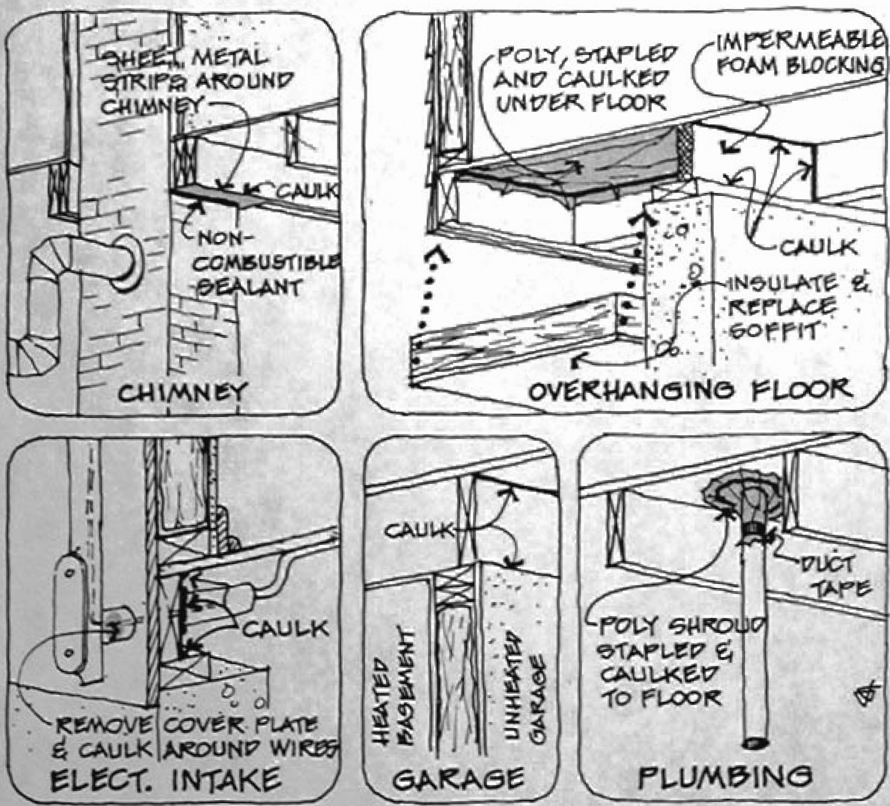

OLD FLOORS CAN BE TRICKY to seal—particularly with board-type subflooring. If the house is built over a vented crawlspace or an unheated basement, the floor should be sealed as well as possible from the prime living space. This limits infiltration and keeps moisture and radon (if present) out of the living space. If the basement is finished and heated, it is usually sealed at the walls, not at the floor above.

Retrofit realities rarely match textbook diagrams. Pipes and wires get in your way, spaces are inaccessible, and the building details you discover often boggle the mind. And because textbook buildings rarely match real ones, real energy savings often fall short of predictions.

Researchers have found that airflows around, behind, and through insulation account for many of the missing Btu's. To combat these leaks, sophisticated retrofitters often concentrate on basement and attic work—trying to block the main leakage paths up through the house. Once the exterior walls have been insulated and sealed, as in the Turner retrofit, infiltration and heat loss through interior partitions rival losses through exterior walls.

Attic leaks (called "bypasses") rob the house of heat in two ways. First they increase the overall rate of infiltration driven by the stack effect. (The taller the height between low and high leaks, the stronger the stack pressure.) Second, they chill the interior walls—increasing conduction losses through them. Sealing in the home's interior will reduce infiltration, but it won't stop partitions and chases that are open to the attic from filling with cold air. Only sealing in the attic will. In addition to increasing fuel bills, drafts and cold walls make it hard for the owners to feel comfortable no matter how many Btu's the furnace churns out.

Basement bypasses increase the stack effect and carry moist air into the house. Basement-to-attic leaks—such as chimney chases—bring the moist air right up to the attic, where it can cause problems.

Shown here are typical attic and floor bypasses and how to seal them. While the principles apply to all houses, each will demand creative solutions.

whether to install a continuous ceiling vapor barrier. And I didn't want to enclose the ceiling joists in poly," says Turner. "'A house has to breathe,' I was told at the time."

All floors got R-19 batts stapled to the joists—kraft paper facing down into a vented crawlspace. The crew punctured the kraft-paper backing to let any moisture escape, but the interior side of the cavity received no vapor barrier. At the time, Turner saw no practical way to create a vapor barrier on the warm side on the floor insulation, short of removing the hard-pine finish flooring.

Of the house's 34 windows, a few were replaced with double glazing and storms. The rest got triple-track exterior storms and inexpensive sheet-vinyl glazing on the interior—a poor man's triple glazing. The family installed high-R window-insulation panels on subfreezing nights. They left some panels in all winter. "If I did it over," says Turner, "I'd use triple glazing, maybe with night insulation in bedrooms and baths."

To house the new furnace and water heater, they built a small 6-by-12-foot concre te-block basement under the first-floor bath, and wrapped it in 4 inches of beadboard. Four inches of beadboard was also added around the base of a large chimney where it protruded into the crawlspace.

Expectations vs. reality

The work completed, Turner moved in and fired up the oil-fired furnace and woodstove, only to find that the house ate up almost 20 MMBtu more fuel than expected—based on an estimated load of 4 Btu/(ft² dd). That first winter, total energy use for heating—half wood and half oil—was about 135 MMBtu, rather than the 117 MMBtu estimated.

When Turner realized that the house's performance was not up to snuff, he called in a crew of house doctors to investigate. With a blower door and infrared scanner, they quickly spotted massive air flows up through the slatted-wood ceilings on the second floor. And this was on a relatively mild 35°F day. The added infiltration, reasoned Turner, could easily account for the missing Btu's. Calculations revealed that in a house this size, an extra 0.2 air changes per hour (over the estimated 0.5 air changes per hour) would make the difference.

Another problem Turner faced the first winter was a large ice dam on the sloping north roof that caused minor