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Predicting Mold Growth in Walls

by Mostafa Nofal, Ph.D.

Moisture levels in the building envelope can cause biological, chemical, physical, or structural damage to construction materials in houses. The type of damage depends on the temperature, moisture levels, time of exposure and mechanical loading and also the types of building materials. In wood-frame construction, wood products may be damaged by biological activity.

The Institute for Research in Construction (IRC) at the National Research Council of Canada (NRC) is developing a method to assess durability by linking structural and hygrothermal analysis computer models.

Determination of the Rate of Damage

The development of a good moisture damage model requires experimental data. Damage due to biological action is one mechanism that affects wood durability. A wide range of organisms, including fungi, termites, carpenter ants, wood-boring beetles and marine borers, can live in and consume wood depending on the materials, the location and the micro-environment.

Fungi damaging building envelopes are mainly mold, mildew, and wood-rotting fungi. Mold fungi also cause odours and health problems in some individuals. Under the right conditions fungi cause significant loss of strength in wood materials. A fungal attack depends on six critical requirements:

1) wood type,
2) free or unbound water,
3) favourable temperature,
4) a characteristic time of exposure,
5) oxygen and
6) available, digestible carbon compounds.

The results of experiments conducted in Finland were used to develop a formula for the rate of mold growth. The experiments identified how much time it took for initial growth and percentage of area covered with molds.

To predict the mold growth, it is necessary to know the type of building materials and relative humidity and temperatures of the surface over the simulated period. The temperature and relative humidity are obtained either from field measurements or from predictions.

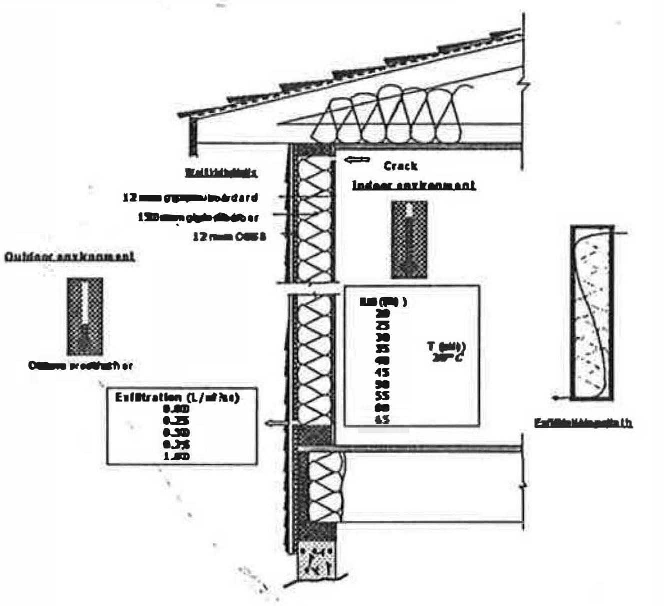

Fig. 1 Wall system and boundary conditions for worst case scenario for exfiltration.

Mold Growth Prediction

For the case of exfiltration shown in Fig 1, the bottom and top of the sheathing membrane is most susceptible to mold growth. Mold growth increases as the air leakage rate increases (Fig. 2) and decreases as the relative humidity of the surface decreases.

An indoor relative humidity of 20% to 35% gives the same amount of mold growth. Only the

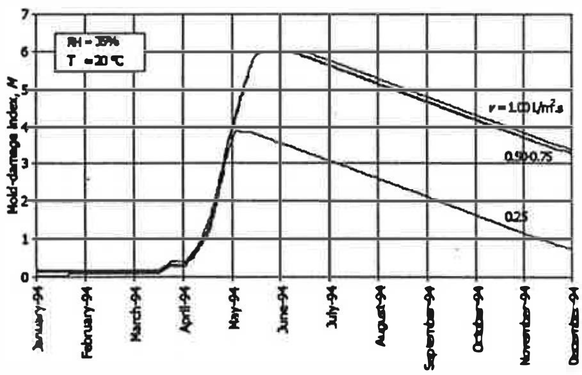

Fig. 2 Effect of air leakage rates on mold growth

bottom 40 mm of the wall was covered by mold for indoor relative humidities higher or equal to 35%. These results show that hygrothermal analysis alone cannot be used to assess performance and durability. The results show that exfiltration rates are much more important for mold growth than once thought.

