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Cold Climate Housing NEWS

Cold Climate Housing Center, Minnesota Extension Service
Minnesota Cold Climate Building Research Center, University of Minnesota

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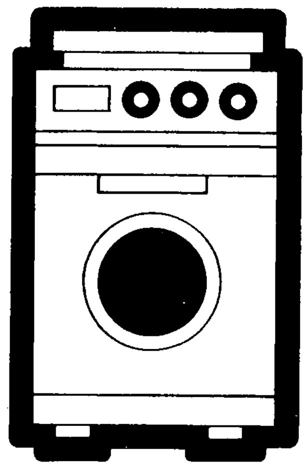
MnBRC Volume 2, Issue 3

Appliances And Energy Use: 1990's

Wanda Olson, Design, Housing and Apparel

Consumers can benefit by selecting energy-efficient appliances. To help consumers with their selections, appliance efficiency standards have been established. The law establishing the standards, the National Appliance Energy Conservation Act (NAECA), was signed in 1987. The standards for clothes washers (requiring a cold water rinse option), for dishwashers (requiring an "air dry" option), and for gas clothes dryers (electric ignition) took effect in 1988. Electric ignition rather than standing pilot for gas ranges and ovens with a power cord is scheduled to take effect on January 1, 1990. In Minnesota electric ignition has been required since 1979. The standards for refrigeration and water heating appliances are scheduled to take effect, on all models manufactured, on or after January 1, 1990.



Refrigerators and Freezers

There will need to be many new models of refrigerators and freezers introduced, since only 25% of the models available in 1987 meet the new requirements. The standards specify the maximum energy consumption according to volume (cubic feet), type of defrost, features such as through-the-door ice (refrigerator), and style such as upright or chest (freezer). These features are considered to be a benefit to the consumer and additional kilowatt hours (kwhs) are allowed for them. Table 1 gives some indication of how current models listed in the *1989 AHAM Directory of Certified Refrigerators and Freezers* fit with the NAECA requirements.

Water Heaters

The efficiency standards for water heaters are based on storage tank volume. The efficiency is indicated by its energy factor (EF), which is an overall efficiency based on heating 64 gallons of water per day.

Continued on page 2.

INSIDE THIS ISSUE

Windows Make A Home

Patrick Huelman, Forest Products

Windows are a very important component of our homes. First, they play an important role in our physical and psychological comfort, health, and well-being in the home by providing a vital connection with the exterior environment. Secondly, they provide architectural interest and character to both the interior and exterior of the home. Thirdly, they are a major contributor to the energy efficiency or inefficiency of the home. This article will address the energy aspects of window location as well as the individual window unit.

Continued on page 4.

This archival publication may not reflect current scientific knowledge or recommendations.
Current information available from University of Minnesota Extension: http://www.extension.umn.edu.

Table 1.
Examples of NAECA Requirements for Refrigerators and Freezers and kwh/yr Consumption of Available Models

Category	NAECA Requirements Maximum kwh/hr by Volume		kwh/yr Range for Models By Volume Category
	12.5 cu. ft.	14.4 cu. ft.	12.5 - 14.4 cu. ft.
Refrigerator			
Manual defrost	520	551	500-696
Refrigerator/freezer-automatic defrost	18.5 cu. ft.	20.4 cu. ft.	18.5 - 20.4 cu. ft.
Top freezer (no ice)	859	903	840-1347 (ice and no ice)
Top freezer (door ice)	971	1021	840-1347 (ice and no ice)
Side freezer (no ice)	895	1116	1033-1705 (ice and no ice)
Freezers	13.5 cu. ft.	15.4 cu. ft.	13.5 - 15.4 cu ft.
Upright with manual defrost	569	577	649-800
Upright with automatic defrost	839	869	918-1114
Chest with manual defrost	423	451	460-741

Sources: Section 430.32 Federal Energy Conservation Standards - Equations. January 1, 1990. *1989 AHAM Directory of Certified Refrigerators and Freezers.*

Table 2.
Average Energy Use and Operating Time When Preparing 30 Food Items on Four Cooktops[1]

Cooktops	Watts	All Menu Items Average watt hours	All Menu Items Average minutes	Breakfast Items Average watt hours	Breakfast Items Average minutes
Conventional coil	1500	190	15.0	191	10.1
Solid element with thermal limiter	1500	187	16.1	214	11.6
Solid element with thermostatic control	1500	193	16.6	230	15.4
Induction coil	1200	194	16.6	162	11.4

[1]Lovingood, R.P., S.G. Bentley, A.B. Lindstrom, and L.G. Walton. 1987. Innovation and conventional cooktop: energy use, operating time, user interaction, and other characteristics of performance. *Proceedings of the 38th International Appliance Technical Conference.* Columbus, Ohio: 120-126.
Note: These food items represent all of the cooktop operations of the AHAM menu for range energy testing.

