Today, things are different. For environmental and other reasons, manufacturers and suppliers have stopped using such chemicals, and as a result, the risk that these building

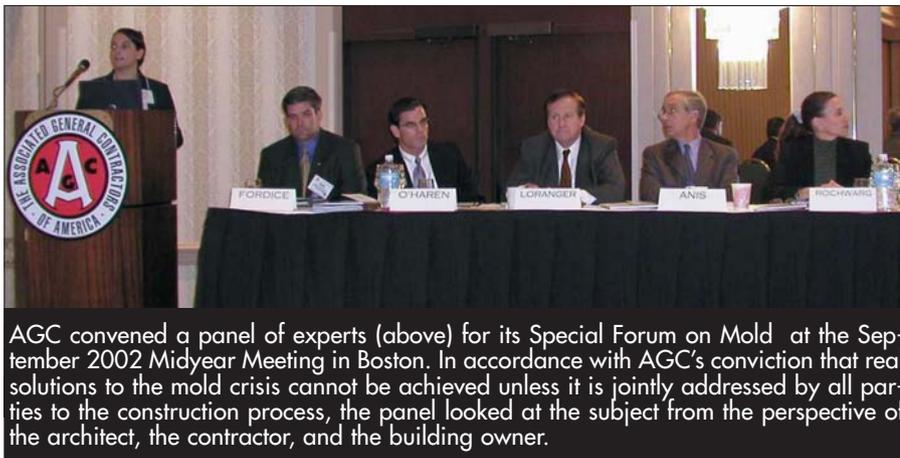
the parties to the construction process have to contemplate and account for the various ways that water or moisture may enter or accumulate in a particular building. Unless properly designed and constructed, and subsequently maintained, the building site may permit excessive volumes of either surface or underground water to reach the foundation, and once there, such water may well threaten to penetrate the foundation. Outside air can carry ambient moisture and humidity into a building through any openings in the building envelope, such as doors and windows, or through any ventilation ducts or shafts that pull outside air into the building. Obviously, storms can also cause water to penetrate such openings. Mechanical, plumbing and other systems, including vapor barriers, can cause water to condense in various locations.

envelope, or through any leaks that may develop over time. Among the highest priorities in this effort are the HVAC system and the building envelope, including the roof. Also important but often overlooked are the hardscape and landscape exterior of the building, including any plants that could trap moisture and provide protection for mold. Owners also have to control all water used to clean and otherwise maintain the building.

Experts can measure the amount of moisture in building materials both during and after construction. Contractors commonly refer to the percentage of water content. Dry kilned wood, for example, has a residual water content of approximately 11% to 14%. The percentage of water content is not, however, capable of accurately predicting whether mold will grow on the material. Not all of the water in the material is available for mold growth. Experts are therefore likely to focus on the "equilibrium relative humidity" (ERH, or sometimes just RH). The ERH measures the ratio of the water vapor pressure in a given material to the vapor pressure of pure water under the same conditions. By measuring the water vapor pressure, experts can come closer to measuring the amount of water that is available for mold growth. A value of 70% is the approximate lower limit for most fungal growth.

Another common term, derived from the food industry, is "water activity," symbolized as "aw." This measure is favored by the American Conference of Governmental Industrial Hygienists (ACGIH), and is equivalent to the ERH, but expressed as a decimal or fraction, and not a percentage. Thus, a substance with a water activity (aw) of 0.7 would have an ERH of 70%, and vice versa. A water activity level of 1.0 is pure water. Meters are available that will perform these measurements, including both portable and laboratory versions. While some of these meters are a great deal more complex than the common two-prong moisture meters, they can greatly improve the measurement of the moisture available for mold growth.

It would not, however, be reasonable to expect one or more of the parties to the construction process to engage experts continuously to measure the amount of moisture in any and all building materials throughout the course of construction. Nor would it be reasonable to expect owners continuously to measure the moisture in all areas of all completed buildings. It might be useful to measure the moisture in certain materials or areas



AGC convened a panel of experts (above) for its Special Forum on Mold at the September 2002 Midyear Meeting in Boston. In accordance with AGC's conviction that real solutions to the mold crisis cannot be achieved unless it is jointly addressed by all parties to the construction process, the panel looked at the subject from the perspective of the architect, the contractor, and the building owner.

materials will support the growth of mold is actually higher than that it used to be. As noted below, the parties should consider substitutes for organic building materials on a case-by-case basis, but it would be too much to expect the parties to find cost-effective substitutes for all of them.

All molds also require a certain amount of moisture. They need water to absorb nutrients into their cells and to release extra-cellular enzymes, metabolites and waste products. Molds also need water to maintain their form and shape. Different mold species require different amounts of water, and some species are amazingly tolerant of drought, but all molds require some amount of water to grow and reproduce. Many of the so-called "toxic molds" can tolerate conditions well below those that cause wilting of most common plants. All molds, however, require water, and some of the "toxic molds" seem to need more water than other molds.

Therein lies the key to reducing the growth of mold in buildings. To minimize the risk of a mold problem, all of

Unless properly trained, maintenance crews can also create problems. All of these factors require serious consideration throughout the life of a building.

Each party involved in the building process has a critical role to play. At the outset, the architects and engineers have to design the building properly, and both design professionals and building owners have to select appropriate materials and systems. During construction, contractors have to protect these materials from water damage, to handle them in accordance with any requirements that manufacturers have established, and to install them in accordance with the contract documents. Contractors also need to account for any water that any construction process may require.

Following completion, owners have to operate and maintain the building properly. Owners and their maintenance personnel have to control the water that enters or accumulates in the building through ventilation systems or water pipes, through openings in the building

(continued on page 18)

of a building, perhaps at certain times, but nothing would seem to justify any kind of blanket rule.¹⁰

On the other hand, it would be reasonable to expect one or more of the parties to react, in some fashion, to any visible sign that mold is growing on building materials. As already noted, mold grows exponentially. The sooner someone takes action, the smaller any problem will be.

Exactly who should react, and exactly how, will depend on many things, including when, where and how the mold is discovered. Contractual arrangements are critical to consider. And so are the amount and nature of the mold. While it is important to act, it can be very costly to overreact.

Unfortunately, there are few guidelines for mold assessment or remediation. In the past, it was common to clean moldy materials with bleach. In the future, much more will be expected. Bleach simply cannot kill the mold inside a material. It cannot prevent a mold problem from recurring.

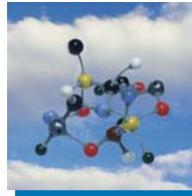
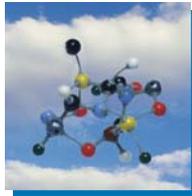
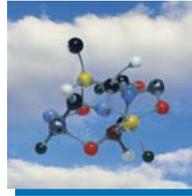
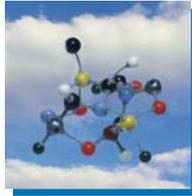
The most commonly cited guidelines for mold remediation are the guidelines that New York City has published.¹¹ They are entitled "Guidelines on Assessment and Remediation of Fungi in Indoor Environments" and they are posted on the city's web site at www.ci.nyc.us/html/doh/html/epi/moldrpt1/html.

The U.S. Environmental Protection Agency (EPA) has also published guidelines, entitled "Mold Remediation in Schools and Commercial Buildings." They are posted on the agency's web site at www.epa.gov/iaq/molds.

PART III BUILDING DESIGN, MATERIALS AND SYSTEMS

It is relatively simple to suggest that we have to control the various ways that water may enter or accumulate in a building. It is quite another thing to exert such control. Water is a tireless foe that will forever seek to enter buildings and accumulate in unwanted areas. Design professionals, construction contractors and building owners can and should minimize the risk of high humidity, condensation or other water in a building. Product manufacturers should also do their part. But no one should equate such an effort with a guarantee of success.

To minimize the risk that a tenant or other occupant will nevertheless leap from any discovery of mold to the conclusion that someone must have been negligent, the owner and its design professional should start raising questions



The bottom line is that the scientific community has yet to reach anything approaching a consensus on the health effects of inhaling mycotoxins in the relatively low concentrations found in some buildings.

about mold during the design and development phase of the project. The decisions made during this early period can and do affect everyone's legal risks, and indeed, they may affect those risks just as greatly as the actions taken during the actual construction, operation and maintenance of a building. As the owner and its design professional conceive and draft the plans for the building envelope, and begin to identify the materials and products they will specify, they should appreciate that many of their early decisions will either increase or decrease the risk of mold.

At this point in the process, the owner and its design professional have a golden opportunity to consider all of the potential causes of excessive moisture and ultimately mold. Proper attention to the design and detailing of the building can make a big difference. The owner and its design professional can systematically consider the climate, temperature, relative humidity, type of envelope, dew points, outside air requirements, and intended occupancy. A "tight" building envelope is obviously desirable. A good design will, however, include a "contingency plan" to allow the interior to dry out if—and inevitably, when—water does enter. Owners and their design professionals can also address the many

internal sources of water, including the HVAC and plumbing systems.

