The mold-resistant houses in Snowflake

Most of the houses in the Snowflake EI community are built to be mold resistant, in addition to being less toxic and low EMF. The methods have proved themselves to work over more than three decades.

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Mold is a hazard for people with environmental illnesses, both the spores and the fumes they emit. A healthy house should include features to limit the possibility of mold growing there.

The Snowflake community in Arizona has pioneered healthy construction methods since its first house was built in 1988. The decades since have provided valuable experiences with what works in that climate.

Mold prevention

Once mold becomes a problem, it is difficult to fix it in a way that allows a person with MCS to continue living in the house. Preventing mold from starting is thus the way to go.

Mold needs two things to grow: moisture and food. Mold prevention focuses on removing both of these as much as possible.

A traditional way to preserve food so it doesn't get moldy is to dry it, such as with dried fruit.

Moisture in a house can come from leaky plumbing, leaky roofs, high humidity, and condensation. Condensation happens when moist air meets a cold surface, which then becomes wet. An example of condensation is when windows get foggy after taking a shower on a cold morning. It can also happen many places that are hidden, such as inside walls, if the house is not built correctly, or is poorly managed.

Mold can grow on anything, but it much prefers to grow on what is food for it, such as books, wallpaper, clothes, and wood. It can grow on surfaces that are not food for it, such as tile and synthetic carpets, if there are dust particles it can eat.

The Snowflake climate

The Snowflake neighborhood is located at around 5800 ft elevation (about 1500 meters) in the high desert of Arizona. The annual rainfall is 12 inches (300 millimeters), which mostly falls during the months of July through September, which tempers the summer heat. Even during the summer it doesn't rain every day and it is rare the outdoor humidity stays above 50% for more than a couple of days at a time.

The heating season is from October through April, which means the houses will be kept dry by the heated air inside, even when the outside humidity climbs on cool days and nights.

This climate in itself makes it difficult for mold to grow, unless moisture is constantly provided. If a mold colony has started, removing the source of moisture should make the colony go dormant as the air will usually not provide enough moisture (except during prolonged rain).

People who are looking for extreme mold prevention may wish to consider the Mojave desert further west, where the rainfall is half that of Snowflake. The

downside is the summer temperatures are much higher and airconditioning is needed. Even in that climate older regular houses are commonly moldy, especially those using evaporative cooling.

Mold-resistant materials

MCS-safe materials also tend to be resistant to mold. The floors are made of concrete covered with ceramic tile. Most houses have no wooden boards at all (OSB, plywood, etc).

Regular lumber is used for the wall studs and rafters, though people usually specify the lumber must be kiln dried and not stored outside at the lumber yard. Some have used lumber that is somewhat more mold resistant, such as Douglas fir.

Some houses have steel studs for their interior walls. They cannot be used for exterior walls as the thermal bridging is a mold hazard.

Cabinets and shelving are of steel, either with chrome or baked-on paint. Wooden cabinets are rarely used, and then only with high-quality wood sorts, such as maple.

Mold resistent wall construction

Most houses use gypsum wallboards, even though the gypsum and paper backing are a heaven for mold if they get wet. Using magnesium or cement boards are too expensive for most people.

When the gypsum wall board is installed, it is lifted about an inch (2 centimeters) off the floor (two inches if the floor will be tiled later). This is conveniently done using a piece of wood to hold the board up while the screws go in.

This simple feature creates a gap below the wall board. In case of flooding, the board will not wick up the water from the floor. This feature saved two houses from major renovations after they were flooded from unattended washing machines that backed up.

Outer wall with redwood bottom plate, Douglas fir studs, housewrap and plumbing. Insulation and drywall came later.

The bottom of each wall must be mold resistant. The regular practice is to use toxic pressure-treated wood placed horizontally on the floor (bottom sill), with a soft strip of plastic underneath.

In the Snowflake houses, the plastic strip is still there, but the toxic wood is replaced with wood that is naturally rot resistant. There are multiple sorts, the one available in Arizona is redwood. Redwood is otherwise not used in these houses, as it is very expensive and also more aromatic.

Regular folks commonly use redwood for decks that never need to be painted.

Basements and crawlspaces

Basements and crawlspaces under a house are mold hazards. None of the site-built Snowflake houses have such.

Vapor barriers

Vapor barriers are used to prevent condensation. It is an airtight membrane that blocks warm moist air from moving to a place where it will be cooled so much it generates (condenses into) moisture.

The Snowflake building code specifies that vapor barriers must be used on exterior walls and ceilings. It is to be placed on the inside of the insulation. This prevents moist inside air from migrating into the walls and make the insulation and studs wet.

Building codes for some other climates, such as Florida and southern Arizona, have other specifications for the use of vapor barriers.

The Snowflake EI houses conform to the local building code. Their vapor barriers are aluminum foil mounted on the room-side of the wall boards (regular houses use plastic hidden behind the wallboards).

The EI houses also use house wrap, which is a permeable plastic barrier placed between the siding and the insulation. It slows down air movement on windy days. It *looks* like another vapor barrier, but it does not block the movement of moisture.

There should never be two vapor barriers, as moisture can become trapped in between them during extreme weather and then not get out again.

Bathrooms

The bathroom generates a lot of moisture and wet surfaces. The best solution is to tile all surfaces, with mold-resistant cement board behind the tile. The grout and cement boards are not a full vapor barrier, so for the outer walls and ceilings to the attic, a vapor barrier is needed behind the cement board as a barrier to prevent condensation (especially if cracks later develop).

