SBCA™ Research Report

Mold on Wood Structural Building Components

SRR No. 1807-01

Structural Building Components Association (SBCA)

September 11, 2018

Structural Building Components Association (SBCA) | 6300 Enterprise Lane, Madison, WI 53719 | 608-274-4849 | sbcindustry.com

Table of Contents

Introduction:

Issues involving mold on building materials, whether during construction or in completed and occupied structures, have gained media attention in recent years. Unfortunately, the emotion, with respect to both real and perceived health effects of mold-related situations, leads to actions that may not be grounded in sound science. This research report seeks to provide fact-based information about causes, effects, and mitigation of mold growth on lumber and wood structural building components.

Key Definitions:

APPROVED SOURCE. (*IBC* Section 202)

An independent person, firm or corporation, *approved* by the *building official*, who is competent and experienced in the application of engineering principles to materials, methods or systems analyses.

BUILDING DESIGNER: (*ANSI/TPI 1* Section 2.2)

The owner of the building or the person that contracts with the owner for the design of the framing structural system and/or who is responsible for the preparation of the construction documents. When mandated by the legal requirements, the Building Designer shall be a registered design professional.

BUILDING OFFICIAL: (*ANSI/TPI 1* Section 2.2)

Officer or other designated authority charged with the administration and enforcement of the Building Code, or a duly authorized representative.

CONTRACTOR: (*ANSI/TPI 1* Section 2.2)

Owner of a Building, or the Person who contracts with the Owner, who constructs the Building in accordance with the Construction Documents and the Truss Submittal Package. The term “Contractor” shall include those subcontractors who have a direct Contract with the Contractor to construct all or a portion of the construction.

DUTIES AND POWERS OF BUILDING OFFICIAL: (*IBC* Section 104.1)

The building official is hereby authorized and directed to enforce the provisions of this code. The building official shall have the authority to render interpretations of this code and to adopt policies and procedures in order to clarify the application of its provisions. Such interpretations, policies and procedures shall be in compliance with the intent and purpose of this code. Such policies and procedures shall not have the effect of waiving requirements specifically provided for in this code.

MEANS AND METHODS OF CONSTRUCTION: ((*ANSI/TPI 1* Section 2.3.4.4)

The Contractor is responsible for the construction means, methods, techniques, sequences, procedures, programs, and safety in connection with the receipt, storage, handling, installation, restraining, and bracing of the Trusses.

PRE-INSTALLATION CHECK. ((*ANSI/TPI 1* Section 2.3.4.6)

The Contractor shall examine the Trusses delivered to the job site for: (a) Dislodged or missing connectors, (b) Cracked, dislodged or broken members, or (c) Any other damage that can impair the structural integrity of the Truss.

POST-INSTALLATION CHECK. ((*ANSI/TPI 1* Section 2.3.4.7)

The Contractor shall examine the Trusses after they are erected and installed for: (a) Dislodged or missing connectors, (b) Cracked, dislodged or broken members, or (c) Any other damage that can impair the structural integrity of the Truss.

RESEARCH REPORTS: (*IBC* Section 1703.4.2)

Supporting data, where necessary to assist in the approval of products, materials or assemblies not specifically provided for in this code, shall consist of valid research reports from approved sources.

TRUSS DAMAGE DISCOVERY. ((*ANSI/TPI 1* Section 2.3.4.8)

In the event that damage to a Truss is discovered the Contractor shall: (a) Ensure that the Truss not be erected, or (b) That any area within the Building supported by any such Truss already erected shall be appropriately shored or supported to prevent further damage from occurring and shall remain clear and free of any load imposed by people, plumbing, electrical, mechanical, bridging, bracing, etc. until field repairs have been properly completed.

TRUSS DAMAGE RESPONSIBILITIES. ((*ANSI/TPI 1* Section 2.3.4.9)

In the event of damage, the Contractor shall: (a) Contact the Truss Manufacturer and Building Designer to determine an adequate field repair, and (b) Construct the field repair in accordance with the written instructions and details provided the Truss Manufacturer, Building Designer, and/or any Registered Design Professional.