During this phase of the project, the owner and its design professional should also consider the pros and cons of arranging for a peer review of the designs they develop and the materials and products they specify, including the envelope and HVAC system. While such a peer review is likely to have some cost, it could also put both the owner and the design professional in a much better position to demonstrate—if necessary—that they took every step that a reasonably prudent person would normally take.

In any case, such a peer review would help the owner and the design professional ensure that they have fully considered all of the many trade-offs between the cost of construction and the risk that the mold in the building will reach levels later considered to be excessive. Some building materials are less expensive than others, and specifying those materials can cut the cost of construction. In the process, however, the owner and its design professional may also increase the ultimate cost of keeping the mold spores in the building under control. While some of the newer and mold-resistant drywall costs more, it may still be the most cost-effective way for a particular owner to go. Such drywall is among the materials that at least promise to reduce the risk that the mold will ever get out of control.¹² Owners and their design professionals also have the option of specifying that the contractor shall spray microbial inhibitors to any wood framing in areas that will enclose plumbing. Humidistats are another option. At relatively little cost, these devices may help the owner exert direct and consistent control over the relative humidity inside the building.

Unfortunately, the trade-offs between cost and risk are easy to overlook. The design, development and construction phases of a project are all stressful. Once the drawings are 75% complete, many an owner learns that its project is over budget. Hoping to save money, the owner may, for example, consider changing the brick or stone veneer to a synthetic stucco product. What does such an owner really need to consider? Is it enough for the owner to determine and compare the cost of constructing its two alternatives?

The answer, of course, is no. Notwithstanding the pressure to meet its construction budget, the owner has to recognize that the total cost of changing the building envelope may be much greater than the immediate savings in the cost of construction. Whether acknowledged or not, the

total cost includes at least the cost of ensuring that the veneer continues to perform in the intended manner over the life of the building. It could include, in the worst case, the cost of mold remediation and/or litigation. In this hypothetical situation, some of the questions that the owner would need to discuss with its design professional and even its construction contractor include the following:

❑ Is the new exterior surface more likely to crack?

❑ If it did crack, how difficult and expensive would it be to repair? And how would any repair affect the appearance?

❑ How would the design professional account for the fact that this building—like all others—is certain to move?

❑ Could the contractor (or its subcontractor) get insurance coverage for the products that would be specified? Are insurance carriers excluding coverage for either the installation or the use of these products? Could the owner get insurance coverage for the completed work?

❑ If and when water got behind the exterior surfaces, how would it get out? What would provide the backup moisture protection? Would the materials behind the exterior be susceptible to moisture?

❑ To what extent would the exterior system depend on high performance sealants (such as silicone or urethane)? Would these sealants work with the particular product that the owner has in mind?

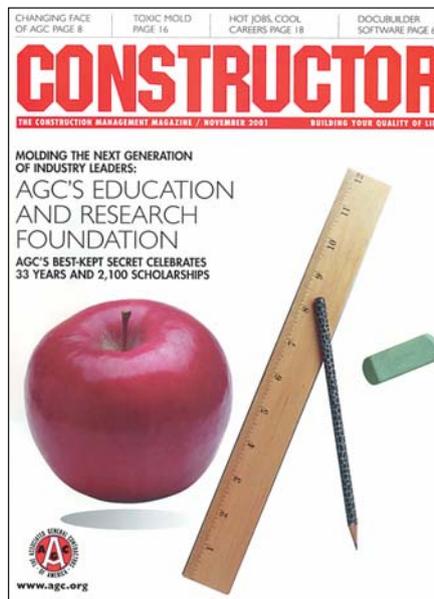
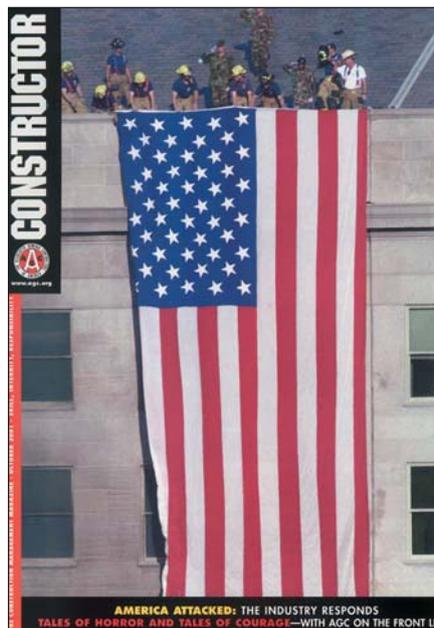
❑ How frequently would the exterior require inspection? How frequently would the owner have to caulk the exterior of the building?

❑ How much would the owner have to budget for maintenance?

Under pressure to keep a project within budget, the owner and its design professionals may pay too little attention to the long-term costs and risks of their decisions. Those costs and risks are nevertheless real, and if ignored, they will, soon enough, become immediate problems.

Few contractors are licensed to practice architecture and even fewer are empowered to make budgetary decisions. Many contractors can, however, help owners identify both the immediate and the long-term costs of various alternatives. Contractors can also help owners identify many of the specific questions that owners need to discuss with their design professionals. Many if not most of these questions are likely to fall into the following areas:

Building Envelope. This is the primary barrier to any water intrusion. The building envelope must be continuous in



CONSTRUCTOR published an award-winning, three-part series on so-called "Toxic" Mold in the October, November, and December 2001 magazines. The series won a Silver Award from the American Society of Business Publication Editors. You can download the articles at no charge by logging onto www.constructormagazine.com and clicking on the second hot button down, "Archives 01/99 To Present."

order to provide a solid shield to water entry. The transition points of each material are significant risk areas, and designing multiple materials into the envelope will multiply the risk. Flashings are particularly noteworthy because the design may omit the details necessary to construct an envelope that is and will, with proper maintenance, remain watertight. Caulk is simpler but requires careful application and continuous maintenance.

Windows and Doors. Almost all of these openings provide opportunities for water intrusion. Door thresholds that fully comply with the Americans with Disabilities Act are very important but, at the same time, they can make it easier for water to enter. Windows are likely sources of leaks. Flashings can, however, anticipate this problem and direct water out of the building. The selected window and door products are major factors to consider. When selecting additional hardware, such as door sweeps, climatic and other conditions need to be considered.

Roofing Systems. Owners and their design professionals need to select their roofing systems very carefully. These systems are among the most important barriers to water penetration. Because they are impermeable, roofing systems also trap moisture inside a building. The last 20 years have witnessed significant changes in roofing products, including their value and integrity. For health and environmental reasons, and to control costs, entirely new products have become available. The size of individual roofing pieces, and the insulation and other components of modern roofing systems, often make it very difficult to identify the source of any water penetration or the extent of saturation. In general, more expensive systems provide better and longer protection (and warranties).

Owners also need to ensure that the roof design and installation both follow the manufacturer's instructions. Indeed, it may be advisable for the owner to require an independent inspection by a qualified roofing inspector (and/or a manufacturer's representative). Even if

(continued)

the owner does, the roofing system may not, however, meet the owners' expectations. Manufacturers are continuously updating their products and revising installation details to improve their results. In addition, HVAC systems, plumbing systems and skylights and the like often require a bewildering pattern of penetrations through the roof system. The construction contractor should be sure to install the system in accordance with the contract documents, and should avoid damaging a completed roofing system, but everyone needs to note that many external factors affect the way that a roof ultimately performs.

Vertical Enclosure Systems. Virtually all vertical enclosure systems absorb moisture or permit it to penetrate, not because they are poorly designed or constructed, but because virtually all of them are made up of a number of different materials. Changes in temperature and exposure to the sun cause the different materials to expand and contract at different rates. Unless designed and constructed with tolerances that will allow the materials to move, the systems would tear themselves apart. On the necessary assumption that at least some water will penetrate the system, owners and their design professionals have to ensure that their systems also give water some way to get back out. For example:

- Masonry systems should have weeps that will allow any moisture that migrates to the inside of the masonry wall to drain out.

