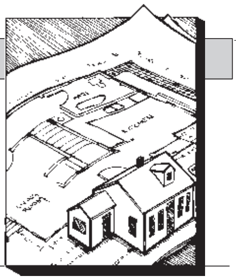

Insulation & Ventilation: One Architect's Approach

by Gordon F. Tully

As a relief from the steady diet of architectural theory that has filled this column for almost a year, I thought it would be fun, given the focus of this month's issue, to revisit the turf I spent eight years plowing: energy.

Massdesign, the old name of our firm, earned a reputation for creating solar houses that did not look like grounded spacecraft. These days solar is either taken for granted or ignored altogether, and we are moving on to other matters. But while solar design no longer is an architectural specialty, saving energy is still very high on our (and our customers') priority lists.

Insulating the Walls

By far, the toughest question to answer is where the insulation should go. I just reread an article by Henri de Marne in the February 1984 issue of *NEB*, and I found it full of convincing advice based on his experience. He advocates insulation outside the studs because it covers up holes in the wall, keeps the walls warm and free of moving air, and prevents pipes in the wall from freezing.

My pontifications on the subject emphasize different elements of the problem, however, so I come out in favor of rigid insulation with a vapor barrier (i.e., "Thermax" or "Tuff-R") on the inside—a method de Marne considers a necessary evil, to be used only when all else fails.

We always have wanted to try outside insulation, but we never could get our details together. Sheathing and insulation vie for the same space, nestled against the studs.

If we weren't designing custom houses, the sheathing could be dispensed with in favor of metal bracing along with rigid insulation and metal or vinyl siding. Or we even could use "Thermo Ply" or its competitors to provide a little insulation, an air barrier and diagonal bracing in one thin sheet. For custom houses, our only option would be to install styrofoam (or "Foamular" or "Amofoam") next to the studs and to cover that with plywood sheathing.

But we always have been obsessed with having a good air/vapor barrier on the inside, and we can't get six-mil poly to behave. It gets carved up by wallboard installers and electricians, the joints are usually lousy, and it has bad press. One builder I know installed six-mil poly perfectly—by the book—in a new house, and he swore he never would do it again.

So we use Thermax or Tuff-R on the inside. (If you use Tuff-R, you need to cover it with gypsum board, whereas Thermax can be left exposed.) And once you spend all that money for board insulation inside a house, there's little incentive to do it all over again outside.

Inside board insulation has all the problems de Marne mentions, but it seems to work fine. Unless you go to the enormous trouble of fitting some gizmo between each joist (which we can't seem to get builders to do), the joist spaces are unprotected with *either* system. We seal electrical and pipe holes with silicone; the joint between the board and the electric boxes can be made very tight and thus be easily sealed.

If you take this approach, be sure to use a foil-faced foam to provide a vapor barrier. Anything with the word "sheathing" on it isn't satisfactory, because it's specifically designed not to form a vapor barrier (which is what you want in sheathing). Both Thermax and Tuff-R are excellent vapor barriers.

One last thing about walls: We never place studs at 24 inches on center. Gypsum board that is $\frac{5}{8}$" thick spanning 24 inches is twice as bouncy as ½"-thick gypsum board spanning 16 inches, but it has the same bending strength. We sometimes aren't able to place even *rafters* at 24 inches o.c.; in custom designs, there seldom is a run of rafters long enough to make the wider spacing worthwhile.

As you can see, the debate on the best place for insulation is far from over. Like everyone else, we always are trying something new. The point is not that our method is better than de Marne's, or vice versa, but that different kinds of houses may require different approaches. Our designs demand very careful construction, and almost any system will work under these circumstances. With average-quality construction, outside insulation probably is an excellent idea, because it helps cover up mistakes.

Vapor Barriers

New research slowly works its way into the debate. We have known for a long time (thanks to the Canadians, who do most of the useful building research) that air moving through holes in walls is a more important source of condensation than gaseous water vapor moving through solid materials. Despite this, we are reluctant to dispense with good interior vapor barriers.