TRUSS MANUFACTURER: (*ANSI/TPI 1* Section 2.2)

Person engaged in the fabrication of Trusses.

Background:

Health Effects of Mold

Humans are exposed constantly to molds in the environment. Mold spores are in the air we breathe, the soil in our gardens, and in and around virtually every part of our living and working environment.

Exposure to mold can happen through skin contact, inhalation and ingestion. Framing lumber and structural building components in a newly completed structure are typically encased by sheathing panels and/or siding on the outside and drywall on the inside—thus, there is virtually no chance for occupants to be exposed to any mold on the wood through skin contact or ingestion.

In addition, adverse health effects from inhalation of mold spores in water-damaged buildings are not conclusively supported by available peer-reviewed reports in medical literature, and there is no federal health-based standard for exposure to mold. The Environmental Protection Agency (EPA) states, "Standards or Threshold Limit Values (TLVs) for airborne concentrations of mold, or airborne mold spores, have not been set. Currently, there are no EPA regulations or standards for airborne mold contaminants."[1] The Occupational Safety and Health Administration (OSHA) while not having set forth any mold regulations or standards, has published an informational bulletin on mold mitigation, remediation, and cleanup methods.

The majority of common molds are not a concerning threat to healthy individuals. According to the Centers for Disease Control and Prevention (CDC):

> "There are very few reports that toxigenic molds [those that can produce mycotoxins] found inside homes can cause unique or rare health conditions such as pulmonary hemorrhage or memory loss. These case reports are rare, and a causal link between the presence of the toxigenic mold and these conditions has not been proven."[2] In the 1990s, a number of cases of acute idiopathic pulmonary hemorrhage (AIPH) in infants were thought to be caused by mold and received much public attention. However, following investigation failed to prove a causal link between mold and the AIPH cases. A causal link has still not been demonstrated between mold and AIPH, such that, currently, the CDC makes clear on their website: "To date a possible association between acute idiopathic pulmonary hemorrhage among infants and *Stachybotrys chartarum* (or *Stachybotrys atra*, two different scientific names for the same mold) has not been proved."[3]

[1] https://iaq.zendesk.com/hc/en-us/articles/212104637-Are-there-Federal-regulations-or-standards-regarding-mold-

[2] https://www.cdc.gov/mold/stachy.htm

[3] ibid.

In a Western Wood Products Association report titled Mold, Housing & Wood, Drs. Coreen Robbins and Jeff Morrell assess the current state of research surrounding mold's ability to cause adverse health effects, stating:

> In extensive analyses, neither the Institute of Medicine (IOM) or the World Health Organization (WHO) were able to conclude that any adverse health outcomes were generally caused by the presence of mold in damp indoor environments (IOM, 2004; WHO, 2009). They did find sufficient evidence to conclude that there is an association between the health effects of upper respiratory (nasal and throat) tract symptoms, cough, hypersensitivity pneumonitis in susceptible persons, wheeze, and asthma symptoms in sensitized persons and mold or damp indoor environments. However, they reported no evidence that mold or damp environments are causing these health effects. This means that these health effects are more commonly found in moldy or damp environments compared to non-problem environments, but it's not known what specific agents are causing the health effects. Other factors associated with environments with mold and damp can produce these health effects, for example dust mites are a well known cause of asthma and thrive in damp conditions. So, a person living in a moldy or damp environment with these adverse health effects has to be evaluated individually to determine the cause of their problems and whether or not they are related to their environment (IOM, 2004; WHO, 2009).

Although there is no evidence to support the claims that mycotoxins from certain mold spores are causing illness in humans, prudent action with respect to mold cleanup is still advised, especially for individuals with the health conditions Robbins and Morell enumerate above. OSHA also addresses risk of mold exposure for certain populations, stating:

> it does have the potential to adversely affect those who are immune-compromised (those with "AIDS, uncontrolled diabetes, or those taking immune suppressive drugs") and may trigger asthma attacks in some who are allergic to mold.