Table 3.
The Time Needed to Raise the Temperature of 3-1/2 Cups of Water 153°F in an Aluminum Saucepan and on Four Different Cooktops[2]

	Nominal Power (in watts)	Time (in minutes)
Gas	3,400	5.5
Glass ceramic with halogen lamp	1,800	6.4
Glass ceramic with conventional element	1,500	7.7
Solid element	1,600	9.1

[2]Adams, F.J. and O.T. Evans. 1985. Cooking by light - a revolutionary approach to the electric hobs. *Proceedings of the 36th International Appliance Technical Conference.* Madison, Wisconsin: T 1-12.

Appliance And Energy Use: 1990's

Continued from page 1.

The minimum EF for a 40-gallon gas water heater is 0.63 and for a 52-gallon electric heater is 0.96. The EF's for models of water heaters are listed in the *Consumer's Directory of Certified Efficiency Rating for Residential Heating and Water Heating Equipment*, published semi-annually by the Gas Appliance Manufacturer's Association (GAMA). The efficiency of a water heater affects the cost of operating dishwashers and clothes washers, because most of the cost of operating these appliances is in the use of heated water.

Cooking Appliances

There is very little difference in the operating costs of cooking appliances when the same fuel is used. The energy used in cooking varies mostly with operator use and less with the efficiency of the appliance. Nevertheless, there are many questions to be answered about the newer cooktops and their energy efficiency and speed of heating. Tables 2 and 3 report energy and time information from two laboratory studies.

U.S. Energy Use Growing

Total U.S. energy use increased by 4.4 percent to 80 quads (quadrillion Btu of heat) in 1988. This exceeds the previous high of 78.9 quads reached in 1979. Meanwhile, domestic oil production in the U.S. dropped 400,000 barrels per day in 1988. Oil production in the lower 48 states was the lowest since 1950.

Excerpted from Oregon State University Extension Service Energy-gram, March-April, 1989.

Windwashing And Its Effects On Wood Frame Buildings

Timothy D. Larson, Forest Products

Windwashing is defined as the penetration of the building envelope by outside air. The discovery that air leakage (or *exfiltration*) in cold climates leads to more moisture condensation problems than diffusion alone has increased interest in developing a good air barrier within the building envelope. Builders have used polyethylene and/or drywall in combination with caulks and gaskets on the warm side of the envelope to establish the air barrier. This has become particularly effective in reducing air leakage through ceilings into attic spaces. This article focuses on the areas of the building where intrusion or entry of air from the outside occurs and the problems it may create.

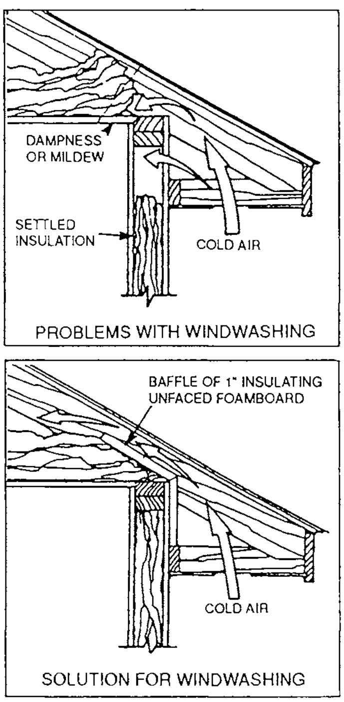


Figure 1.

The Minnesota Energy Division has written an excellent piece on the entry of air into the insulation at the truss heel/exterior wall intersection (see References). Figure 1 shows the problem and the solution with this type of windwashing. Air is shown entering through the soffit and then penetrating the attic insulation. This type of windwashing leads to interior condensation and energy loss. Signs of this condensation include thermal dusting, paint failure, drywall deterioration, water staining, mold, and mildew. Placing a baffle at the truss heel location to direct the ventilation air up over the insulation into the attic space can solve the problem. When continuous soffit venting is used, it is advisable to use baffles between each of the trusses. For more detailed information on this type of windwashing, contact the Minnesota Energy Division at (612) 297-5175; or in Minnesota call toll free 1-800-652-9747. Ask for the 1989 winter edition of the *Home Builders' Energy Update*.

