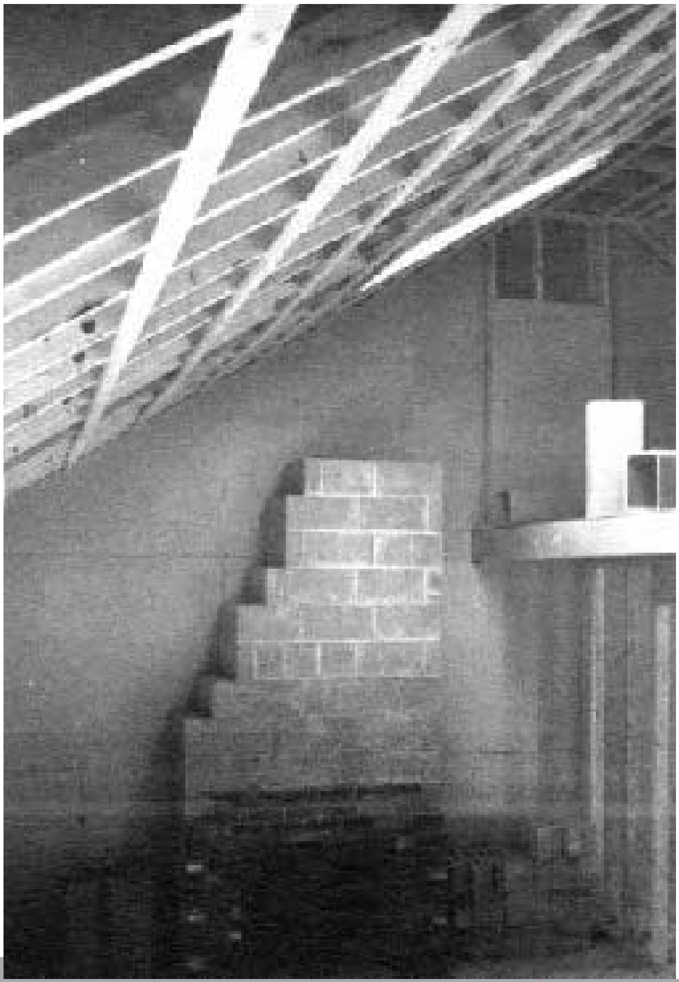
Tight Cathedral Ceilings

by Bill Eich



The key to a problem-free cathedral ceiling is a tight air barrier in the ceiling—roof ventilation is secondary

I build in northwest Iowa, in an area where no building code is enforced. This has allowed me to experiment with many different cathedral ceiling designs over the years. When a new technique works, you look pretty smart; when it doesn't, you do what it takes to correct the problem, maintain your credibility, and keep your client happy. To quote Brian Curran, one of the first builders of superinsulated housing in the U.S., "It's easy to tell who the pioneers are—they're the ones with the arrows in their behinds!" I've taken my share of arrows over time; perhaps this article can save you from taking a few over cathedral ceilings.

Cathedral Ceilings—Only Part of the Big Picture

For a cathedral ceiling to perform well and not collect moisture, the rest of the house must also work to keep dampness out. No ceiling ventilation scheme can compensate for big influxes of moisture. Adequate gutters, good site drainage, and foundation drain tile will keep water away from the house, while sealed poly, rigid foam, and pea gravel under and around the basement floor and foundation walls will keep the house from sucking up moisture from the ground. Without such control of moisture sources, no cathedral ceiling will perform well. With proper control and a good air barrier, such ceilings can work beautifully even when unventilated.

Sealing the Interior

The tighter you build a house, the higher the indoor moisture levels typically are. In an airtight home, you can maintain this high moisture level without doing damage to the structure. But if moist indoor air finds a leak in the air barrier—even of a few square inches—you can expect to find damp insulation in the attic and condensation stains on the ceiling. A larger leak may cause it to "rain" inside. This is one reason I use an exhaust-only ventilation system in most of my houses; the slight negative pressure it creates inside the house tends to reverse the air flow through any small leaks in the building shell, reducing the likelihood that excessive moisture will be forced into the ceiling.

For the same reason, I try to seal the inside surfaces of the house as tightly as possible. To achieve this, we use the Airtight Drywall Approach (ADA), taping all drywall carefully, sealing switch and outlet openings, and installing rubber gaskets around the top plates to make the drywall system airtight. Other alternatives for airtight walls include sealed layers of rigid foam or sealed sheets of polyethylene.