Active mold growth indicates an underlying moisture problem that should be corrected, as moisture promotes the growth of bacteria and dust mites that may cause illness by themselves or in concert with molds.

Conditions Promoting Mold Growth

Molds can grow on cloth, carpet, leather, wood, wallboard, household dust or anything that is made of organic material. Sustained mold growth requires moisture, organic material (a food source), and a suitable temperature generally in the range of 40ºF to 100ºF. According to the North Carolina Department of Health and Human Services:

> "Many fungi grow well at temperatures between 60 and 80 degrees Fahrenheit."[4] When one or more of these three conditions does not exist, the mold colony will become dormant. The easiest condition to control is moisture.
>
> Moisture content above 19% for approximately one week is required for significant surface mold growth to occur on lumber and/or wood structural building components. Lumber surface mold growth occurs on most species of wood when the moisture content by weight is between 20% and 28%.[5] In most cases, surface mold growth is a superficial phenomenon that does not affect the strength or long-term durability of the wood.
>
> Wood decay fungi, on the other hand, require much higher moisture levels to grow, as the moisture content of the wood must be above the fiber saturation point (i.e., approximately 28% by weight, varying for different species) for more than one week.[5]

[4] https://epi.publichealth.nc.gov/oee/mold/grow.html
[5] https://www.sbcmag.info/content/9/mold-construction

Best Practices:

Photo 1: Mold on Lumber

Photo 2: Mold on Installed Wood Members

Mitigating Mold Growth on Components
Mold can occur naturally on the surface of structural wood components during both the manufacturing process and construction if the optimal temperature and moisture conditions exist. Surface molds, which come from a variety of sources (including airborne spores) feed off the sugars and starches that are readily available on the surface of the wood. Mold on the surface of lumber does not cause rotting or otherwise affect the strength of wood framing. However, mold is a symptom of high moisture which, if allowed to exist for prolonged periods, can be damaging to any structure and will promote the development of wood decay fungi. Keeping lumber dry, therefore, is important to mitigate both mold growth and decay.

A moisture meter can be used to determine the relative moisture content of components and help ensure they are staying dry. Drying lumber that is determined to be too moist reduces the likelihood that mold will grow, while not guaranteeing the wood will remain free of mold. The lumber must remain dry in order to mitigate mold growth. Wood that has been dried such that mold has stopped growing may still have mold on it and simply needs to be cleaned with soap and water to remove the residual mold.

Photo 3: Wood Tested with Moisture Meter

When drying lumber to mitigate mold growth, however, keep in mind that while wood-based materials dry slowly by the processes of evaporation and/or diffusion, evaporation can be accelerated by increasing ventilation, and/or by using heat sources such as heaters, heat lamps, furnaces, etc. Be warned that gas heaters can generate large amounts of moisture during the combustion process, and additional ventilation is often required so as not to add to the moisture load.

Storage of Components
Properly storing components is one important facet of mitigating mold growth. If feasible and efficient, store components under roof and with clearance above the ground to avoid wetting from storm runoff and to permit air circulation. Do not store components in areas that will collect water (e.g., swales, basements, drainage areas, etc.). Structural components

stored longer than two to three weeks should be covered with a tarp or plastic sheeting to protect against moisture gain. The covering should be weighted down on top of the stack to prevent it from blowing away but kept loose along the sides of the stack; otherwise, circulation will be reduced and moisture held in. One alternative is to stake the sides of the tarp so there is clearance around the structural components, allowing air circulation.

Mitigating Mold Growth During the Construction Process

Good construction planning allows for a sequencing that protects all moisture-sensitive building materials, including structural components, from excessive wetting that could lead to mold growth. However, a reasonable amount of wetting can be expected during the typical construction process. Wood structural building components will dry out under dry outdoor weather conditions after the structure is put under roof, sheathed, sided and roughed-in (mechanicals) — assuming the structural components are not exposed to further wetting from rain. Such drying must occur before the components are “closed-in” (e.g. covered up with insulation and drywall). Adequate conditioning of the interior of the building is required for the proper application of insulation and drywall, and may require additional heat and/or ventilation to speed up the process.

