regarding drafts and cold spots. They can [illegible] retrofit measures will most affect their comfort, though these are not necessarily the ones that will most affect their fuel bills. To track down the more tricky heat leaks and to evaluate the real effects of your efforts, expensive monitoring equipment—fan door and infrared scanner—are invaluable. In lieu of a blower door, an attic fan can be used to pinpoint leaks with a smoke gun or cigarette. Even with top equipment, though, judgment and experience are needed for success in this business.

Moisture problems

At the same time, the contractor should be keeping a lookout for evidence of existing or potential moisture problems. Telltale signals are peeling paint on the exterior, condensation on windows in winter, and, in extreme cases, mold, mildew, or "dryrot."

First you must find the source of the moisture. Often you will have to look no further than the basement. If surface water is leaking in, often rerouting a downspout or a little judicious grading around the foundation can do wonders. If the source is groundwater, install a sump if improving the subsurface drainage is not feasible. Whatever the tack, keep the water out of your house.

Also prevent water from entering in the vapor state. If there's an earth floor, cover it with heavy poly. If you have a porous wall (unprotected block or stone), patch it, then paint or poly it. If free water seeps through, and you can't stop it, isolate it from the room air and conduct it away.

Next you want to keep the basement moisture from rising into the wall cavities and the attic and roof areas. For the most part, the same measures taken to control indirect air leakage will control moisture transport. Pay attention to chases and cavities from basement to attic. One caution: if you are unable to keep the sill area relatively dry, be careful about enclosing it since the free circulation of air is probably what's kept it alive.

Inside the building, the stack effect will be carrying moist, household air up toward the attic through any available openings in the ceiling such as attic hatch, light fixtures, and plumbing. Pay special attention to these.

Other problems

Reducing the rate of air circulation in a home will increase the level of humidity and indoor pollutants. Since most leaky homes in cold climates are too dry in winter, the extra moisture should be welcome and eliminate the need for mechanical humidification. Other airborne materials, however, will also increase in concentration. The ones that have received the most attention to date are formaldehyde, radon, and combustion gases. If you have reason to believe that these or other pollutants may be trouble, exercise caution. Pay attention to potential problems such as an attached garage, basement workshop or darkroom, and unvented kerosene heaters and gas ranges. Isolate and ventilate these spaces as necessary.

Beyond some threshold, combustion and draft air for atmospheric heating equipment can become a problem. The interactions with other ventilation and exhaust systems becomes complex and critical. Other than switching to an induced-air or direct-vented unit, there is no foolproof solution. In some cases, it is feasible to supply air to an enclosure built around the furnace (*Building It Right*, 6/84).

Weather report

A house is a complex system with many interactive effects. Altering one function or component generally affects others. Predicting the full effects of your intervention with certainty is no more possible than predicting the weather. In fact, many of the same forces come into play. In the retrofit business, it pays to be cautious and, if warranted, advise the occupants on the signs of furnace, moisture, or air quality problems. In most cases, problems will not occur. Old houses have a lot of forgiving qualities, and are rarely tightened to hazardous levels. Most often, the environment will be more comfortable and healthier than pre-retrofit.

The savings

In a 1979 study by Richard Grot and Roy Clark of 250 low-income households, the mean natural air-infiltration rate was 0.86 air changes per hour, as measured by tracer-gas decay. In all, 40 percent fell in the 0.5 to 1 ach range. Assuming that typical sealing work cuts the rate by 30-percent (I'm told a fair estimate), this would result in winter savings of about 8 MMBtu for a 1500 square foot house in a 6000 degree day climate. With oil heat at $1.25/gallon, this represents an annual savings of about $115. With electric heat at 10¢/Kwh, the annual savings increase to about $240. Comfort is increased at the same time due to fewer drafts and higher indoor humidity. And rather than creating moisture problems, a well-planned retrofit can cure what had been a chronic moisture problem. Finally, by blocking the routes of cold air-flow through the house, the savings from retrofit air sealing may exceed that predicted solely by reductions in air infiltration. This is due to the reduction of convective airflow through building cavities that rob the building of heat and rob fibrous insulations of their insulative value. In a feature article next month on house doctoring, *Solar Age* will explore this issue in depth.