Any of these air-barrier systems, if applied diligently, can keep moisture out of ceilings and walls. Ventilation then becomes unimportant. In fact, I have so much confidence in my airtight drywall system that in most of my cathedral ceilings, I use no ventilation at all. In others, I provide minimal ventilation by installing soffit vents only. About the only time I do a full soffit-to-ridge ventilation job is when a house's design or location makes it particularly hard to seal or particularly prone to moisture intake.

Sometimes it takes more than one system to make a good air barrier; for instance, if a cathedral ceiling is to have a wood finish, you need a good poly or foam insulation air barrier behind it, because it is impossible to make a wood ceiling airtight.

Tape, gaskets, and blocking. In our airtight drywall system, we seal the tops of the drywall to the edge of the top plate with 3/8 x 3/8-inch saturated urethane "Sure-Seal" gaskets from Denarco Sales (12710 Idlewild Street, White Pigeon, MI 49099; 616/641-2206). EPDM rubber gaskets from Resource Conservation Technology (2633 N. Calvert Street, Baltimore, MD 21218; 301/366-1146) also work well. Such gaskets cost 10¢ to 15¢ per lineal foot. We apply them around the perimeter of the ceiling on the top plate or on the drywall backing (see Figure 1), then lay the wallboard over them so that it compresses them; this ensures a tight seal between the wallboard and the top plate, preventing any moisture within the wall cavity from finding its way to the ceiling space. As for interior walls that meet the cathedral ceiling, we always install and seal the ceiling before building those walls so there's no internal connection.

We also carefully seal all penetrations in the outside wall top plates. Foam sealants work best for larger gaps around pipes or wires, while flexible caulks or acoustic sealants work for smaller cracks. For larger pipes you can also use rubber boots like the ones used on roofs for plumbing vents.

A peculiar problem arises wherever a vaulted ceiling abuts a wall that is half exterior and half interior and which rises up past the peak of the cathedral ceiling (see Figure 2). To make up for the lack of a sealing top plate at such spots, I install tightly fitting solid blocking between the studs just below the ceiling line, gasketing both sides of the blocking. This prevents moist interior air from leaking into the vaulted attic via the wall cavity.

Sealing light fixtures. Recessed lights in cathedral ceilings also present problems. Because recessed lights are so difficult to seal well, we try to discourage them whenever possible. We encourage track lighting instead. However, in some cases a client will accept only recessed lights. When this happens we have two types of lights we like to go with: a recessed, insulated can made by Juno (Juno Lighting Inc., 2001 S. Mt. Prospect Road, Des Plaines, IL 60017; 708/827-9880), or a compact fluorescent model made by Scientific Component Systems (1200A N. Van Buren Street, Anaheim, CA 92807; 714/630-3453).

The Juno "IC-2" is a high-quality insulated can that has fewer holes than standard cans do. Its built-in thermal overload protection allows you to insulate right over the fixture. (Avoid the temptation to seal the few air leaks remaining on the can, as this would void the U.L. label and set you up for liability problems.)

The compact fluorescent, by Scientific Components Systems, is the best recessed lighting option I've seen. It has a low wattage (two 7-watt bulbs), low operating temperature, and high lumen output, yet it costs about the same as a standard recessed fixture, and it is airtight. Its only drawback is that you can't use a dimmer switch with it, and trim choices are limited.

Standard light openings are relatively easy to seal. Bring the light wire through a solid 2x4 block, seal the wire with a foam sealant, and then use a shallow, surface-mounted metal rough-in box after the drywall is hung. Another way is to use a poly pan rough-in box (from Lessco, 990 Mink Lane, Campbellsport, WI 53010; 414/533-8690) and seal the poly air barrier to it. Yet another method uses a special ceiling box (model BX-OCT-F) made by Nutek Plastics, a Canadian company, and available from Columbia, International (800 Beriault Street, Longueuil, Quebec, J4G 1R8 Canada; 514/677-2841). Nutek's product has a recessed flange that makes it easy to seal the drywall barrier or poly air barrier to it. The poly pans cost about $2 to $2.50 each, and the Nutek boxes cost about $4.

Dealing with skylights. To reduce condensation potential and save energy, I use the highest R-value skylight my budget allows—at minimum, a double-glazed, low-E, R-3 model. I carefully gasket between the skylight's jambs and the framing to prevent air leaks around its frame. To provide ventilation in the rafter space below and above the unit, I either notch the top edges of the rafter below and above the skylight or install cross-purlins over the rafters to provide lateral flow (more on that later).