Tile and cement boards are expensive, so some have compromised and used gypsum wall boards covered with aluminum foil for areas not around the shower. This seems to work too.

All houses have a bathroom window so the moisture can be vented out quickly. Some also use fans placed in the window, or mounted on a duct to the outside.

Windows

Windows can cause condensation. Double-pane glass is a must. Most windows have aluminum frames with a thermal break, as they are less toxic than plastic or wood frames.

A few houses have aluminum frames without the thermal break because of contractor screwup. They have condensation problems in the winter.

The window sills are usually tile on top of cement board, to be mold resistant. Moisture may gather on the window sill from condensation on the window or if the window is left open during rain (people use open windows for ventilation).

Airconditioning

None of the Snowflake houses use swamp coolers (evaporative cooling) as that is a major mold hazard. A few houses occasionally use regular airconditioning, though most do not use them at all. The summers are mild enough, with cool nights, that site-built houses with concrete floors don't need airconditioning. The heavy floors even out the daily temperature swings.

Eliminating sheathing and decking

Regular American stick-built houses usually use manufactured wood boards as part of the roof and the outer walls. They are toxic and a potential source of mold. Most of the Snowflake houses have no manufactured wood (plywood, OSB, particle board) at all.

Mounting steel roof panels without decking underneath.

Steel panels are used both for roofing and siding. The panels are strong enough that there is no need for boards underneath. This is both according to the manufacturer's documentation and over 35 years of experience in Snowflake.

Instead of boards, the panels are mounted on wooden lumber (2x4s), which are nailed horizontally to the wall studs and to the trusses. The panel manufacturer's literature specifies the maximum distance between the horizontal lumber, though the houses all have them somewhat closer so people can walk on the roof.

Roof penetrations and fittings

Ideally, the roof should be two completely unbroken surfaces. Any roof penetration or flashing are potential leak hazards. A leaky roof is hard to detect, so a lot of moisture may have entered before it is discovered.

Modern American houses often have complicated roofs that change size and direction. These are considered beautiful, and perhaps a show of wealth. The Snowflake houses use simple roofs.

Roof penetrations are for venting the sewage pipes, so they flow easily. Such a stack is typically needed for each commode and drain. There can also be vents of various other kinds.

That can be a lot of roof penetrations. Worse, some regular houses vent into their attics instead of to the outside, which is a mold hazard.

The Snowflake houses use as few roof penetrations as possible. The various stack pipes go up into the attic and then horizontally to a central place where they meet into a single stack that goes up through the roof.

The horizontal stack pipes are slightly sloped so any condensation will flow back into the sewer. As no water actually flows in these stack pipes, there is no need for much sloping.

The roof penetrations are placed as high on the roof as possible. This gives better venting of any sewage gases, and there will also be less stress on the stack (and caulking) from snow on the roof.

Good housekeeping

Mold prevention is not just a matter of good design. It also requires good daily practices.

After taking a shower, the moist air must be vented out of the house. That also goes for some cooking.

Don’t bring in a bunch of moldy books or papers. Store such elsewhere, scan them or throw them out.

Get rid of moldy clothes and moldy furniture.

Fix leaks promptly, whether a leaky roof or a leaky pipe.

Make sure the house is adequately heated in the winter.

Inspect the caulking around all roof penetrations every couple of years.

These are common sense, but people fail to do them and then there is trouble.

Not all the same

Each of the Snowflake houses is unique, they were built over more than thirty years. The features listed here are not used in all of them.

Building inspectors sometimes wouldn’t accept anything they hadn’t seen before, even instructions provided by the manufacturers. Some builders were forced to put decking under the roof panels. They either used plywood or wooden planks placed close together.

Proven to work

The methods described here have proved themselves to work over the decades. High winds and snow have never damaged any of the roofs or sidings (except once the wind made a canoe into a projectile that rammed one house).

Checking for mold in the wall before buying an existing house in Snowflake. None was found.

None of the houses have become moldy because of these construction methods. The most recently sold house was thirty years old and the buyer hired a well-known out-of-state mold inspector to check before buying. Others have done ERMI mold tests. Two houses were checked by removing pieces of the siding.

A couple of houses have been thoroughly flooded (from failing washing machines) and survived without having to replace drywalls or other building materials.

Whether all these methods will work as well in other climates is uncertain.

The houses that did get moldy

Some of the houses did get moldy, but none of that appears to be caused by how they were built.

Heating was the dominant cause. Some people simply didn't heat their house enough, so the walls were so cold moisture condensed inside the vapor barrier.

One house with stucco walls became so moldy it was visible in places, such as around the stove. It was impossible to clean up, so the house had to be sold to regular people.

In another case, a renter didn't like the heaters there and heated the house using the electric stove. To prevent the coils from overheating she had a big pot with water on the stove at all times. This put a lot of moisture in the air, so condensation dripped from parts of the ceiling. The landlord was able to fix the mold problems by replacing the drywall sheets.

Some mold experts suggest a house should never be cooler than 62 degrees Fahrenheit (17 C), to prevent condensation on the walls. The surfaces of the outer walls will be cooler than the room air, or walls that are interior to the house.

More information

More articles about environmentally safer house construction and renovation at www.eiwellspring.org/saferhousing.html.

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