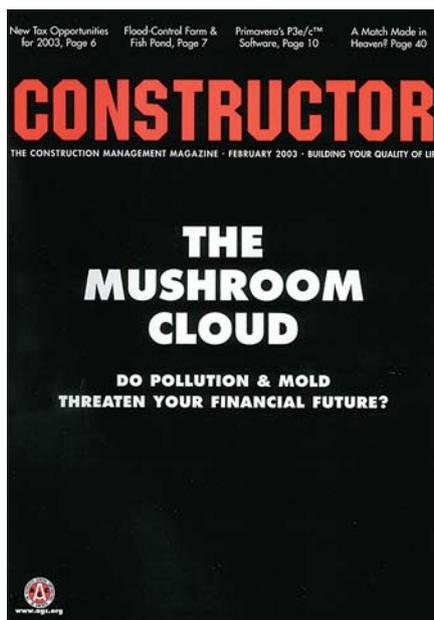
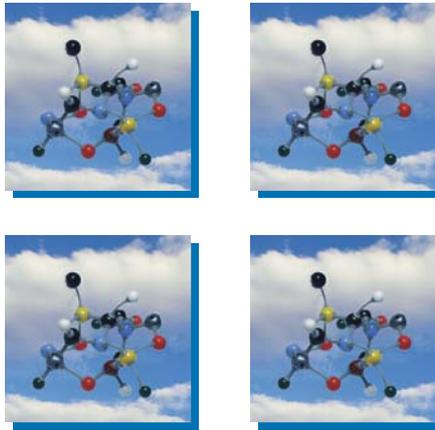
- All glass and metal curtain wall systems should also have drainage weeps. The difference in the amount of expansion and contraction between glass and aluminum in the same exposure to sun is significant.

- The very nature of the EIFS system requires it to include a drain-board system that will allow trapped moisture to escape.

- Over time, the shrinking and swelling of hard-board systems also require these systems to allow for the natural drainage of any penetrating moisture.

- In the many parts of the country with naturally high humidity, and a high potential for thermal condensation, pre-cast concrete walls should have drip pans on the inside face to gather and drain moisture.

Of course, the construction contractor has to install the vertical enclosure system in accordance with the plans, specifications and other contract documents. In fact, the contractor is responsible for ensuring that its employees and subcontractors perform their work in accor-



The February 2003 issue of CONSTRUCTOR featured two "must read" mold articles for construction contractors. The first was a sobering look at potential liabilities entitled "Do Mold and Pollution Threaten Your Financial Future? If you thought your CGL policy would protect you from legal claims, think again." The second, "Contractual Risk Allocation for Mold Conditions," explained "How the AGC Document 200 can be modified to fairly allocate risk among all parties." You can download an electronic version of the entire magazine at no cost by logging onto www.constructormagazine.com.

dance with these documents. If the plans and specifications call for weep holes in a masonry wall, the contractor has to include them. The contractor also has to ensure that excess mortar does not somehow block them. At the outset, however, the owner and its design professional have to include the appropriate features in the plans and specifications.

HVAC Systems. These mechanical systems can either decrease or increase the risk of moisture problems. Oversized sys-

tems offer more power but may not cycle as often as necessary to dehumidify outside air. Condensate pans and drainage systems have to be properly designed and installed. Negative air pressures invite moist air into buildings in humid climates. Fresh air intakes can offer energy savings, but without preconditioning they can also introduce humidity into a building. The contractor should check any insulated ducts for any signs of water damage before installing them, but the owner has to accept the responsibility for ensuring that they remain free of moisture. Lined ducts can become breeding grounds for mold if they become wet.

In the drive to improve energy efficiency, manufacturers have made HVAC systems ever more complex. Minor misprogramming of computer-controlled systems can cause significant problems, drawing significant amounts of very moist outside air into a building with no exhaust. Particularly in more humid climates, the system may need to condition outside air before introducing it. Owners and their design professionals also need to be sure to locate fresh air intakes away from standing water, bare soil, plant debris or accumulated bird or animal droppings. They should also minimize the entrainment of cooling tower mist by locating intakes at least fifty feet away from cooling towers and evaporators. Owners and their design professionals also have to determine the potential effects of any humidification system they may choose to include.

Plumbing. Most plumbing is hidden within the walled spaces in buildings. It can cause significant problems that easily go undetected. Owners and design professionals should therefore pay close attention to how they design the plumbing system, and contractors should ensure that pipes do not leak. Some common problems include too little insulation on cold water pipes, drains that are clogged or left unconnected, vents that fail to exit the structure, and nails, screws and other fasteners that penetrate pipes.

Duct Chases and Elevator Shafts. During construction, duct chases and elevator shafts are often exposed to the elements. After completion of the building, elevator shafts can still collect water unless drained. The elevator pits are normally the lowest points in a building, and they require fire sprinkler systems. Owners and their design professional might do well to consider water or mold-resistant products for these chases and shafts, and both sump pumps and moisture alarms for the elevator pits.

(continued on page 22)

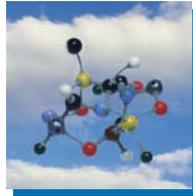
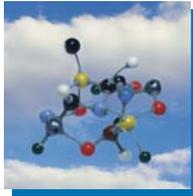
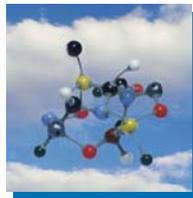
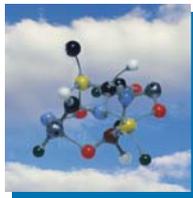
Site Conditions. The scope of the construction work should expressly include any site work necessary to move water away from the building during its construction (and meet all legal requirements for erosion and sediment control). The contractor may have some suggestions for the owner to consider, based on its actual experience with the site, but a fundamentally sound plan is something that the owner and its design professional need to include in the specifications.

Permanent Drainage Systems. The owner and its design professional also need to ensure that the civil plans and actual conditions will drain moisture and water away from the building after the contractor completes it. Important details include landscaping, backfill and soil compaction. Moisture is in virtually all soil. Along with any induced moisture (from irrigation, or broken water or sewer pipes, or other sources), this naturally occurring moisture needs to have a way to drain off.

Foundation Damp Proofing. The contractor has to pay attention to the foundation work, making sure, for example, that the ground has been properly leveled and properly covered with gravel, mirafly cloth, and the like. The contractor also has to pay attention to any crawl space that has a dirt floor. To cut down on the transmission of moisture and other naturally occurring gases from such a floor, the design documents may require the contractor to place an elastomeric, polypropylene or other plastic barrier over it (and then seal the covering to the lower walls). Before any work begins, the owner and its design professional have to select any waterproofing membrane that may need to go below the concrete slab at the very base of the building. What product and what thickness will perform best? It is important to keep moisture in the soil and out of the building.

Interior Walls. Paper-backed gypsum board contains adhesives and cellulose on which mold can feed. Other composite materials, such as particleboard, OSB, and similar products, contain resins that can also support mold. Vinyl wall coverings can condense the water vapor in drywall and encourage mold to grow in wall cavities or in insulation. Foil-faced fibrous cavity insulation and foil-backed gypsum sheathing can also keep buildings from drying out if—and when—they get wet.

These are just some of the building components that can provide extra protection against what some would consider a mold problem—or, if poorly addressed, contribute to such a problem.



In general, the earlier the schedule requires the contractor to begin finishing the interior, the greater the risk of permitting water to enter or accumulate in places or materials that will accommodate mold.

Few of the many necessary decisions are, however, easy to make. The relevant factors are many. They include the building type, intended use and climate. The airflow in some buildings, such as schools and courthouses, is vastly different during periods of use and non-use. Buildings in hot and humid climates have different needs than buildings either in cold climates or in areas with seasonal swings.

It would be understandable for building owners to turn to their construction contractors for advice and assistance. Normally, building owners cannot, however, expect their contractors to review the adequacy or sufficiency of the building design, or the adequacy or sufficiency of any specified materials or systems.¹³ Contractors are not licensed to practice architecture and they do not hold themselves out to the world as design professionals. Nor do they normally carry the insurance they would need to engage in the business of providing professional advice on building design.¹⁴

Nevertheless, contractors can provide some assistance. They may well request a contractual arrangement, if only to make it clear that they are not providing professional advice, and more precisely, that they can only share the benefit of their actual knowledge and experience. With that kind of understanding, con-

tractors can, however, help owners and their design professionals identify important questions and determine the cost of various options.

PART IV CONSTRUCTION SCHEDULE AND SEQUENCE

The contractor normally creates the schedule for the construction of the building, determining the sequence in which either the contractor or its subcontractors will perform each of the various tasks. That schedule must, however, fit within the broad parameters that the owner and its design professional have set. Those parameters include the date when work may commence, the deadline for completion, and the materials and systems that the owner's design and specifications require the contractor to procure.

Those parameters drive much of everything else. And for that reason, the owner and its design professional should consider them carefully. Among other things, they should identify and discuss the costs and benefits of allowing either more or less time for the actual construction of the building. What would it cost to give the contractor time to seal the building envelope, and to dry out the interior, before beginning to install the drywall and other finishes? What could be the ultimate cost of setting an aggressive schedule that requires the contractor to load drywall into the building, and to start installing the finishes, while the interior is still exposed to the elements?