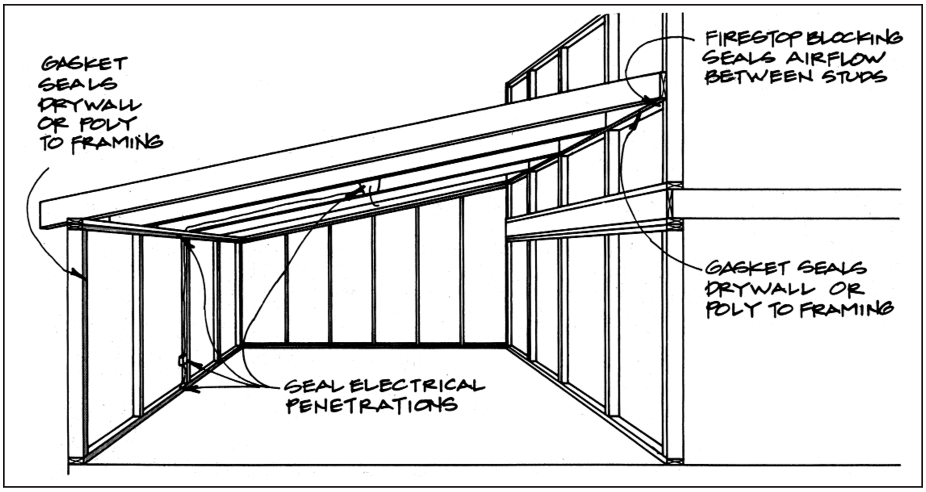


Figure 1. *An "airtight drywall system" keeps excess moisture from moving up into the cathedral ceiling cavity. Crucial to the system is meticulous taping, sealing of all openings, and a gasket at the ceiling/wall intersection.*

Figure 2. *Where a cathedral ceiling meets an exterior wall that extends up past the ceiling, use blocking in the wall to prevent infiltration of moist household air into the ceiling cavity.*

Figure 3. *Foam blocks at the bottom of a rafter-framed cathedral ceiling will prevent cold air intrusion into the insulation near the eaves. The blocks should be caulked in place to ensure a good seal.*

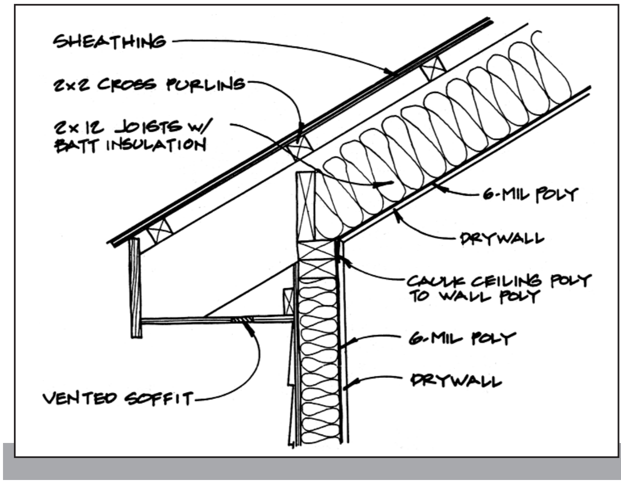


Figure 4. *On a rafter-framed cathedral ceiling, cross-purlins provide good air movement under the sheathing, even where there are obstructions such as skylights.*

Framing and Insulating

We have two basic ways of framing and insulating vaulted ceilings. Where budgets are tight, we go with a 12-inch-thick, R-38 rafter system insulated with fiberglass batts. When we can spend more, we use 16- to 18-inch parallel-chord trusses with blown or batt insulation and end up with an R-55 system.

Ventilation often an option. For both systems, we consider ceiling ventilation optional for most jobs. As explained earlier, that's one of the beauties of creating a tight air barrier—it does more than just keep the house warm, it can actually eliminate the need for ventilation.

Nevertheless, I've included ventilation details in this section for those times when sealing problems, code requirements, client insistence, or other factors make ventilation necessary.

Shallow systems. For the 12-inch system, we use ordinary 2x12 rafters and insulate with fiberglass batts. To keep the batts from sliding into the soffit space and to prevent undue airflow through the batts, we install scraps of foam or wood blocking vertically at the bottom of the rafter spaces, leaving a 1½- to 2-inch space above the blocking if we want to ventilate (see Figure 3). This is a good place to use up your scrap pieces of foam sheathing. You can cut them snug between the trusses and caulk them in place, or you can leave your exterior wall sheathing one inch short of the top of the wall and nail the infiltration stops in when the soffit is installed. After the blocking is in and as the ceiling goes up, we lay in the batts (either one 12-inch layer or two 6-inch layers), taking care that we don't leave any gaps or spaces.

When I want to ventilate a rafter system, I add a 2x2 nailer along the top edge of each rafter (to allow an air space above 12 inches of insulation), then nail 2x2 cross purlins perpendicular to those. This arrangement allows air to flow freely over the entire roof system regardless of obstructions such as skylights (see Figure 4).

