GETTING PRACTICAL:

ENERGY DETAILS THAT BUILDERS CAN LIVE WITH

The best details balance tricky theories with common sense

by Jon Slote

As a quality engineer for Acorn Structures, I travel regularly to construction sites to see how builders are making out with new energy-saving building techniques. Invariably, the innovative concepts and products we read about in the magazines get refined as they are adapted to the realities of the building site.

Following is an off-the-top-of-my-head list of some current theories on energy performance, and how I've seen them reshaped in mainstream building practice. The purpose is not to prove the theories "right" or "wrong," but to demonstrate that a judicious balance between what's optimal for energy performance and what's practical to build leads to the best overall results.

Foundation Insulation

Theory: Exterior rigid insulation is superior to interior insulation because it couples the thermal mass of the masonry walls with the interior.

Practice: This is a popular notion, with major problems, both theoretical and practical.

The concept of added thermal mass has no practical value unless there is some free or very inexpensive way to warm it. Basements almost never have enough south glass to warm their walls by sunlight, especially since whatever sunlight falls in the room is largely absorbed by the massive concrete floor. All that coupling the walls to the interior really does is increase the time required to heat the basement each time the furnace cycles on.

The practical difficulties with exterior insulation are many. Boards move around during backfilling, creating gaps in the insulation barrier which are very difficult to fix. Details at the joint between foundation wall and siding are typically quite ugly. Methods of protecting the insulation above-grade are tedious or expensive or just don't work. I have seen a lawn mower chip off a stucco cover and take a chunk out of the extruded polystyrene beneath.

By comparison, furring in the basement walls and insulating with fiberglass is far easier to do correctly (see Figure 1). Pulling the frame wall in from the foundation wall also creates a handy chase for drainage pipes and wiring. Inspections of many of our older homes have not revealed problems with condensation which theoretically could be associated with this design. We consider this a track record worth sticking with.

High-Efficiency Furnaces

Theory: High-efficiency furnaces are an easy way for a builder to make a home energy-conserving without making design changes.

Practice: While I never want to give builders or designers license to ignore good energy design, there's some truth to this statement. We find that customers have, by and large, been happy with their high-efficiency equipment. For example, customers' fears over Lennox's pulse-combustion system being too noisy have not been confirmed.

One problem does persist: Some of the highest-efficiency models are only available with fairly low-capacity fans. The Yukon Ultima EX-95 (Yukon Energy Corp., 378 W. County Rd. D, New Brighton, MN 55112; 612/633-3115), for example, is rated at a robust 96-percent efficiency, but has an airflow of only 1,000 cfm—about enough for a 2,000-square-foot house (heating contractors typically try to install ½ cfm per square foot). We've

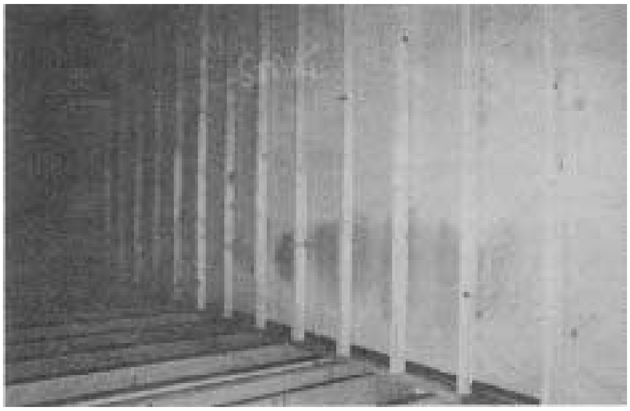


Figure 1. *Furring of basement walls and stuffing with fiberglass is easier than exterior insulation—and performs about as well.*

Figure 2. *Compressible foam Sill Band Sealer is most efficiently installed from the top during the framing. Unfaced fiberglass is added on the interior.*

heard complaints from owners of homes larger than this who were dissatisfied with the airflow of such equipment. The lesson is clear: Never sacrifice sufficient airflow to achieve higher efficiency.

Band Joist Detailing

Theory: Band joists should be insulated just like walls, with plenty of insulation and a winter-warm-side vapor retarder.