Danish research on cathedral ceilings has demonstrated a number of problems associated with windwashing. The most serious of these problems was the use of batts too small to fill spaces between the insulation and the rafters. This caused a tremendous drop in ceiling insulation performance. Oversized batts and poor installation also degraded the performance of ceiling insulation. Furthermore, it was found that increasing the air speed from 0.65 ft/sec to 1.3 ft/sec dropped the R-value of the ceiling from 18.1 to 14.1 (a 21.9% reduction in R-value). This reduction took place in what was defined as perfectly installed fiberglass batt insulation. This research emphasizes the importance of proper insulation installation in cathedral ceilings and the protection of that insulation from windwashing, particularly at the junction of the ceiling and the exterior wall (by use of a baffle) so that ventilation air does not enter the insulation.

Windwashing also affects exterior walls. This is particularly visible at corners during the winter when mold and mildew appear because of condensation. There are many reasons for the condensation. Thermal bridging is one. This occurs when the number of studs at the corner reduces the potential to insulate and causes a greater heat loss. Natural convection or air movement in the corner is restricted so interior surfaces at this point are colder than other interior surfaces. Also radiant heat exchange is not good at the corner of exterior walls which leads to reduced surface temperatures. Furniture in corners contributes even further to the reduction of air flow and radiant heat exchange that takes place at corners. The geometry at the corner causes more conductive heat loss than at other places in the exterior wall. This is referred to as two-dimensional heat flow.

Research at the University of Toronto indicates that the preceding reasons were generally not enough to account for the condensation that was taking place at the corners of exterior walls. Laboratory research reveals that wind pressure differences at the exterior corners resulted in cold outside air entering, traveling through, and then exiting the wall at exterior corners (see Figure 2). It was shown that the wind

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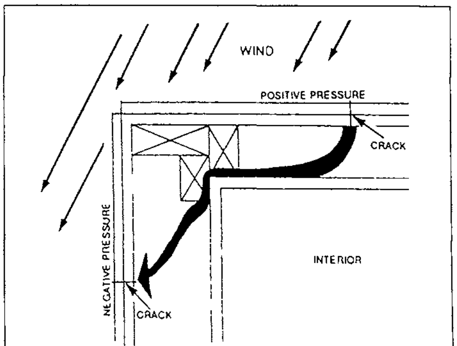


Figure 2. Windwashing at exterior wall corners.

Windows Make A Home

Continued from page 1.

Window Location

Window unit location, including orientation, position, and sun and wind exposure, is the single most important variable in determining the energy consequences of a window. With regard to orientation, a south window will contribute valuable solar heat gain in the winter and be easy to shade in the summer. A west window, however, is exposed to harsh winds and little solar heat gain in the winter, while having very large solar heat gain in the summer. The window's position on the wall and in the room will determine how much solar gain it will receive in the winter, how easily it can be shaded in the summer, and how effective summer breezes will be for natural cooling.

Shading south windows with properly designed overhangs and shading east and west windows with trees, vines, or architectural shading devices will significantly reduce cooling loads. Likewise, protecting west and north windows from winter winds by natural or architectural windbreaks will reduce heat loss and drafts.

Window Unit

The three key attributes to consider when evaluating the energy efficiency of a specific window unit are the window's R-value (or U-value), airtightness, and solar transmission. R- value is a measure of the resistance to the flow of heat. The U-value, which is the reciprocal of R-value, is frequently used in the window industry instead of the R-value. The R- value has a direct effect on conduction heat loss and gain through the window and the temperature of the inside glass or frame surface. Interior surface temperature affects condensation on the window and thermal comfort near the window. A high R-value will lose less heat and will have a higher interior surface temperature, which reduces the likelihood of window condensation and improves thermal comfort. The R-value of a window unit is affected by both the frame material and glazing system used.

In addition to R-value, window airtightness influences infiltration heat loss and gain as well as thermal comfort near the window. Infiltration is the uncontrolled flow of outdoor air into the home. The airtightness is primarily determined by the type of operation and the way the unit is installed in the building envelope.