In fact, the schedule is something on which all of the parties would do well to collaborate. The owner and its design professional may be able to see many of the ways that their decisions will affect the schedule and sequence of construction activity, but the contractor may be able to see things that the owner and its design professional have missed. Collectively, the three may find that they can accomplish several things. They may be able to schedule certain activities for certain times of the year, when they can expect better weather. They may be able to identify unique ways to protect the materials that will go into the building, or to coordinate the interior finishing with the building drying. They may be able to develop special protocols for the project. At this point in the process, the owner can still seek and engage any experts that it may need to evaluate the expected project conditions.

In general, the earlier the schedule requires the contractor to begin finishing the interior, the greater the risk of permitting water to enter or accumulate in places

AGC ATTACKS MOLD ACROSS A BROAD FRONT

In an effort to protect contractors and prevent an industry and national crisis, AGC is fighting a fierce battle against mold on a number of fronts. Last year, AGC's Mold Litigation Task Force took the lead. Rick Poppe of the Weitz Company in Denver, Colo., chaired the task force. This year he is also the vice chair of AGC's Building Division (see personal profile on page 6).

Please note: If you have input or questions about this document, contact Michael Kennedy, AGC's general counsel, at (703) 837-5335 or kennedym@agc.org.

The association's first line of attack is training and education, including publications such as the one you are reading, which was created by the Task Force and can be downloaded in its entirety at no cost from the AGC website at www.agc.org. You'll also find a wealth of other mold-related publications and presentations on the website, including the following:

Is Your Mold Claim Covered? Explores the several issues that can arise if and when a contractor seeks insurance coverage for work completed in the past—before the insurance industry began to put specific and express mold exclusions into commercial general liability (CGL) and other insurance policies.

Environmental Insurance Solutions for Mold. Outlines and describes the mold insurance coverage that is likely to be available for future work, including the steps necessary to secure such coverage.

Pending State Legislation Addressing the Growing Issues Surrounding Mold. Covers mold and related legislation several states are considering, including measures that one state has already passed.

Managing the Risk of Mold. Outlines and explains the federal government's interest in the subject of mold, including the prospects for Congressional action, what federal agencies are doing, and where AGC is positioned.

Want more? Access the search engine on www.agc.org, plug in the word "mold," and hit your return key for 65 references to the topic. You'll find a complete compendium of news articles and other AGC publications and activities related to mold, including the *Special Forum on Mold* presented at AGC's Midyear Meeting in Boston and last fall's *Risk Summit*, held in partnership with the Associated Specialty Contractors.

or materials that will accommodate mold. The more complete the building envelope, the lower the risk will be. It is important to protect drywall and other interior finishes from the elements to the extent feasible.

If the owner settles on an aggressive schedule, it should give particularly serious consideration to other ways of mitigating the risk of mold reaching unacceptable levels. For example, if the owner's deadline for substantial completion will require the contractor to begin finishing the interior well before the envelope is sealed, then the owner and its design professional should pay particularly close attention to the finishes they select. All owners should also weigh the risks involved in selecting special materials that have long lead times, or take longer to install, and may therefore delay the completion of the envelope.

Owners should expect contractors to perform their work in accordance with the plans, specifications and other contract documents. They should also expect contractors to avoid trapping water in finished work, and not to ignore any visible signs of mold that may appear during construction. They should not, however, expect contractors unilaterally to take steps that could increase

the cost of constructing a building, or delay its completion. At the end of the day, the contractor still has to work within the parameters that the owner and its design professional have set.

The actual construction process has three relatively distinct phases. The first is the phase when all work is "exposed." The second begins when the contractor completes the roof and at least much of the envelope, when the building is "partially enclosed." The third begins when the contractor completes the envelope and the interior conditions can actually be "controlled." During the first of these three phases, the foundation, the frame and everything else is exposed to the elements. During the second phase, the contractor will normally begin to rough-in the interior and may install some of the finishes. The third normally includes the start-up and operation of the HVAC system.

The "Exposed" Phase of Construction. Microscopic mold spores have a natural tendency to hang or float in the air. Indeed, they are as ambient as the moisture noticed on a humid day. During the "exposed" phase of the construction process, they can easily come to rest on building materials and components, whether installed or simply stored. Add

water from any natural or other source, and at least theoretically, these spores may begin to grow. The concrete, the steel and many of the other materials normally used and installed during this phase of construction are, however, less than ideal substrates for mold. In addition, the natural ventilation of the site will normally dry out any materials that do get wet. One could argue that a construction contractor should keep everything dry, or quickly dry out anything that does get wet, even during this early phase of construction, but of course, that would ignore the tremendous cost of doing so. While it may be reasonable to expect a contractor to protect certain materials or components from water damage, it would not be reasonable to expect a contractor to protect everything from the elements.

Water gets its first opportunity to enter and accumulate in the structure when the contractor excavates the foundation. Unfortunately, many things can disrupt the normal sequence of the work below grade, which would include the footings, the underground utilities, the slab on grade (SOG) and waterproofing. In some instances, the contractor does not have the guidance that it needs to complete the utilities and SOG. In fast-track construction, the design may not be complete enough to permit the contractor to lay out and install the utilities. Even then, however, the contractor would not normally consider the measures necessary to control the ambient moisture within the structure to be within the scope of the work. It would be reasonable to expect the contractor to protect any materials either stored or installed in these areas from flowing or standing water but not from ambient moisture.

If the owner or its design professional can reasonably foresee anything likely to preclude the contractor from following the normal sequence for the work below grade, it should consider the cost-effectiveness of any special efforts to control the ambient moisture in those areas. It should identify and account for anything that would build a dark, damp and unventilated basement area into the construction schedule for any significant period of time.

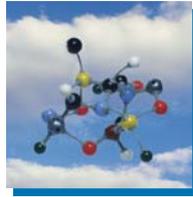
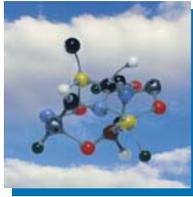
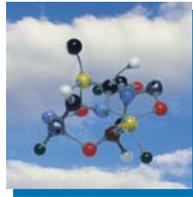
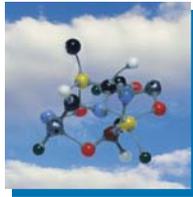
Concrete often lies at the heart of this first phase of the work. Concrete resists the flow of water but does allow wicking via capillary action. Depending on the circumstances, it may be reasonable to expect a contractor to keep porous organic materials from coming into pro-

(continued on page 26)

longed contact with concrete, prior to its installation. To the extent necessary to protect such materials from water damage, it would be reasonable to expect a contractor to remove standing water from decks, and to keep deck openings covered or dammed. It would be similarly reasonable to expect contractors to use dunnage to create space between concrete decks and any drywall stored on them. It would not, however, be reasonable to expect a contractor to keep everything from ever coming into contact with concrete. Indeed, in a concrete structure, this material largely defines the area within which the work must proceed.

The “Partially Enclosed” Phase of Construction. The second phase of construction has much in common with the first. During this phase, building materials and components normally have some protection from the elements, but that protection is far from complete. Naturally ambient mold spores can still come to rest on building materials and components. Rain and snow remain threats, and ambient moisture is still impossible to control. Certain construction processes will still require water, and to make matters worse, any charged water pipes could break. In addition, the materials and components used and installed during this phase may be more porous, or have more organic content, than the materials and components used and installed during the “exposed” phase of construction. On the other hand, it may still be reasonable to expect the natural ventilation of the site to be enough to dry out any areas that do get wet. One could argue that a construction contractor should not load or install drywall or any other porous materials or components, or anything that has a high organic content, into a building that is only partially enclosed. That could, however, extend the time required to complete the building and ultimately its cost. It would be reasonable to expect the contractor to protect building materials and components from flowing or standing water, but not to expect protection from high humidity, or blowing rain or snow, or leaks in the incomplete envelope.

If the owner wants to implement an aggressive risk management program, it needs to specify that the contractor shall not load or install any such materials into the building before the construction has reached the “controlled” phase. Given the cost and other implications of waiting for the “controlled” phase to load drywall and other finishes into the building, it would not be reasonable to expect



Among the internal systems that merit attention, the HVAC system may merit the most. Many experts suggest that an owner keep the relative humidity of the indoor air below 60 percent. Other experts prefer 50 percent.

a construction contractor to make a unilateral decision to wait that long.

In general, during this phase of the work, the contractor should keep interior spaces, and any materials or components stored in those spaces, reasonably clean and protected from water damage, periodically collecting and removing waste that contains cellulose or other organic matter, such as paper, wood, sawdust and adhesives. The contractor should also discard or replace any materials that water actually damages, and should discard, replace or clean any stored materials that actually begin to grow mold.