Through use and age, a few potential sources of unwanted moisture in buildings can include: (1) improperly maintained A/C systems that can create excessive condensation, (2) plumbing leaks, (3) gaps in flashing, roofs, siding or masonry, (4) poorly sealed windows, (5) porous slabs and foundations, (6) inadequate drainage, (7) faulty roof drains and downspouts, and (8) poor ventilation and/or air circulation combined with high indoor humidity—from showers, cooking or other activities. All of these things can result in condensation that promotes mold growth. It should also be noted that structures with exposed dirt crawl spaces and basements are more prone to have more airborne mold spores than structures that do not.

However, well-designed, well-constructed, and well-maintained structures, regardless of the materials used in their construction, will not support conditions suitable for the growth of mold. If built properly, the inside of the any structure (including the interior spaces and the building cavities) will stay dry enough to help keep mold spores from becoming active.

Remediation of Mold on Structural Building Components

While mold does not affect the performance of the wood, the general public may perceive it as a problem. Superficial mold can be easily removed by scrubbing with water and detergent followed by rinsing.

The following steps are recommended if mold is detected on structural components. **Before** close-in:

- Identify and correct any underlying moisture infiltration or exposure problems. Water should be drained or removed from horizontal surfaces and ventilation should be increased to facilitate drying. Sawdust and other construction debris will inhibit the drying process.
- Scrub the surface of the component with detergent and water, rinse and allow drying before covering, enclosing or painting.
- Remove and replace damaged building materials that cannot be cleaned.

The goal of mold remediation is the removal of most of the mold; it is not necessary to kill the mold. The mold cleanup is complete when the involved area is free of dust, and no residue transfers to a clean cloth or glove when wiped across the involved surface.

Note that mold spores cannot be permanently eradicated by cleaning or disinfecting. While such cleaning will remove spores present at the time of cleaning, it will not protect surfaces against mold spores that arrive at any time after the cleaning solution is gone.

Robbins and Morrell state:

> Even if a building is stripped of all components and every spore is killed or removed, normal background mold spores from outdoors or on replacement parts will be present and have the potential to grow. The most important objective in any mold removal is to eliminate any sources of moisture. Should the wood framing in a house become wet, through leaks or flooding, it is imperative that the area be dried as soon as possible to mitigate mold growth.

It is not necessary to test for mold once it has been identified. Testing air samples for mold is rarely useful in any building and is of no value in a new building during construction.

A permeable latex paint can be used to cover products that show residual staining or discoloration. Some paints contain zinc, which acts as an inhibitor of mold growth.

Commentary:

The information contained herein is a product, engineering or building code compliance research report (see *IBC* Section 1703.4.2) prepared in accordance with the referenced building codes, testing and/or analysis using accepted engineering procedures, experience, and technical judgment.

SBCA Research Reports provide an assessment of only those attributes specifically addressed within a given report.

Responsibilities:

- Product design, installation, quality control and code compliance are the responsibility pursuant to a specific scope of work as follows:
    - The Building Designer shall prepare the Construction Documents, which shall be of sufficient clarity to indicate the location, nature and extent of the work proposed, and show in detail that such documents conform to the Legal Requirements, including the Building Code.
    - The Contractor is responsible for the construction means, methods, techniques, sequences, procedures, programs, and safety in connection with the receipt, storage, handling, installation, restraining, and bracing of all structural elements.
    - The Truss Manufacturer shall obtain the Truss design criteria and requirements from the Construction Documents. The Truss Manufacturer shall be permitted to rely on the accuracy and completeness of information furnished in the Construction Documents or otherwise furnished in writing by the Building Designer and/or Contractor. The Truss Manufacturer shall manufacture the Trusses in accordance with the final Truss Design Drawings, using the quality criteria required by this Standard unless more stringent quality criteria is provided by the Owner in writing or through the Construction Documents.

