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Controlling Condensation In Weatherized Houses

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We have become aware during recent years of the advantages of conserving energy in our homes. High priced energy, the threat of energy shortages, government sponsored financial incentives and developing social pressures have prompted us to insulate, caulk, weatherstrip, seal, tighten, glaze, cover and close. We have learned to limit heat loss by tightening our houses to reduce air infiltration and by insulating our houses to reduce heat conduction. Air infiltration losses through cracks and other openings in many instances have been reduced by 75 percent; conduction losses through walls, ceilings and floors, even in older homes, have often been reduced by 35 percent. Energy consumption for heating and cooling has been impressively reduced, and our houses are more comfortable to live in because of more uniform temperatures.

Weatherproofing Problem

However, the things we have done to weatherproof our houses are aggravating a very real problem — condensation. Fig. 1 illustrates general patterns of heat and water vapor movement through a poorly weatherproofed house. Fig. 2 shows potential moisture condensation problems that can occur in a typical weatherproofed house. Water, or frost in some cases, forms on interior window surfaces and on structural members in attics and crawl spaces. Mildew forms on draperies and wooden window sills. Condensed water vapor runs down roof rafters in attics, soaks through the insulation and produces water stains on interior surfaces. The most serious damage, however, occurs to structural wood if dry rot is allowed to develop.

To control condensation problems in an enclosed space, the amount of water vapor in the air must be controlled based on the temperatures of the air and of the building surfaces. This is referred to as relative humidity, the amount of moisture in the air at any given temperature compared to its water saturation point.

Within the house itself, a certain amount of water vapor in the air (relative humidity) is needed to prevent respiratory discomfort. But, too much water vapor will lead to condensation when the air touches a cool surface such as a window pane. In attics and crawl spaces, condensation problems occur because wintertime heat loss to those areas is limited by heavy insulation. The cooler air has less capability to carry water vapor and is not as "active" in escaping through built-in air vents.

Controlling Humidity

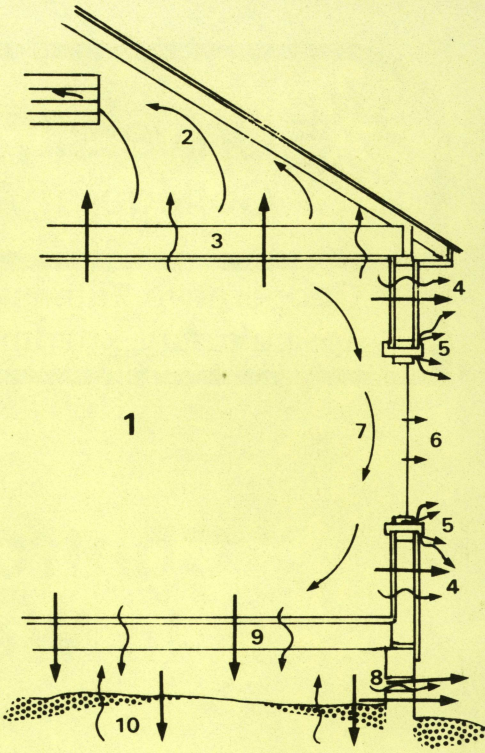
The air's relative humidity in an enclosed space can be controlled:

- By limiting the water vapor entering the area.
- By increasing the temperature of the air in the area.
- By allowing dryer air to circulate through the area.

Fig. 3 illustrates some methods for controlling condensation problems.

Corrective measures often detract from the energy efficiency of the house; some are expensive and difficult to achieve. A homeowner should remember that his house is a big investment, and that a problem such as dry rot must not be allowed to happen. The amount and the severity of steps needed to control condensation problems depend upon those factors which contribute to it, including the weather. It is usually best to apply the simpler, less expensive corrective measure first and resort to the more extreme measures only if needed.

Fig. 1. Heat and water vapor movement in a typical, poorly weatherized house.



1. Water vapor enters air from human respiration, plant transpiration, bathing, washing and cooking. Heating system has to replace heat losses, but water vapor losses keep relative humidity low.
2. Warmed attic air moves in convection currents, absorbing moisture from surfaces.
3. Substantial amounts of heat and water vapor enter attic.
4. Heat and water vapor move through walls.
5. Air moves through cracks and openings, carrying heat and water vapor.
6. Large amounts of heat are lost through window panes.
7. Natural convection currents keep warmed air moving by window surfaces.
8. Warmed air carrying water vapor escapes through crawl space vents.
9. Heat and water vapor enter crawl space from inside of house.
10. Water vapor enters crawl space from earth.