Practice: We began using compressible polyethylene foam blocks called Sill Band Sealer a few years ago, and found instant acceptance among builders. These are precut to fit in the joist spaces and are made by Sentinel Products, a Division of Packaging Industries, Inc. (130 Main St., Box 3, Hyannis, MA 02600; 617/775-5220). One reason for their popularity is that they can be installed from on top of the floor system (see Figure 2) before it is sheathed, which is much easier than reaching up to insulate from the basement level.

Over time we realized that there was a thermal weak link at the uninsulated sill plate. We considered moving the Sill Band Sealer in about 12 inches, and putting fiberglass behind it to keep the vapor retarder (that is, the foam) on the winter-warm side. Then we saw how mechanical tradesmen simply discarded the foam when they had to run ducts, pipes, and wires through this area.

Our current recommendation is to install the foam tight to the band joist, and put fiberglass inside the foam to cover the top of the foundation wall. If a tin knocker completely removes the fiberglass for a duct, at least the foam is still there to do its job.

Footnote: Some concerns have been raised about Sill Band Sealer shrinking on the job. We have measured the shrinkage over 28 months in laboratory samples to be about 1/32 inch per year in both length and height. If shrinkage continued at this rate, which we think is unlikely, it would be well over a decade before any gaps appeared between the foam and the joists. Furthermore, we have seen no evidence of the foam coming loose in the field in two to three years of service. So for now, we don't find this a pressing issue.

Low-e Glass

Theory: Low-e is a foolproof invisible insulation which a builder would be foolish not to install.

Practice: Our experience has been that low-e's thermal performance is certainly all it's cracked up to be. We hear gleeful stories of owners sitting comfortably in shirtsleeves in our low-e solariums on winter nights in New England. There are two caveats, however.

First, be wary of mixing brands of low-e on the same house. People easily get used to a tint on glass if there's no other color to compare it to, but any differences between windows can be distracting.

Second, we're recommending cleaning low-e glass with a vinegar-based window cleaner (such as "Glassworks" by Texize, available at grocery stores) rather than an ammonia-based one. Ammonia can react with the separating powder (used for protecting some new windows during shipping) to produce a milky film. If this happens, try a cerium oxide-based liquid cleaner (such as "Sparkle," available from C.R. Laurence Co.; 800/421-6144). Clients seem to notice this film more on low-e glass because their attention is already drawn to its subtle tint.

Skylights

Theory: Skylights are an attractive, exciting way to add passive solar gain to a building.

Practice: Builders hate anything that puts holes in an otherwise watertight roof, but there are other reasons to be concerned about skylights.

Sunlight pours through a skylight when the sun is high in the sky—when it's usually too warm to want that much sun. Thus, skylights usually contribute more to overheating than to useful solar gain. For that reason, we recommend exterior sunscreens (such as from Vimco, 8301 Old Staples Mill Rd., Richmond, VA 23228; 800/446-1503) for skylights which are inoperable or hard to reach. These are typically left on year-round. Another more costly option is to reduce the solar gain by using bronze or reflective glass.

In winter, skylights lose a lot of heat-as evidenced by condensation in the skylight well and melting snow on the roof. To combat this heat loss and reduce condensation, we're recommending that an inexpensive interior storm window be installed at the bottom of the skylight well to triple-glaze the assembly (Figure 3). In addition, the skylight headers should be insulated from cold roof-ventilation air with rigid foam blocks such as Sentinel's Sill Band

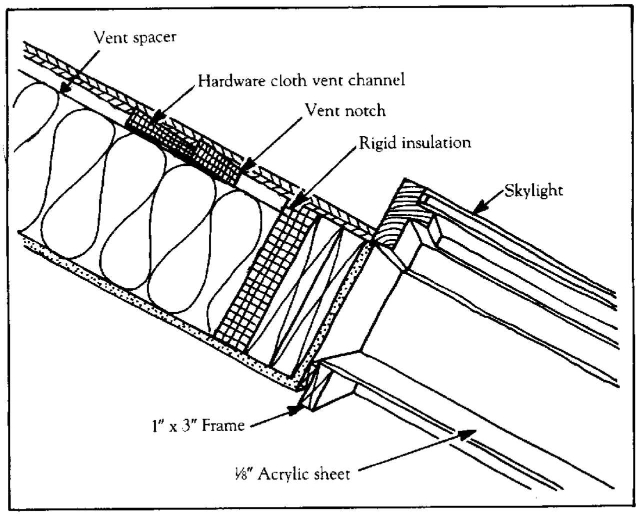


Figure 3. *An inexpensive acrylic storm panel will reduce heat loss. The rigid insulation around skylight headers helps fight condensation.*

Sealer. This helps prevent condensation by keeping the skylight well warmer.