We hang onto the vapor barrier because we are worried a lot about interior humidity. "Keep it at about 40 percent," we lecture our clients—but what if they don't? What if they get heavily into pasta and don't turn on the exhaust fan in the kitchen? One of our clients now runs a catering business out of her kitchen—what's the humidity there? The average house may be all right, but we get sued by *particular* owners—not "average" ones.

As a result, we are careful to install good interior vapor barriers everywhere except at the joist boxes, where there is tight construction and lots of wood to absorb moisture during the relatively short winters we have near Boston.

Indoor Air Quality

We generally don't get obsessed with interior ventilation, except when we design small houses for plan books, such as the saltbox house we designed for Northeast Utilities. Then we worry *a lot*—but not to the extent of adding an air-to-air heat exchanger. We prefer to induce ventilation with bath and kitchen fans, letting it in through hearth air intakes, boiler air intakes, ordinary leaks and open windows. I am not against air-to-air heat exchangers in principle, but they are like active solar systems: relatively new gizmos and therefore a source of glitches and a nuisance to design.

If our clients are worried about indoor air pollution, we tell them that they should exclude smokers first and foremost; that solves about 95 percent of the problem. Then they either should use electric cooking or interlock the gas range and oven to the exhaust vent.

None of our houses is built on a radon-rich site, where, of course, special pains must be taken.

Venting the Roof

The roof-venting problem finally has been solved by "Cor-A-Vent," an ingenious creation of corrugated-carton-type plastic that is tucked inconspicuously under the ridge bundle. We use it not only at the ridge, but also at the eaves, where slices of the stuff can be slid into slots in the soffit, avoiding those hideous aluminum soffit vents.

"ProperVents" go under the roof deck wherever insulation touches the roof. Even building inspectors demand the stuff. In one case, we had to put it into a small, totally unvented cavity.

We still have trouble with cathedral ceilings under hip roofs. "Simple," you say. "Omit them." That indeed is the usual solution, but we like to make life difficult for ourselves and our clients—that's what architects are for.

You can't vent a hip ridge unless you plan to keep lots of buckets underneath when it rains. So you have a problem venting dead-end rafter spaces at a hip at a hip. (The same problem emerges at valleys over cathedral ceilings, too.) We generally resolve it by dropping the valley and hip rafters and cutting a triangle off the top of the rafters framing into the valley or hip ridge—which has the effect of creating modest air passages running up the valley or ridge. These passages collect air from the rafter spaces that end at the valley or ridge (which must be vented at the eaves) and carry it up to the top of the roof.

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Details such as this never will meet the BOCA ventilation codes, which require the area of the vent cross section to be 1/300 the floor area if you have a ceiling vapor barrier. And if you're building a house near the sea and try to meet code, given the wild winds that blow onto our shores, you'll end up with all of the great outdoors inside your roof.

But whatever amount of ventilation you can get generally seems to be plenty. A little is much better than nothing—and in fact a little is preferable in areas where it's quite windy.

Our good friends at Acorn Structures tell us that skylights or other interruptions in north-facing cathedral ceilings—especially at bathrooms—cause most of the roof-condensation problems they have encountered. It is absolutely crucial to keep the ventilation going around a skylight, yet I would bet that fewer than one builder in 10 actually does this. We have adopted Acorn's nice detail of cutting notches into the tops of the rafters and arranging ProperVents to duct ventilation air to the sides of a skylight and then back to the rafter spaces above.

We need more (and more careful) building research dedicated to answering the insulation and ventilation problems for every kind of house in every location. Until then, the debate will go on, and we all gradually may converge on a few good solutions.

The only real mistake you can make is to ignore the problem. We may have cheap oil for five or even 10 more years, but the houses you build will be around for 10 times as long. Don't pass an energy pig down to the next generation. Leave off the Victorian trim for now, and spend your money on hidden things. You may not get published, but you'll be able to sleep at night. ■

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