Solar transmission is the percentage of solar energy that occurs on the glass that passes through the window. High solar transmission percentages are preferable in the winter and low percentages are desirable in the summer. The solar transmission is affected by the type of glass and coatings used in the glazing

There's More To Windows Than Meets The Eye

Patrick Huelman, Forest Products

Windows are an important consideration in building any structure. However, buying one window unit or buying another window unit is only one factor affecting building performance. The interior window treatment you select can also have a profound impact on the window's energy performance. Related to energy performance are the issues of comfort and control of condensation. In general, a window with a higher R-value will have a higher interior surface temperature and will improve thermal comfort near the window in the winter thus reducing the likelihood of condensation. On the other hand, certain window coverings can actually lead to increased incidence of moisture condensation, frost, or ice on the window unit.

Window coverings such as drapes, blinds, and shades have the tendency to reduce heat and air flow to the inside window surface, thus reducing the temperature of the glass. Because these coverings are not tightly sealed, moisture in the indoor air can still travel to the window surface. Therefore, during periods of cold exterior conditions or high indoor humidity, condensation will be likely to occur. For instance, under normal conditions a standard double pane window will begin to experience condensation when the outside temperature is 0 degrees and the indoor relative humidity is 35 percent. However, if a window covering is closed, condensation would begin at warmer outdoor temperatures or lower indoor relative humidities. (See the CCHC publication "Home Indoor Winter Relative Humidity: What is Acceptable?" HE-FO-3415).

Movable or nighttime window insulation is designed to greatly increase the R-value of the window when it is used. This can significantly improve the energy performance and thermal comfort of the window. However, lower glass temperatures make a very tight air seal critical to prevent condensation and frost formation between the window and the movable insulation.

A few other subtle contributors to window condensation problems include interior screens and deep window sills. An interior screen retards the flow of warm room air across the window surface. Although this can reduce heat loss, the glass temperature drops which increases the potential for condensation problems. Large or deep sills also retard the flow of warm room air across the bottom of the window unit (allowing cooler air to fall off the window and pool before cascading into the room). This results in a much cooler glass surface. For most windows, the bottom will be the first location for condensation to begin forming. This can be an early warning sign to employ a moisture management strategy to prevent heavy condensation, frost, or ice buildup if exterior temperatures remain cold (See the CCHC publications "Humidity and Condensation Control in Cold Climate Housing," CD-FO-3567 and "Moisture Sources Associated with Potential Damage in Cold Climate Housing," CD-FO-3405).

system.

R-values, which indicate airtightness, and solar transmission percentages for window units are commonly listed by the manufacturers. However, uniform standards do not exist for these ratings, nor do standards for the methods used to obtain them. Although the ratings do assist for comparison purposes, they may not be performed under similar conditions and may not be representative of a particular unit. This has led to increased pressure from designers, builders, and consumers for standards to be developed in the window industry.

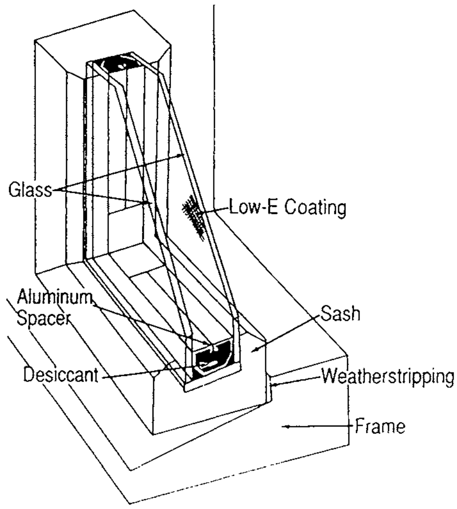
Window Type

Two of the most visible differences in windows are the type of operation and the frame material used. Common operational types include double-hung, casement, awning, sliding, and fixed. Other less common types include hopper and jalousie. From an energy standpoint, the most critical aspect of window operation is air infiltration. Windows that slide along the weatherstripping tend to have higher leakage rates compared to windows that pull tight against the weatherstripping. Of course, a fixed window will usually have less air infiltration than operable units.