Fireproofing is a good example of a material that contractors normally have to install during either the first or the second phase of construction even though this material may have a high potential for absorbing and retaining moisture and could serve as a substrate for mold. Contractors can spray and install fireproofing materials on and around steel and other structural members of the building only while these members are open and exposed. During these phases of construction, the most that owners and others can reasonably expect is for construction contractors to perform the work in a sequence that will give any wet materials adequate time to dry, before enclosing the material in drywall or other interior finishes.

Insulation is another example of a material that the contractor may have to install during the second phase of construction, even though certain kinds of insulation can absorb a great deal of moisture. It would be reasonable to expect the contractor not to install any insulation that is actually wet. Depending on the circumstances, it may or may not be reasonable to expect the contractor to coordinate the installation of the insulation with the construction of the curtain wall. It would not be reasonable to expect the contractor to make a unilateral decision to go so far as to wait for the next phase of construction to begin installing insulation.

The “Controlled” Phase of Construction. If the goal is to minimize the risk of a mold problem, then the single most important point in the construction schedule may well be the point at which the contractor completes and seals the building envelope. At that point, the construction process enters the “controlled” phase and the contractor can begin to install drywall and other finishes without risking their exposure to rain or snow. On the other hand, mold spores will continue to hang in the air, and water will still have many natural and other sources.

In addition, ambient moisture may remain a significant risk. Everything depends on how well the contractor can control the moisture and humidity inside the building. As this phase begins, the HVAC system may not be operational. Even if it is, the distribution system may be incomplete, or the owner may want to delay its start-up (for warranty or other reasons). If the distribution network is reasonably complete, if the contractor can seal the access points to the building, and if the insulation is in place, the HVAC system may enable the contractor to control the temperature and humidity of the interior space and may enable the contractor to maintain effective dry-in conditions. The owner and its design professional therefore need to establish clear priorities for the sequencing and commissioning of the HVAC system, and related work, in the contract documents.

During the “Controlled” phase of the work, one of the greatest risks is condensation. The root causes of condensation are temperature and ambient moisture. But many things can and do affect these factors. These things include wall coverings (which may be impermeable), negative air pressures and cold spots that result from the incomplete insulation of the building or the way that HVAC system operates. Sometimes contractors uti-

lize desiccant dehumidifiers or indirect fired heaters to dry areas where they are installing or applying certain finishes, particularly if water is visible in those areas. It is not, however, common for contractors to use such equipment just to control temperature or ambient moisture.

The contractor should have a plan for protecting materials from water damage. The contractor should pay attention to the way it procures materials, schedules their delivery and then stores them, particularly on the construction site. The contractor may, for example, establish procedures for checking materials for any water damage before accepting their delivery. The contractor should also have procedures for keeping drywall, ceiling tiles, insulation and other porous materials dry and for dealing with any porous materials that do get wet. Such materials cannot be protected from ambient moisture but, once delivered, they can and should be protected from other sources of water. Contractors may also need to think about the sequencing of work that requires water. As water-based materials dry, where will the water go? The contractor should not permit new or additional work to cover or enclose any fireproofing, insulation or other porous materials that are clearly wet.

The contractor should also have some kind of protocol for dealing with any large and unexpected water intrusion into any completed portion of the building. Such a protocol could include procedures for investigating its cause and effects, and for dealing with both.

Unfortunately, the most appropriate way for dealing with any visible mold remains far from certain—in large measure because medical effects of exposure to mold are so intensely debated. The most commonly cited guidelines for the assessment and remediation of mold remain those published by the New York City Department of Health.¹⁵ Many experts also cite the guidelines published by the U.S. Environmental Protection Agency.¹⁶ The government has yet, however, to publish any standards. Suffice it to note that owners and others can and should expect construction contractors not to ignore any visible signs of mold or other fungi growing on any stored or installed materials.

In sum, the schedule is something on which all of the parties would do well to collaborate. What is feasible, and reasonable, will vary from one phase of the work to another. Within each of the three major phases of construction, the parties also have many factors to consider. They should also prepare themselves to respond

NATIONAL ASSOCIATION OF HOME BUILDERS RESPONDS TO MOLD

In response to increased concern about mold in indoor environments, the National Association of Home Builders (NAHB) has moved aggressively to educate its membership on household mold and to provide resources for homeowners, tenants and potential homebuyers. "NAHB believes that there are many common-sense approaches that will aid our industry and consumers in the effort to control indoor mold growth," said David F. Wilson, vice president/treasurer of NAHB and a single-family builder from Ketchum, Idaho.

In addition to builder and property owner education, NAHB has developed educational materials for homeowners, tenants and potential homebuyers, who play a vital role in controlling moisture and minimizing mold growth in the home. "One of our most successful efforts is a booklet called *Get the Facts on Mold*, a bestseller from BuilderBooks.com that makes a great handout to home buyers," said Wilson. "NAHB also has developed a bilingual website at www.moldtips.com."

Of interest to both the industry and consumers, the NAHB Research Center operates ToolBase Services. Funded by private industry and the U.S. Department of Housing and Urban Development, ToolBase.org is a repository for detailed mold resources.

NAHB supports laws, regulations and policies that will ensure that adequate insurance coverage for mold claims is available to builders, contractors, remodelers, multifamily owners and managers, and consumers at an affordable cost. The association opposes legislative and/or regulatory action concerning mold that is not based upon scientifically sound and reliable data, that does not include regional flexibility, and that imposes requirements that are not cost-effective, technically achievable, and attainable.

"NAHB is committed to working with industry groups like the AGC to tackle the issue of indoor mold," said Wilson. "By sharing research and resources, together we can make sure that both the housing industry and the general public have comprehensive, accurate information on mold."

to at least some of the risks that are and will remain beyond anyone's control.

PART V OPTIONS TO CONSIDER

The many unanswered questions about the health effects of mold may well leave an owner uncertain of how aggressively it should manage the risk of mold. As noted earlier, mold is essentially everywhere. Mold spores are in every building, and in

truth, the only question is whether they will begin to grow.

The building owner can and should expect its construction contractor to protect stored and installed materials from water damage, and to complete all work in accordance with the contract documents. If largely or entirely based on past practice, those documents may not, however, go as far as today's legal environment—and insurance market conditions—would justify. In today's world, more may be better. It is obvious but worth emphasizing that the owner always has the option of authorizing and directing a more aggressive effort to manage the risk that the mold in its building will become a problem. The owner can expand the scope of the contractor's work. The owner can set priorities. The owner can also blend various experts into the construction team. While they have much to offer, few design professionals or construction contractors have any special expertise in the subject of mold.

To be sure, many of the options are likely to increase either the direct or the indirect cost of constructing the building. Making it a high priority for the contractor to complete and seal the building envelope before the contractor begins to finish the interior may, for example, require the owner extend the deadline for substantial completion. The benefits may, however, justify the expense. It is and will always be the owner's prerogative to determine how reducing the risk of mold compares with the owner's other goals and objectives.

One factor that an owner may want to consider is the intended use of the building. The available medical science does suggest that some populations are more sensitive to mold than others. For example, hospital patients are more vulnerable than the general population. In conjunction with the American Hospital Association, the American Institute of Architects has therefore developed and published a set of special *Guidelines for the Design and Construction of Hospital and Health Care Facilities*. Going well beyond what would normally be considered necessary to manage the risk of a problem with a retail or office building, the guidelines provide that "[p]lanning for health care facilities shall include . . . provisions for infection control. . . ." ¹⁷ The guidelines add:

During the programming phase of a construction project, the owner shall provide an Infection Control Risk Assessment (ICRA). An ICRA is a determination of the potential risk of transmission of various agents in the facility. This continuous process is an

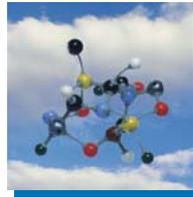
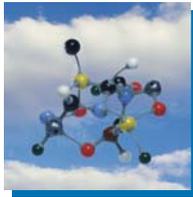
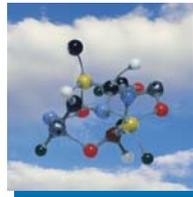
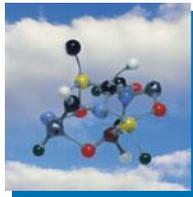
(continued)

essential component of a facility functional or master program to provide a safe environment of care. The ICRA shall be conducted by a panel with expertise in infection control, risk management, facility design, construction, ventilation, safety and epidemiology. The panel shall provide updated documentation of the risk assessment throughout planning, design and construction.¹⁸

Not every building is a hospital or health care facility, and it would be unreasonable to expect every owner to treat every building as if it were such a facility. These guidelines do, however, demonstrate that an owner that either wants or needs to launch an aggressive effort to manage the risk of a mold infestation does have options to consider. Construction contractors do not have all of the expertise necessary to design or implement every option. They cannot, themselves, conduct an ICRA. To the extent qualified, and the contract documents so provide, contractors can, however, expand the scope of the work they perform. They can also work with any experts that an owner may engage. During the design and development phase of a project, many contractors can also help owners identify both the immediate and the long-term costs of various alternatives, and to that extent, many contractors can also help owners sort out their priorities.