Roof Insulation

Theory: It's *how,* not *how much,* insulation is installed that really counts.

Practice: I agree. But we need to add one other criteria: *where.* Every winter, we see snow on our homes melt off of attic roofs before the cathedrals. What causes the extra heat loss in the attics?

There appear to be several reasons for this phenomenon. First, Acorn houses virtually never have attics spanning the entire width of the house, and thus use kneewalls. The insulation can go either in the attic floor and kneewalls or in the sloped roof. Since the combination of attic floor and kneewalls has more surface area than the sloped roof, it suffers greater heat loss. Second, kneewalls generally have R-13 insulation, while roofs get R-30. Third, attic floors are often penetrated by pull-down stairs, recessed lights, etc. (which clients do not want to give up in order to live in an energy-efficient house).

Our rule now is to always insulate the sloped section of the roof—whether the ceiling is cathedral or flat (Figure 4). Obviously, this rule may not apply to all styles of house. But for anyone building with cathedral ceilings anywhere in the house, I'd recommend it.

Roof Ventilation

Theory: A well-ventilated roof is your best protection against ice dams.

Practice: It is clear that poor roof ventilation is a contributor to most of the ice dams that we've seen over the years. Our roof design uses a fiberboard vent spacer installed over the fiberglass to maintain a soffit-to-ridge airflow. While this system has generally worked well, some particularly troublesome areas have shown up over time, especially:

- *Venting around skylights and chimneys.* We've seen problems here with excessive snowmelt causing ice dams below. Also, we've seen wet roof sheathing from condensation. To remedy this, we specify notches—about an inch deep by 4 inches wide—in the rafter tops to allow the air to flow around the obstruction.
- *Venting hips and valleys.* Rafter spaces which don't connect both to the eave and the ridge lack either inlet or outlet vents. A series of notches compensate (Figure 5).
- *Venting through notches where paper-faced insulation has been hastily installed.* We find installers prone to installing paper-faced insulation much too tightly along the joists, resulting in a sag in the middle of the insulation (Figure 6). We're concerned that this can cut off airflow through the notches. We're going to borrow a solution invented by one of our builders (Dave Siegert, of Davidsonville, Md.), and slip hardware cloth into the notches to keep them open. The heavy screening is formed into a wide shallow "U-section" that fits in the notches across the width of the skylight or obstruction. ■

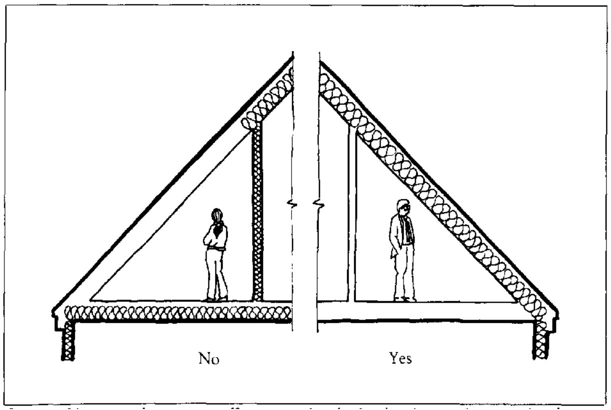
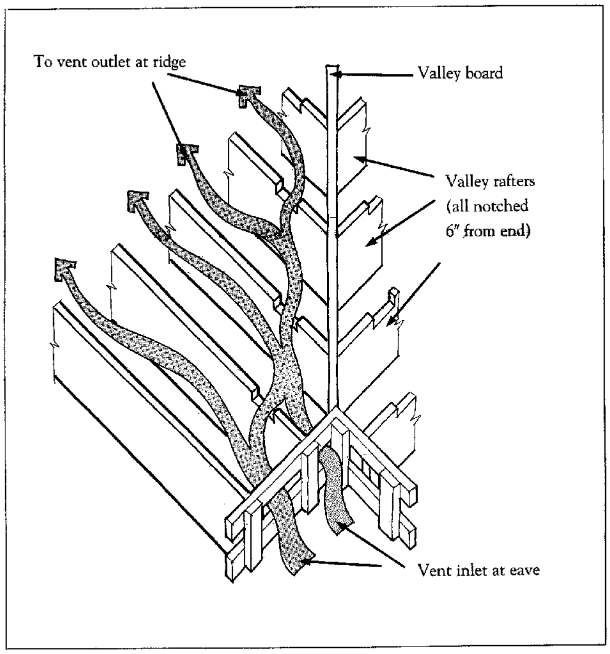