The frame material will not only affect the amount of heat loss or gain, but also the dimensional stability and long-term durability of the window. Common frame materials include wood, vinyl, and metal. Wood framing, which can also have metal or vinyl cladding, will generally have the highest R-value. In cold climates, metal windows must have a thermal break to avoid condensation and frost buildup.

Glazing System

The glazing system (which includes glazings, coatings, gas space, and edge materials) will be the dominant element of the overall energy efficiency of the window. Most windows will use glass, although there are a number of plastics (including acrylics, polycarbonates, and polyester films) that can be used as outer or inner panes. The actual glazing materials have an extremely low R-value--the R-value of a single layer of glazing is the result of thin air films on the two surfaces. A large fraction of the improved performance of multiple glazings is the increase in the number of air films. For instance, three layers of glazing will have six air films.



Recently, there has been a great deal of research and development in coatings to improve window performance. For many years there have been solar control coatings, primarily reflective and heat absorbing, for windows used in commercial buildings. Now much of the emphasis in residential windows is low-emissivity (also referred to as *low-e* coatings). These invisible coatings, which are microscopically thin layers of metal oxides, allow shorter wavelengths of sunlight to pass through and longer wavelengths of heat to be reflected, thereby reducing heat loss and increasing thermal comfort. Windows with these coatings will retain heat inside the home in winter and reject heat from the outside in the summer. The low - e coatings also reduce solar transmission, which is a penalty in the winter on southerly windows, but is a benefit in the summer, especially for east and west windows.

Also important in determining the R-value of a window is the air space or gap between multiple glazing layers. The wider the air space, the higher the R-value. For instance, standard double glazing with a 1/4 inch air space is R=1.75, while the same glazing with a 1/2 inch air space is 2.04. A relatively new development in windows replaces the air in the space between multiple glazings with argon or krypton gas. These heavy gases help reduce heat transfer between glazing layers.

Another area of recent activity in the window industry is the material used at the edge of the glazing unit to separate multiple glazings. In the past this has been predominantly an aluminum spacer. But with aluminum's high conductivity and the condensation associated with higher heat loss at the edge, alternative edge spacers are being developed. These include a welded glass edge, a bituminous material with a corrugated aluminum strip, an insulative foam tape, and a fiberglass spacer. Besides changing the type of material used at the edge of the glazing unit, condensation at the window perimeter can also be reduced by burying the edge of the glazing unit further into the frame material.

When planning a new home or contemplating window replacement, keep in mind that proper window location can significantly improve both winter and summer energy efficiency and thermal comfort with little or no cost. When selecting a window unit, remember that the increased initial cost of highly efficient windows will usually be offset by long-term savings of energy and reduced maintenance. High R-values will reduce conduction heat losses, increase thermal comfort, and reduce condensation. Improved airtightness will help reduce infiltration heat losses and improve thermal comfort. High solar transmission percentages are desirable for south windows and are especially important for passive solar designs.

The House Doctor

The intent of this comlumn is to discuss issues or problems currently being encountered by contractors, builders and consumers in building and maintaining homes in cold climate regions.

Fixing A Home Radon Problem

Michael Noble, President, Natural Resources Corporation and Energy Outfitters, Ltd.

The Call for Help

A couple built a new home in 1987 on an idyllic rolling site in south central Minnesota. They decided to test for radon last October using a firm from the EPA Proficiency list. They chose a short term screening test since they were in the midst of remodeling their basement for their new business--a child day care center.

The charcoal canister to test for radon came by mail and the owner deployed it in the basement near an open sump. The couple was very distressed when they received the results: the result was 58.4 picocuries of radon per liter of air (pCi/L), a high measurement for this part of the country.

The wife's first instinct was to move to a motel, which her spouse talked her out of. He convinced her that they should seal the sump and make another charcoal measurement. It came in much lower, but still high at 21 picocuries.

Diagnosing the Problem

Energy Outfitters, a Minneapolis radon mitigation firm, began the diagnostics with an interview of the owners. A visual inspection of the basement revealed several items which would have a bearing on the planned mitigation. Two ends of a continuous drainage tile were in the sump. The walls were block, mostly above grade, covered with 2x4 framing and sheetrock. Loose joints on cold air returns and air bypasses from the basement into the attic raised the question whether the furnace fan or the house itself might be depressurizing the basement and sucking in radon gas.