In today's legal environment, the owner should always consider at least the option of either taking or requiring special efforts to limit the risk of what could become a mold problem. Without going so far as to meet the standards for the design and construction of health care facilities, the owner can take or require any number of procedures or protocols. As already mentioned and suggested, the owner can retain a third party to peer review the plans and specifications for appropriate design detail. Recognizing the benefits as well as the costs of doing so, the owner can also specify that its contractor shall:

- use desiccant drying techniques to the extent necessary to keep the ambient moisture in all or any identified portions of the interior below specified levels at specified times;
- install specific materials—that the owner has determined to be more resistant to mold—in all or any portion of the building, such as elevator shafts;
- not load or install any drywall or other porous or organic materials in the building before construction has reached the “controlled” phase;



□ hang all drywall some specified distance from the floor, and use J bead and fire sealant to ensure the separation;

□ respond to any water found standing inside the building in a prescribed manner; and

□ make itself available to the owner for a post-completion walkaround, for example, eleven months after the owner takes control of the building.

The owner may also find it cost-effective to verify and document the contractor's work, or to develop and implement other special procedures. The owner can, for example:

□ retain a third party to inspect and verify that the contractor has effectively sealed the building envelope;

□ require the contractor to designate a specific individual to watch for certain objective conditions, including any water found standing in any interior spaces, or any condensation;

□ retain a third party to inspect the work and to document that the contractor is using sound practices and performing the work in accordance with the contract documents; and

□ retain an expert systematically to monitor any of the more sophisticated measures of building dryness, including the moisture content of any concrete, masonry or other materials.

The owner can also engage a third party to help the owner prepare a plan for the proper operation and maintenance of the building. The owner should have a written set of procedures for doing both. It is particularly important to plan for the regular inspection and maintenance of the building's exterior, including all caulked joints and weeps.

If the owner wants to expand the scope of the contractor's work, or to require any special protocols or procedures, the owner needs, however, to pay very close attention to its contract documents. Any specifications requiring special efforts to mitigate

the risk of mold need to be as clear and precise as possible. By their very nature, such provisions are unique to the particular project and not something that construction contractors regularly encounter. To help prepare them, the owner may even want to retain a third party with expertise in all of the relevant areas—building design, building construction and, of course, the science of mold.

The owner cannot reasonably expect the contractor to include special measures in its bid or proposal on nothing more than an assumption that the owner would find such measures to be cost-effective. The fact remains that the vast majority of buildings do not suffer from any known mold problems. An owner may or may not consider any of a number of such measures to be reasonably necessary for the construction of a particular building. If the contract documents do not require any special efforts to manage the risk of a mold infestation, the contractor has to assume that the owner only expects what would normally be considered necessary to avoid water damage to stored or installed materials. Taking this fact into account, the published guidelines for the construction of hospitals and other health care facilities provide that “[t]he design professional shall incorporate the specific, construction-related requirements of the ICRA in the contract documents.”¹⁹

In sum, owners have many options to consider. They can expand the scope of the contractor's work and they can blend various experts into the construction team. They can go so far as to require the building to be constructed as if it were a hospital or health care facility. In some cases, special measures will be considered cost-effective. In other cases, they will not. If the owner wants to implement a particularly aggressive effort to manage the risk of a mold infestation, it simply needs to ensure that its contract documents make that clear. Otherwise, the contractor will reasonably assume that the owner is only interested in those measures normally considered adequate.

PART VI BUILDING OPERATION AND MAINTENANCE

When the contractor completes the building, the contractor turns the building over to the owner, and from that point forward, the latter bears the responsibility for the building's operation and maintenance. In some cases, the contract documents may call on the contractor to help the owner find any expertise that the

(continued on page 30)

owner needs to develop an operation and maintenance plan and/or to train the people who will actually operate and maintain the building. But normally, the contractor's work ends when it delivers a building that meets the plans and specifications that the owner developed in conjunction with its design professional.

Operation and maintenance are no less important than design and construction. If the owner does not properly operate the HVAC system, the relative humidity in the building may increase, or condensation may accumulate, to the point where mold will begin to grow. The owner needs to remember that mold spores are and will always be in the building, along with the oxygen and organic materials that these spores need to grow and multiply. No matter how well designed, constructed, operated or maintained, the building will always provide at least three of the four things that mold needs.

One short but true story may be useful to consider. It involves two identical buildings newly constructed for a public owner in Florida. Shortly after substantial completion, the owner modified the sequence of operations for the HVAC systems. Motivated by a desire to reduce its energy costs, the owner increased the temperature of the chilled water. The owner also raised the discharge air temperatures at the cooling coils of specific air handling units. In addition, for extended periods of time, when the buildings were not in use, the owner shut the HVAC systems down.

The changes in the sequence of operations had the intended effect of increasing the indoor air temperatures but still keeping them at levels that the owner deemed acceptable for the buildings' occupants. Standing alone, these changes also saved the owner \$100,000 a year in energy costs! Unfortunately, they also changed the way that the systems treated the outside air brought into the buildings. No longer did the systems dehumidify the outside air to the extent necessary to prevent mold from growing. The changes had the effect of saturating the buildings with relative humidity often as high as 70%.

Shutting the systems down also affected the relative humidity of the indoor air. The buildings and their systems had all been designed to maintain positive pressurization. When the owner shut the systems down, it permitted the pressurization to go negative. In relatively short order, the relative humidity of the indoor air reached equilibrium with the relative humidity of the outside air.

This owner reduced its energy costs, but in the process, it also turned its buildings into what some have called "mold factories." Mold species grew rapidly throughout both buildings. The ultimate result was a costly class action lawsuit. Whatever the owner saved in energy costs, it more than spent on legal fees and mold remediation.

Of course, many owners are tempted to do similar things. For building owners, energy costs are a significant cost of doing business and anything that can significantly reduce those costs is sure to merit attention. Many school systems still close their buildings and shut down their HVAC systems for the entire summer. In today's world, however, energy costs are far from the only costs that owners need to consider. The importance and cost of mold remediation have increased dramatically, along with the risk of mold litigation.

As already emphasized, mold spores are literally everywhere. They are microscopic in size and flow naturally through the air. Every completed building has these spores in it. Every new building will surely host them. In addition, every building has the oxygen and organic matter that these spores need to grow and multiply. The only variable is water. Once the building is substantially completed, and the owner takes control, the owner needs to ensure that its operating procedures are strong enough to prevent water from entering or accumulating in the building to the point where the mold will begin to grow. For the most part, the owner should keep the HVAC system turned on. Among other things, the owner should also consider the costs and benefits of humidistats.

Maintenance is the other critical issue. It begins with the building envelope. Regular inspection and maintenance of the building envelope is critical. Caulked joints and weeps are particularly important to maintain. If ignored, leaks can become extremely serious problems. Cleaning and other maintenance of the interior may well require the use of water, and when it does, the owner also has to ensure that the water does not accidentally find its way into enclosed spaces or soak finished materials. The owner also has to pay attention to the landscaping. It is not unusual for owners to plant bushes, shrubs and other plants and then forget about them. Plants, however, provide habitats for a variety of molds. Proper pruning, thinning, and removal of dead materials will allow light and venti-

lation to reduce the temperature and humidity that mold needs to thrive.

What the owner is really trying to avoid is any entry or accumulation of water in any location where water should not be. The most obvious example of such a "water event" is a flood resulting from a heavy rain or the overflow of a river or lake. Other examples include any window or other leaks in the building envelope, or any release of water within the building, as would occur if a water pipe cracked or broke, or a toilet simply overflowed. Less obvious but equally important examples include overflow of any condensate pan or pit, water seepage through foundation walls, excessive water buildup in any elevator pit, or condensation on windows, doors, pipes, drains or mechanical systems. All of these things can provide enough water or moisture for mold to begin to grow. All of these are things that the owner wants to avoid.

Of course, the owner cannot hope to avoid any and all water events for the entire life of the building. Some are inevitable. And for that reason, the owner also needs to be prepared to respond, and to do so quickly. Time is of the essence. Quick recognition and rapid response to any water event can easily make the difference between a routine repair and a major mold remediation. To prevent mold from growing, it is often said that wet materials have to be dried within 48 hours.