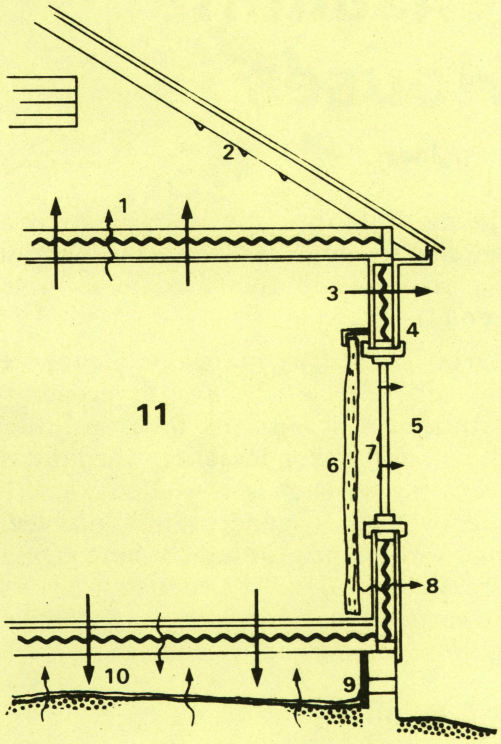


Fig. 2. Potential condensation problems in a typical weatherized house.

1. Insulation and vapor barrier reduce amount of heat and water vapor entering attic. Cooler, less active air reduces effectiveness of attic vents, and relative humidity rises.
2. Condensation can occur, particularly when outside temperatures are dropping.
3. Insulation reduces heat loss through walls.
4. Caulking reduces loss of heat and water vapor.
5. Extra glazing reduces heat loss through windows.
6. Tight-fitting window coverings prevent convective drying.
7. Water vapor in humid air condenses on cool window surface.
8. Vapor barrier reduces water vapor loss through walls.
9. Blocked air vents reduce the escape of water vapor.
10. Insulation and vapor barriers reduce amount of heat and water vapor entering crawl space. Cooler, less active air reduces effectiveness of air escape.
11. Heat loss is reduced and energy savings result. Water vapor losses are reduced and relative humidity increases.

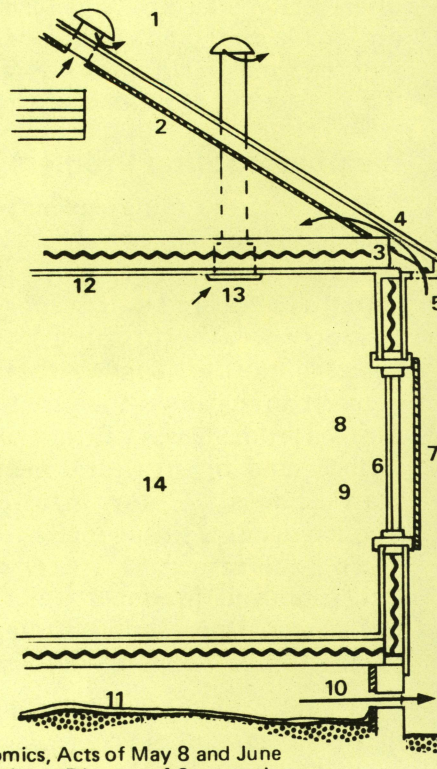


Fig. 3. Corrective measures for condensation problems.

1. Provide roof or gable-end exhaust fans.
2. Insulate the roof.
3. Remove part of the insualtion near eaves to allow controlled heat loss to rafters.
4. Make sure insulation is not blocking air flow.
5. Provide additional attic venting, particularly under eaves.
6. Use triple glazed windows.
7. Install exterior, insulated shutters.
8. Do not block air flow to window surfaces with drapes or furniture.
9. Do not use boxed-in window treatments.
10. Maintain or increase crawl space vent openings.
11. Provide ground vapor barrier; seal barrier to walls; seal all holes and seams.
12. Improve ceiling vapor barrier; put sheet under insulation, *or* paint ceiling with two coats of rubber-base paint.
13. Control water vapor sources: vent clothes dryer outdoors; vent kitchen, bathroom and laundry areas outdoors, not into attic.
14. Increase ventilation rate through house by opening windows or dampers. Use a dehumidifier.

Note: An immediate way to control unwanted condensation on windows and in attics and crawl spaces is to use fans, with heaters if necessary, to blow air over condensing surfaces.

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