The most important diagnostic test was measurement of subtle pressures below the slab to decide whether a drain tile suction system would work. This soil communication test was done by pulling suction from the sealed sump with a vacuum cleaner and measuring for pressure differences at small holes drilled at locations around the slab. The tests were encouraging. We measured 0.02" water gauge of pressure (5 pascals) at remote corners of the slab and in the center while sucking at the sump. This told us that if soil gas is exhausted from the sump with a fan, radon should not come up through the slab.

We also conducted more radon tests using a continuous radon monitor set to log radon measurements in four hour integrated increments. In addition, we deployed a passive monitor (E-PERM) upstairs which integrates the radon levels over the full testing period.

Radon Test Results of Case Study

Test Methods	Location	Timeline	pCi/L
Initial charcoal canister	Basement, near sump	Oct., 3 days	58.4
Follow-up charcoal canister	Basement, sealed sump	Oct., 3 days	21
Continuous radon monitor, closed house conditions	Basement, center	Nov. 10, 24 Hours	19.5
Continuous radon monitor, no closed house condition	Basement, center	Nov. 4-11	11.1
E-PERM, no closed house conditions	Upstairs, dining rm.	Nov. 4-11	9.7

The Installed System

After much discussion on routing the vent pipe, the decision was made to vent the sump and drain tile to the outdoors with a fan. A customized clear sump lid was gasketed and bolted to the floor over the sump. A 4" PVC vent pipe extended from the sump lid, through the masonary wall and up past the eave on the outside of the house. A centifugal in-line duct fan with a weatherproof housing was mounted outside at grade. An inclined manometer pressure gauge was located on the wall near the sump and the homeowner was instructed to monitor the sub-slab pressure. Components were labeled to avoid the risk of the system being shut off.

The following day the owner called to report the reading of the continuous radon monitor. It read 0.2 picocuries at the time, and averaged 0.5 picocuries over the following week. Follow-up E-PERM tests showed 0.6 picocuries in the basement and 0.7 upstairs for the week following mitigation. An Alpha Track Detector was provided for a long-term measurement. The cost of the service was about $1,000, but the owners and builders who follow EPA's recommendations for making houses easy to fix can reduce radon levels even less expensively. Had this

Continued on page 7.

Windwashing And Its Effects On Wood Frame Buildings

Continued from page 3.

factor alone would lower the interior surface temperature enough so that interior relative humidities had to be reduced from 65% to 40% to prevent condensation at the corners under the experimental conditions. In addition to reducing interior surface temperatures, this cold air traveling through the corner of the exterior walls would increase heat loss. This research indicates that one needs to be careful when installing exterior sheathing and/or weather barriers so that windwashing will not take place at exterior wall corners or at other places where wind may penetrate the envelope.

Research in Norway has shown that the lack of a weather barrier (wind barrier) can increase the heat loss through an exterior wall by 50% when it is exposed to a wind velocity of about 13.6 miles per hour. A builder can use the exterior sheathing as a weather barrier if installed correctly.

Attention should be directed towards the design and construction of the building envelope to prevent windwashing. Windwashing can lead to deterioration of interior surfaces as in the cases of exterior wall corners and ceiling/exterior wall intersections. Windwashing can also degrade the R-Value of both ceiling and wall insulation. The remedy to windwashing is to have controlled pathways for attic ventilation and an adequate weather barrier near the exterior surface of the wall.

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Minnesota Energy Division. 1989. "Cold ceiling corner mystery examined." *Home Builders' Energy Update*, Minnesota Department of Public Service, Energy Division, 900 American Center Building, 150 East Kellogg Boulevard, St. Paul, MN 55101.

Nisson, J.D. Ned (editor). July, 1988. "The effect of excessive roof ventilation on ceiling insulation." *Energy Design Update*, P.O. Box 1709, Ansonia Station, New York, NY 10023. Page 7.

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Fixing A Home Radon Problem

Continued from page 6.

house been built according to new construction recommendations by EPA, at minimum it would have a sealed sump, gravel under the slab, and a roughed-in PVC pipe from the basement ceiling to the attic floor, capped at both ends. Another option being researched by EPA investigators is to connect the PVC from the sump lid through to the roof, creating a "passive stack" for the radon. If this stack fails, a fan can be inexpensively added.

