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Publisher's version / Version de l'éditeur:

Columns - The Newsletter of the Alberta, Saskatchewan and Manitoba Associations of Architects, 5, June 4, pp. 4-5, 1998-06-01

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NRCC-43111

A version of this paper is published in / Une version de ce document se trouve dans :
Columns - The Newsletter of the Alberta, Saskatchewan and Manitoba Association of Architects, v. 5, no. 4, June 1998, pp. 4-5

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Technical Brief: Air Leakage Paths Through Exterior Walls

Which of the air exfiltration paths illustrated below lead to the greatest accumulation of condensation on the interior face of the sheathing of an exterior wall (given that all other things are equal)?

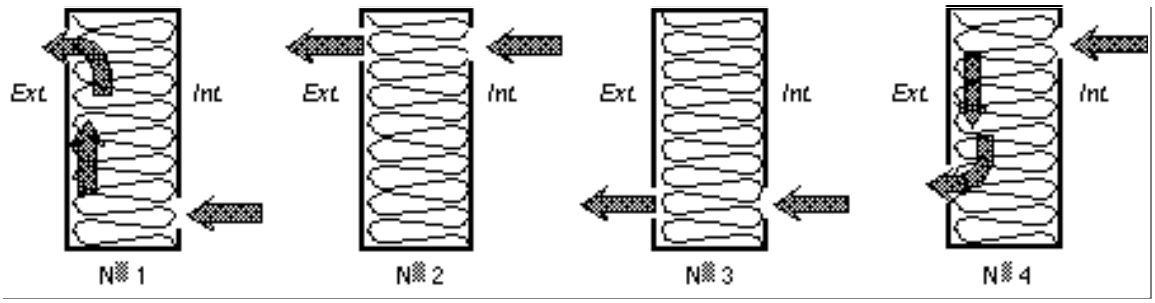

Figure 1. Vertical wall sections of insulated wall cavities

Answer: The long and indirect air exfiltration paths, like paths 1 and 4.

As warm, humid air escapes through an exterior wall, heat transfer takes place between this warm air and the "less warm" surfaces on its path. The parts of the sheathing that are "licked" by this flow of warm (and humid) air will, therefore, be at a higher temperature than the rest of the sheathing. The tendency is as follows:

- The shorter and more direct the air exfiltration path (paths 2 and 3), the closer the temperature of the material at the exit point will be to the air temperature at the point of entry into the cavity.
- The longer and more indirect the air exfiltration path, the less the material around the exit point will be warmed up by this warm air exfiltration.

This IRC news item is based on an article by K.N. Burn entitled "Masonry Wall Systems," DRB, NRC, Forum '82: building science, 1983; available on the Internet at http://www.nrc.ca/irc/bsi/82-2_E.html. To obtain a copy of the paper, phone IRC Client Services toll-free at 1 800 672-7990.

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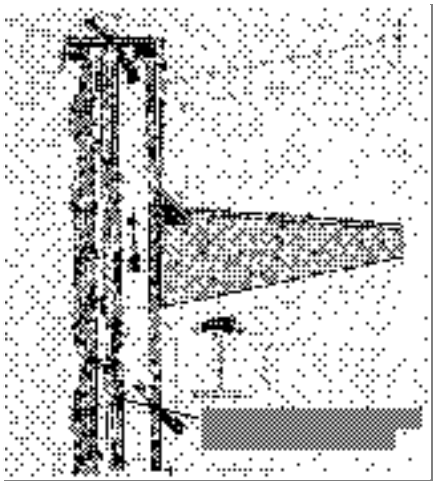
Materials at the exit points in cavities 1 and 4 will be kept at a temperature *below* the dew point of the interior air for *longer* periods in winter than those materials in cavities 2 and 3. That is why cavities 1 and 4 will show a greater accumulation of condensation in winter. How much greater will the accumulation be? Computer simulations (using the model TCCC2D developed by VTT in Finland

and IRC) indicate that for a given winter season, long and indirect air exfiltration paths can cause three times more accumulation of condensation on the sheathing than short and direct paths.
In the envelopes of existing buildings without effective air barriers, one can think of some long and indirect air leakage paths. Think, for example, of the insulated cavities in hollow masonry walls without effective air barrier systems (see Figure 2).

Figure 2 - Hollow masonry walls without an effective air barrier system

However, this does not mean that short and direct paths necessarily cause fewer problems. Air infiltration along a short, direct path, for example at a wall-window interface, considerably cools the interior surfaces, such as window frames, and causes surface condensation, besides making the adjacent interior spaces uncomfortable.



Obviously, we do not choose the air exfiltration paths in a building envelope: they are generally accidental and uncontrolled. What we must do is *minimize* air flow through the envelope walls with an air barrier system. This is a critical component in an overall approach aimed at achieving both a high-quality indoor environment and envelope durability.