In 2001, the State of Maryland appointed an Indoor Air Quality Task Force. The following year, the task force issued its final report, recommending that owners "be required to comply with standards for operation and maintenance of an office building . . ." ²⁰ Whether or not one would agree that government standards and enforcement actions are warranted, it is reasonable to suggest that owners draft and implement written plans for the proper operation and maintenance of their buildings. The Maryland Task Force found that most of the problems with indoor air quality stem from the following errors and omissions:

- failure to perform routine maintenance on HVAC systems;
- inappropriate balancing and reassessment of HVAC systems during building renovation or modification;
- inadequate housekeeping and maintenance, particularly with respect to moisture control; and
- failure to respond to employee complaints about indoor air quality.

The Maryland Task Force report also suggested that any plan for the operation

and maintenance of a building include at least the following:

□ procedures for operating and maintaining the HVAC system in accordance with the current guidelines of the American Society of Heating, Refrigerating and Air Conditioning Engineers, Inc. (ASHRAE), including procedures for maintaining:

- filters and any other air cleaning devices;
 - outdoor air dampers and actuators;
 - humidifiers;
 - cooling coils and drain pans, and any adjacent areas;
 - outdoor air intake louvers and adjacent surfaces;
 - sensors used to control outside air; and
 - air handlers.
- procedures for maintaining floor drains and other sewer systems;
- procedures for drying and sanitizing any areas where water intrudes or excess moisture accumulates;
- procedures for quarterly inspecting building surfaces for evidence of mold growth;
- procedures for removing any mold that might be found and for treating any affected area(s);
- procedures for identifying and correcting any sources of excess moisture; and
- procedures for responding to any complaints that occupants might have.

Molds are prolific organisms that will float into and through a building for as long as it stands.

Water will persist in its effort to enter and accumulate in a building from the day its construction begins to the day it falls. However well the design professional and the construction contractor perform their work, the building owner therefore needs to achieve and maintain some level of proficiency in the operation and maintenance of the building.

The owner should pay attention to the building envelope, regularly inspecting the vertical enclosure system, the windows and doors and, of course, the roofing system. The owner should pay particular attention to flashings, counter-flashings, caulk joints, sealants, and all exposed coatings and paints. The cost of maintaining the building's envelope will rarely approach the cost of restoring it. Trees, shrubs, and similarly decorative and functional elements also require regular and routine maintenance, along with all irrigation and drainage systems.

Among the internal systems that merit attention, the HVAC system may merit the most. Many experts suggest that an

owner keep the relative humidity of the indoor air below 60%. Other experts prefer 50%. In any case, the owner should regularly inspect the HVAC system and perform all maintenance necessary to keep it in good working order.²¹ The owner should also pay attention to all plumbing and piping systems, and to any water used to clean or otherwise maintain the interior of the building. Below grade, the owner should look for any water infiltration through foundation walls.

CONCLUSION

At an early point in the development and design of every project, the owner, its construction contractor and its design professional should systematically sort through all of the issues that mold raises for that particular project. The design professional should ensure that the designs provided for the building envelope, for the HVAC system, and for other mechanical systems, all take the risk of mold into account. The design professional should also pay attention to the design details that have the potential to cause or prevent what some would call a mold problem. The construction contractor should pay equal attention to the way that it handles and stores materials on the site of the work and should ensure that its employees and subcontractors construct the building in accordance with the plans, specifications and other contract documents. Together, the design professional and the building owner should carefully select the building materials and systems they will specify and the deadlines they will impose. And, of course, the owner should identify and assemble the resources that it will need to implement a written plan for the proper operation and maintenance of the building, upon its completion.

The appropriate way to allocate the risk among the parties will naturally flow from the same process. The risk and responsibility for a particular decision or activity should follow the power to make or control it. The party in the best position to develop and implement any one component of the risk management program should bear the risk and responsibility for that component of the program. None of the parties should bear either the risk or the responsibility for the entire program. None of the parties should be expected to warrant or guarantee that a building will remain free of mold.

Traditionally, the parties to the construction process have relied on their insurance policies to manage and protect them against the risk of any property

damage or personal injury that even their best efforts fail to prevent. Unfortunately, the parties cannot continue to rely on their insurance policies to manage or protect them against what could be the ultimate cost of a mold infestation. As noted at the outset, property insurance and general commercial liability policies are very likely to exclude mold. Some pollution and other environmental policies have begun to include some coverage for mold, but that coverage is both costly and limited. Suffice it to conclude that none of the parties to the construction process should be expected to bear more risk or responsibility for a potential mold problem than the particular party has the power to manage effectively.

REFERENCES

- American College of Occupational and Environmental Medicine, *Evidence Based Statements: Adverse Human Health Effects Associated with Molds in the Indoor Environment*, October 2002, available at www.acoem.org/guidelines/article.asp?ID=52, accessed November 21, 2002
- American Industrial Hygiene Association, *Field Guide for the Determination of Biological Contaminants in Environmental Samples*, 1996, at www.aiha.org
- American Industrial Hygiene Association, *Report of Microbial Growth Task Force*, May 2001
- American Industrial Hygiene Association, *The Facts about Mold*, 2003, available at www.aiha.org
- Ampel, Neil, "Emerging Disease Issues and Fungal Pathogens Associated with HIV Infection," in *Emerging Infectious Diseases*, Vol. 2, No. 2, April-June 1996
- Barrett, Dave, *The Renewal of Trust in Residential Construction*, Part II, Vol. I (Commission of Inquiry into the Quality of Condominium Construction in British Columbia), January 31, 2000, Government of British Columbia, Victoria, BC, Canada
- Barrett, Dave, *The Renewal of Trust in Residential Construction*, Part II, Vol. II, (Commission of Inquiry into the Quality of Condominium Construction in British Columbia), March 9, 2000, Government of British Columbia, Victoria, BC, Canada
- California Department of Health Services, Environmental Health Investigations Branch, "Health Effects of Toxin Producing Molds in California" in *California Morbidity*, April 1998, available at www.dhs.ca.gov/ps/deodc/ehib/EHIB2/topics/toxin_producing.html, accessed November 25, 2002
- California Department of Health Services, Environmental Health Investigations Branch, *Misinterpretation of Stachybotrys Serology*, December 2002, available at www.dhs.ca.gov/ps/deodc/ehib/ehib2/topics/Serology2.htm, accessed November 25, 2002
- California Department of Health Services, Hazard Evaluation System and Information Service (HESIS), *Molds in Indoor Workplaces*, March 2001
- Davis, Pamela J., *Molds, Toxic Molds and Indoor Air Quality*, 2001, California Research Bureau, California State Library
- Deacon, J.W., *Modern Mycology* 3rd ed., 1997, Blackwell Science, Ltd., Oxford, UK
- Dotson, Kyle B. and Schneider, J. Edward, *Prevalence of Stachybotrys in Outdoor Air of Houston Area Residences*, Proceedings of the 9th International Conference on Indoor

(continued)

Air Quality and Climate, International Academy of Indoor Air Sciences, July 2002

Environmental Health Directorate, Health Canada, *Exposure Guidelines for Residential Indoor Air Quality*, 1987; Rev. 1989, Publication No. EHD-TR-156, 1989, Ottawa, Ontario, Canada

Environmental Health Directorate, Health Canada, *Fungal Contamination in Public Buildings: A Guide to Recognition and Management*, June 1995, Ottawa, Ontario, Canada

Environmental Health Directorate, Health Canada, *Indoor Air Quality in Office Buildings: A Technical Guide*, revised 1995, Publication No. 93-EHD-166, 1995, Ottawa, Ontario, Canada

Foundation of the Wall and Ceiling Industry, *Mold: Cause, Effect and Response*, March 2002

Fung, Frederick MD, *Toxic Mold: Science or Speculation?* Defense Research Institute, Publication Bi. 2001-0050 C, 2001, Chicago, IL

Kendrick, Bryce, *The Fifth Kingdom* 3rd ed., 2000, Focus Publishing, Newbury Park, MA

Macher, Janet, ed., *Bioaerosols: Assessment and Control*, American Conference of Governmental Industrial Hygienists (ACGIH), 1999, Cincinnati, OH

Maryland State Task Force on Indoor Air Quality, *Final Report*, July 1, 2002, Maryland Department of Legislative Reference, Annapolis, MD

McNeel, Sandra, and Kreuzer, Richard, "Fungi and Indoor Air Quality," *Health and Environment Digest*, May/June 1996, Vol. 10, No. 2, p. 9 et seq., available at www.dhs.ca.gov/ps/deode/ehib/EHIB2/topics/fungi_indoor.html, accessed November 25, 2002

New York City Department of Health, Office of Environmental and Occupational Epidemiology, *Facts about Mold*, available at <http://nyc.gov/html/doh/html/ei/eimold.html>, accessed November 22, 2002

New York City Department of Health, Bureau of Environmental and Occupational Disease Epidemiology, *Guidelines on Assessment and Remediation of Fungi in Indoor Environment*, available at <http://nyc.gov/html/doh/html/epi/moldrpt1.html>, accessed November 22, 2002