Figure 4. *It's easier and more energy efficient to insulate the sloped roof section than to insulate the kneewall and attic ceiling.*



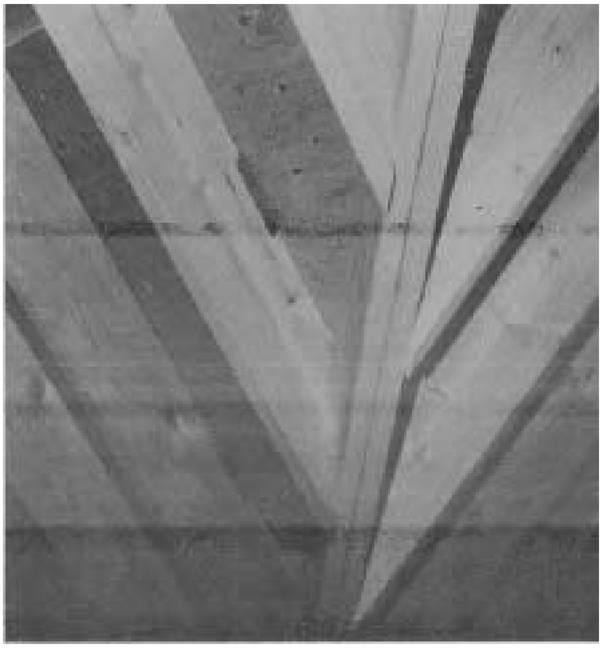
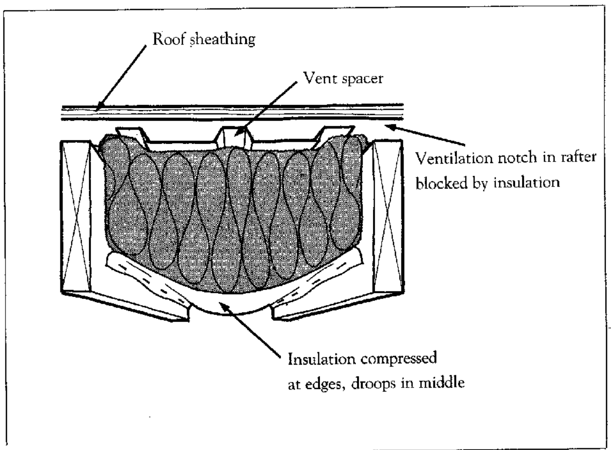


Figure 5. *At hips and valleys, where rafter spaces don't connect to both eave and ridge, a series of notches allows in ventilation air. Similar notches are used around skylights and other obstructions.*

Jon Slote is a quality engineer with Acorn Structures, a designer and manufacturer of energy-efficient custom panelized homes based in Concord, Mass. Jon's role is to assess and improve the quality of the company's products and services.



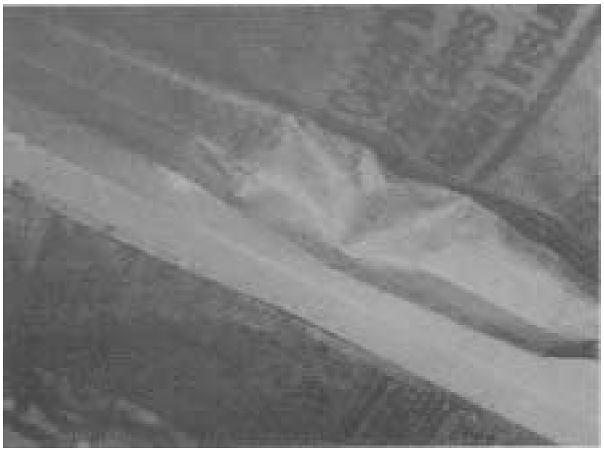


Figure 6. *If paper faced batts are pushed up too tightly against the roof, the airflow through any notches will be blocked. To keep them open, you can box in the notches with hardware cloth (see Figure 3)*