The provisions of model, state or local building codes for building construction do not intend to prevent the installation of any material or to prohibit any design or method of construction. Alternatives shall use consensus standards, performance-based design methods or other engineering mechanics based means of compliance. This Research Report assesses compliance with defined standards, accepted engineering analysis, performance-based design methods, etc. in the context of the pertinent building code requirements.

Some information contained herein is the result of testing and/or data analysis by other sources, which SBCA relies on to be accurate, as it undertakes its scientific or engineering analysis.

SBCA has reviewed and found the data provided by other professional sources are credible. The information in this Research Report conforms to SBCA's procedure for acceptance of data from Approved Sources (see *IBC* Section 202).

Where appropriate, SBCA relies on the derivation of design values and other code provisions, which have been codified into law through codes and standards (e.g., IRC, WFCM, IBC, SDPWS, NDS, ACI, AISI, PS-20, PS-2, etc.). This includes review of code provisions and any related test data that aids in comparative analysis or provides support for equivalency to an intended end-use application. Where the accuracy of design values provided herein is reliant upon the published properties of commodity materials (e.g. lumber, steel, concrete, etc), SBCA relies upon grade/properties provided by the raw material supplier to be accurate and conforming to the mechanical properties defined in the relevant material standard.

The engineering evaluation was performed on the dates provided in this report.

This Research Report is subject to periodic review and revision. For the most recent version of this report, visit sbcindustry.com. For information on the current status of this report, contact SBCA.

References:

"A Brief Guide to Mold in the Workplace" Occupational Safety and Health Administration (OSHA); https://www.osha.gov/

ANSI/TPI 1 – National Design Standard for Metal Plate Connected Wood Truss Construction; Truss Plate Institute; 2007.

"Are there Federal regulations or standards regarding mold?" U.S. Environmental Protection Agency (EPA); epa.gov/mold.

Centers for Disease Control and Prevention (CDC); cdc.gov.

International Building Code; International Code Council; 2015. https://up.codes/code/international-building-code-ibc-2015,

International Residential Code; International Code Council; 2015. https://up.codes/code/international-residential-code-irc-2015.

Robbins, Coreen and Morell, Jeff. Mold, Housing & Wood. Western Wood Products Association; https://www.wwpa.org/

Yost, Nathan. "Mold & Construction." *Structural Building Components Magazine*. January/February 2003 edition; http://www.sbcmag.info/

For Further Reading:

Lumber Quality and Durability - Mold. Structural Building Components Association.

"SBCA QC & Minimizing Mold." Structural Building Components Association

American Lung Association*;* lung.org.

ASTM Manual 40, MNL40, *Moisture Analysis and Condensation Control in Building Envelopes*, 2003

ASTM Manual 18, MNL18-2nd, *Moisture Control in Buildings: The Key Factor in Mold Prevention* - 2nd Edition, 2009

American Society of Heating, Refrigerating, and Air-Conditioning Engineers, Inc. (ASHRAE); ashrae.org.

California Department of Health Services (CDHS); dhcs.ca.gov.

Canada Mortgage and Housing Corporation (CMHC); cmhc-schl.gc.ca.

The Carpet and Rug Institute (CRI); carpet-rug.org.

Canadian Wood Council; cwc.ca.

FPInnovations; fpinnovations.ca.

Health Canada; hc-sc.gc.ca.

National Association of Home Builders; http://nahbnow.com/2014/12/dealing-with-mold-claims/ and https://www.nahb.org/en/research/legal-issues/dealing-with-mold-claims.aspx

National Association of Mutual Insurance Companies (NAMIC); namic.org.

New York City Department of Health & Mental Hygiene Bureau of Environmental & Occupational Disease Epidemiology; https://www1.nyc.gov/assets/doh/downloads/pdf/epi/epi-mold-guidelines.pdf.

University of Minnesota Department of Environmental Health & Safety; dehs.umn.edu.