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Mold growth begins with air leakage more than 0.1 L/m²s. Fig. 3 shows the change in mold growth depending on the air leakage rate at different indoor relative humidities.

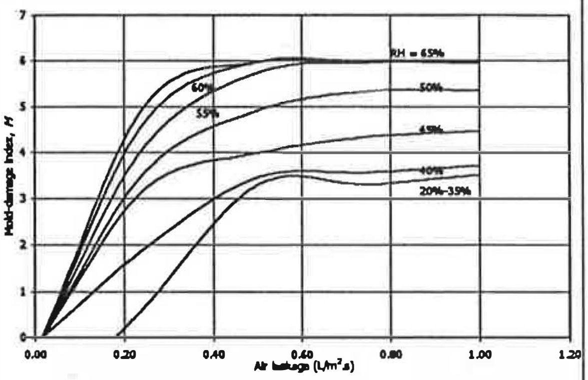

Figure 3: Variation of mold growth

Mold growth increases significantly in the range of 40% to 55% RH (Fig. 4). However, air leakage with indoor relative humidities between 20% to 35% will cause invisible mold growth.

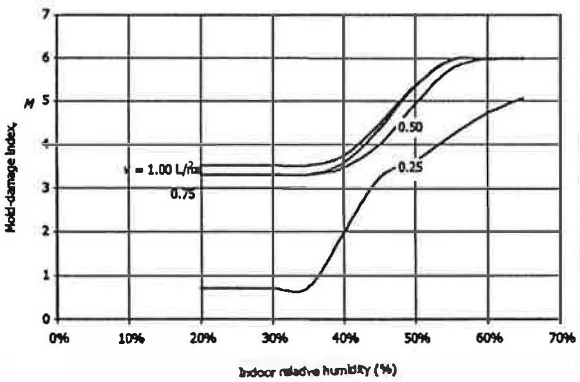

Fig. 4 Effect of Relative Humidity on mold growth

Conclusions

Mold growth will be most pronounced at the bottom and the top of the wall. Mold growth depends on the indoor relative humidity and temperature. High indoor relative humidities increase the probability of mold growth.

The initial results show that durability is not just a function of the strength of the different materials. Physical, biological, and chemical processes are also responsible for the durability of building envelopes. Analysis shows that the air leakage has a significant impact on the wall performance. ✪

Letter to the Editor

Re: Quiet Fans (Solplan Review No. 84)

In your January 1999 issue you had a table listing solutions for noisy fans. We found it peculiar that we did not see our products listed in that table. Our products meet the stringent criteria for quiet fans stipulated by the BC Building Code. The units are also rated and listed in the HVI handbook.

Kanalflakt is an international ventilation products manufacturer with our North American manufacturing facility in New-Brunswick.

Marc Leger P. Eng.
Customer Service Manager
Kanalflakt Inc. Bouctouche, NB

Kanalflakt fans that meet the BC Building Code criteria are:

UQ 80	*80 cfm*	*0.8 sones*
UQ100	*100 cfm*	*1.2 sones*
UQ140	*120 cfm*	*1.5 sones*

Candle Power

You've heard about the energy efficient houses that can be heated just by a candle. But how much heat is there in a candle?

The BTU content of wood is about 8,000 BTU/lb, while a candle is about 15,000 BTU/lb. (You should allow about 10% chemical energy loss from CO and soot). Thus a 4 oz candle that lasts 4 hrs will give you roughly 850 BTU/hr or 250 watts.

Thanks to Norbert Senf of Masonry Stove Builders for this gem.