Texas Counsel on Scientific Affairs, *Black Mold and Human Illness*, CSA Report No. 1-I-02, September 2002, available at www.texmed.org/has/CSA%20Black%20Mold.doc, accessed November 21, 2002

United States Consumer Product Safety Commission, *Indoor Air Pollution: Introduction for Health Professionals*, CPSC Document No. 455, available at www.cpsc.gov/CPSC/PUBS/PUBS/455.html, accessed November 25, 2002

United States Department of Health and Human Services, Centers for Disease Control, "Acute Pulmonary Hemorrhage among Infants - Chicago, April 1992 November 1994," in *Morbidity and Mortality Weekly Report*, Vol. 44, No. 4, February 3, 1995, p. 67

United States Department of Health and Human Services, Centers for Disease Control, "Acute Pulmonary Hemorrhage/Hemosiderosis among Infants - Cleveland, January 1993 November 1994," in *Morbidity and Mortality Weekly Report*, December 9, 1994

United States Department of Health and Human Services, Centers for Disease Control, *Report of the CDC Working Group on Pulmonary Hemorrhage/Hemosiderosis*, July 17, 1999, available at www.cdc.gov/od/ads/ref29.pdf, accessed February 21, 2002

United States Department of Health and Human Services, Centers for Disease Control, *Questions and Answers on Stachybotrys chartarum and Other Molds*, available at www.cdc.gov/nceh/airpollution/mold/stachy.htm, accessed February 21, 2002

United States Department of Health and Human Services, Centers for Disease Control, "Update: Pulmonary Hemorrhage/Hemosiderosis Among Infants - Cleveland, Ohio, 1993 1996," in *Morbidity and Mortality Weekly Report*, Vol. 46, No. 2, January 17, 1997, p. 33

United States Department of Health and Human Services, Centers for Disease Control, "Update: Pulmonary Hemorrhage/Hemosiderosis among Infants - Cleveland, Ohio, 1993 1996," *Morbidity and Mortality Weekly Report*, Vol. 49, No. 9, March 10, 2000

United States Department of Health and Human Services, Centers for Disease Control, National Centers for Environmental Health, *Mold Information*, available at www.cdc.gov/nceh/airpollution/mold

United States Department of Labor, Occupational Safety and Health Administration, Indoor Air Quality Investigation, in *OSHA Technical Manual* TED 1-0.15A, Sec. III Ch. 2, 1999, available at www.osha.gov/dts/osta/otm/otm_iii/otm_iii_2.html, accessed November 25, 2002

US Department of Labor, Occupational Safety and Health Administration, Indoor Air Quality Proposal, Federal Register #59:15968-16039, available at www.osha-slc.gov/FedReg_osh_data/FED19940405.html, accessed November 21, 2002

United States Environmental Protection Agency, *Ambient Air Quality Standards*, available at www.epa.gov/airs/criteria.html, accessed November 21, 2002

United States Environmental Protection Agency, *Final Report: Bioaerosols, Health, and Productivity in a Large Office Building*, EPA Grant No.: R824797, available at http://cfpub.epa.gov/ncer/_abstracts/index.cfm/fuseaction/display.abstractDetail/abstract/76/report/F, accessed November 25, 2002

United States Environmental Protection Agency, *An Office Building Occupant's Guide to Indoor Air Quality*, Publication EPA 402-K-97-003, October 1997, available at www.epa.gov/iaq/pubs/occupgd.html, accessed November 25, 2002

United States Environmental Protection Agency, *Mold Remediation in Schools and Commercial Buildings*, Publication EPA 402-K-01-001, March 2001

United States Environmental Protection Agency, *Mold Resources*, available at www.epa.gov/iaq/pubs/mold/resources.html, accessed November 21, 2002

Weiss, Janet MD, *Comparative Risks of Microbiological Contamination of indoor Air And the Role of Social Amplification of Risk*, Presented at the 2nd National Science Foundation Conference on Indoor Air Health, January 29, 2001

FOOTNOTES

¹ This document is not, however, intended to provide specific guidance on the "best" or even the "correct" way to approach any particular project. Nor is it intended to create any obligations, or to establish any standards or guidelines, for managing the risk that mold will infest a particular building. Each construction project is unique. Each building is unique. The information included in this document is necessarily general in nature.

² This publication focuses on the three primary parties to the construction process. There are, however, any number of other parties to that process. And all have an important role to play. In due course, the communication and collaboration also have to reach and include subcontractors, manufacturers and possibly others.

³ All references to mold or molds should be understood to include mildew or mildews. Mildew is the common name for various types of fungi that grow on paper or on clothing.

⁴ The U.S. Environmental Protection Agency is currently seeking to determine the conditions necessary for the toxins to be produced and to become airborne Davis, Pamela J., *Molds, Toxic Molds and Indoor Air Quality*, 2001, California Research Bureau, California State Library.

⁵ Among the major causes of misunderstanding are the widely publicized and highly tragic fatalities of ten infants

in Cleveland. Initially, these fatalities were blamed on exposure to the mold *Stachybotrys chartarum*. This mold was alleged to have caused hemosiderosis, or bleeding into the lungs, in more than thirty infants. A great deal of publicity was given to these horrible incidents, which came to involve Case Western Reserve University and the Centers for Disease Control. Researchers at the CDC have backed away from their initial conclusion that mold caused the medical problem and now state that they do not have adequate evidence of a causal link between the mold and the disease clusters. United States Department of Health and Human Services, Centers for Disease Control, "Report of the CDC Working Group on Pulmonary Hemorrhage/ Hemosiderosis," July 17, 1999; United States Department of Health and Human Services, Centers for Disease Control, "Update: Pulmonary Hemorrhage/ Hemosiderosis among Infants - Cleveland, Ohio, 1993 1996," *Morbidity and Mortality Weekly Report*, Vol. 49, No. 9, March 10, 2000.

⁶ American College of Occupational and Environmental Medicine, *Evidence Based Statements: Adverse Human Health Effects Associated with Molds in the Indoor Environment*, October 2002, available at www.aceom.org/guidelines/article.asp?ID=52, accessed November 21, 2002

⁷ Id.

⁸ Dotson, Kyle B. and Schneider, J. Edward, *Prevalence of Stachybotrys in Outdoor Air of Houston Area Residences*. Proceedings of the 9th International Conference on Indoor Air Quality and Climate, International Academy of Indoor Air Sciences, July 2002.

⁹ Good housekeeping practices could reduce the risk of mold growing on non-organic substrates, but again, some risk would still exist.

¹⁰ Different molds require different amounts of moisture, and as a threshold matter, it could be difficult to determine exactly how much moisture is "too much."

¹¹ New York's guidelines provide that "relative humidity should be maintained at levels below 60% to inhibit mold growth" but acknowledge that "currently there are not adequate data to relate the extent of contamination to frequency or severity of health effects." At 8. Turning to the subject of remediation, they provide that "[t]he goal of remediation is to remove or clean contaminated materials in a way that prevents the emission of fungi and dust contaminated with fungi from leaving a work area and entering an occupied or non- abatement area, while protecting the health of workers performing abatement." At 8-9. They include specific procedures for remediating each of the following: small isolated areas (10 sq. ft. or less), mid-sized isolated areas (10 to 30 sq. ft.), large isolated areas (30 to 100 sq. ft.), extensive contamination (more than 100 contiguous sq. ft.) and HVAC systems.

¹² If properly installed, better-quality products will generally provide better protection. Such products are not, however, a panacea. They can still jeopardize indoor air quality if the design carries significant installation or maintenance risks, or carries high maintenance costs.

¹³ If the owner is using the traditional design-bid-build system to deliver the project, the contractor does not originate the design, does not exercise control over the design, is not compensated for the design, and typically does not carry professional liability insurance to cover the risk of design errors or omissions.

¹⁴ Of course, these facts could be different if the owner is using the design-build delivery system.

¹⁵ See note 7, supra.

¹⁶ They are entitled "Mold Remediation in Schools and Commercial Buildings," and they are posted on the agency's web site at www.epa.gov/iaq/molds.

¹⁷ American Institute of Architects, *Guidelines for the Design and Construction of Hospital and Health Care Facilities*, 2001 Edition, at 15.

¹⁸ Id.

¹⁹ Id.

²⁰ Maryland State Task Force on Indoor Air Quality, *Final Report July 1, 2002*, Maryland Department of Legislative Reference, Annapolis, MD, at 20.

²¹ For additional guidance on indoor air quality, owners may also want to consult a guide that the U.S. Environmental Protection Agency and the National Institute for Occupational Safety and Health jointly published in 1991. It is EPA Document Reference Number 402-F-91-102, and it is entitled "Building Air Quality: A Guide for Building Owners and Facility Managers." It is available on the Internet at www.epa.gov/iaq/largebldgs/baqtc.html.