For more information on radon, the following publications are available: "Application of Radon Reduction Methods," (EPA/625/5-88/024), which can be obtained from the Center for Environmental Research Information, 26 West Martin Luther King Drive, Cincinnati, Ohio, 45268; "Radon Issues in House Buying and Selling," (Folder HE-FO-3532), and "Radon Facts for House Sellers and Buyers," (Fact Sheet HE-FS-3533), both of which can be obtained by writing or calling the Cold Climate Housing Center.

Radon Policy Action

William J. Angell,
Extension Housing Specialist

Mortgage lenders, commercial property owners, and school officials have recently learned that some of the most important radon policy actions flow from the administrative decisions of government agencies.

Savings and loan (S&L's) associations have been advised that radon is a potential risk and liability in a February 16 bulletin from the federal Home Loan Bank System's Office of Regulatory Activities. The risks to S&L's include borrower loan default if corrective action is costly, direct lender liability for the cost of repairs in the case of foreclosure or S&L ownership or management of the property, and liability in the case of personal injury of an occupant. The Bank System advises lenders to limit risk and liability through a number of steps including defining criteria to reject mortgage applications when radon levels are unacceptably high.

Commercial property owners who desire to lease space or to sell buildings to the federal government are learning that the General Services Administration (GSA) has initiated a radon policy. The policy calls for indoor radon testing. If test results are confirmed above the Environmental Protection Agency's (EPA) threshold for action (4 pCi/L), radon levels must be reduced. Furthermore, GSA advises that temporary employee relocation should be considered if radon levels are above 200 pCi/L.

School officials are receiving further details from EPA and state agencies about how to test school rooms for radon. While EPA believes the radon threat to the general population may be several thousand times greater than that related to asbestos, the cost of radon testing and reduction is comparatively cheap. For example, school radon testing is expected to cost less than $1.00 per child.

On the state legislative front, the 1989 Minnesota Senate failed to pass Senate File 342 that would have funded radon research and education as well as qualified Minnesota to receive federal matching grants. The 1990 legislative sessions will be the next opportunity for Minnesota to join 20 other states that have acted on the radon issue.

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Cold Climate Housing Publications

"Home Moisture Sources," Fact Sheet CD-FS-3396.

"Mold and Mildew in the Home," Folder CD-FO-3397.

"Home Indoor Air Quality Assessment," Folder CD-FO-3398.

"Residential Heat Loss," Folder CD-FO-3399.

"Insulation Basics," Folder CD-FO-3400.

"Moisture Sources Associated with Potential Damage in Cold Climate Housing," Folder CD-FO-3405.

Home Indoor Winter Relative Humidity: What is Acceptable?" Folder HE-FO-3415.

"Radon Issues in House Buying and Selling," Folder HE-FO-3532.

"Radon Facts for House Sellers and Buyers," Fact Sheet HE-FS-3533.

"A Systems Approach to Cold Climate Housing," Folder CD-FO-3566.

"Humidity and Condensation Control in Cold Climate Housing," Folder CD-FO-3567.

"Ceiling Airtightness and the Role of Air Barriers and Vapor Retarders," Folder CD-FO-3568.

"Exterior Wall Airtightness and the Role of Air Barriers and Vapor Retarders," Folder CD-FO-3569.

"Performance of Downdraft Kitchen Range Exhaust Systems," Folder HE-FO-3722.

"Performance of Kitchen Range Exhaust Hoods," Folder HE-FO-3713.

Two video tapes on range exhaust systems are available through the Extension Distribution Center, 3 Coffey Hall, 1420 Eckles Avenue, St. Paul, MN 55108. They are "Performance of Kitchen Range Exhaust Systems" (HE-VH-3593) and "Kitchen Range Exhaust System" (HE-VH-3594).

Several other Cold Climate publications are currently being prepared, reviewed or planned. By writing or calling the Cold Climate Housing Center, you can obtain single copies of the publications listed above. Additional copies of the listed publications can be purchased from the Extension Distribution Center on the St. Paul Campus. Fact sheets are priced at 10¢ wholesale, 20¢ retail, while Extension folders are priced at 25¢ wholesale, 50¢ retail.

During the coming year, CCHC staff will be conducting educational programs in many subject areas related to cold climate housing. A Cold Climate "Central" telephone number--612-624-9219--has been set up in Kaufert Laboratory (Forest Products) on the St. Paul Campus. Incoming calls regarding the program and information requests may be directed to this number or to specialists serving particular subject matter areas.

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Questions? Comments? For more information:

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