We prefer standard continuous soffit vents and a ridge vent when ventilating. I prefer vents made by Air Vent (4801 N. Prospect Road, Peoria Heights, IL 61614; 309/688-5020). Air Vent also makes some very useful metal vent strips that work well on nonstandard cathedral ceiling/roof designs: Peak Filtervent, for venting the top of a contemporary styled shed roof; Flash Filter, for vertical-roof-to-wall connections; and Drip Edge, which works nicely at the eaves line when there is no roof overhang providing room for a soffit vent. These vents come in 8- and 10-foot lengths and cost from $1.50 to $2 per linear foot.

Finally, to prevent the batts from piling or fluffing up to block the vent opening over the eaves blocking described earlier, I first attach a plastic air chute made by ADO Products (7357 Washington Avenue South, Edina, MN 55435; 800/666-8191) to the sheathing just above the eaves. The chute is about 4

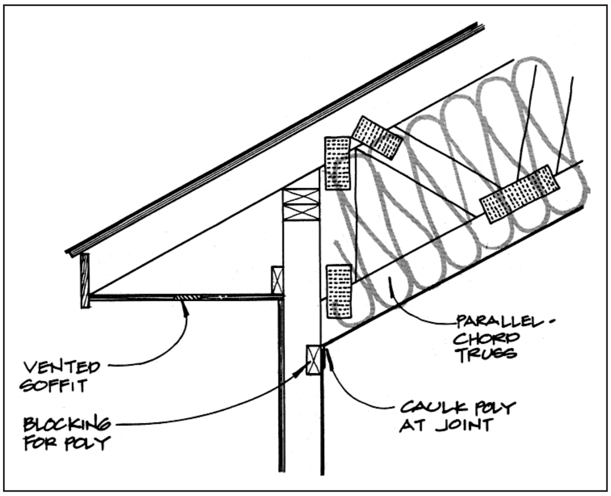


Figure 5. *Parallel-chord trusses can butt into the exterior wall as shown, or sit atop the top plate. In either case, the top chord extends outward, providing an overhang.*

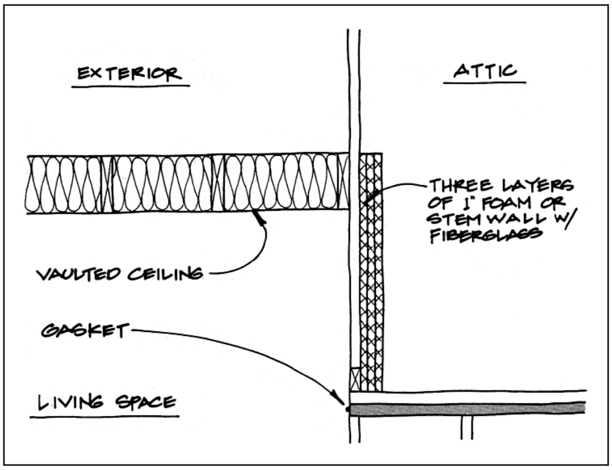


Figure 6. *Where a cathedral ceiling meets a wall backed by attic space, the wall should be insulated to the same R-value as the exterior walls. Foam sheathing usually provides the easiest solution.*

feet long and slides down to the space over the blocking and then staples to the sheathing to make sure the ventilation path doesn't get clogged by insulation. We've found these plastic chutes much more durable than similar cardboard and foam chutes.

Bigger budget, deeper ceilings. For our deeper ceilings we usually use parallel-chord trusses 16 to 18 inches deep. Parallel-chord trusses can either sit atop the exterior wall or butt against it. In either case, the top chord extends out to form an overhang (see Figure 5). If you set the truss atop the plate, you will need to seal at the eaves with foam or wood blocks as shown in Figures 3 and 4.

If a truss roof has a fairly shallow pitch—6/12 or less—we blow in loose fill insulation, leaving enough space (1$^1/_2$ to 2 inches) above the fill to provide air flow along the sheathing. Steeper pitched roofs will encourage the loose fill to collect down toward the eaves, however, so for those roofs we go with batt insulation, choosing thicknesses that will bring the insulation to within a couple of inches of the sheathing. Whenever possible we get batts as wide as the on-center truss spacings—for instance, a full 24 inches instead of 22 inches for trusses 24 inches on-center—so that the batts will expand sideways to fill the spaces between the webs.

Ventilating a truss roof system is fairly simple: you adjust the thickness of insulation to leave a space (1$^1/_2$ to 2 inches) on the sheathing's underside, and provide for air intake and outflow by installing continuous soffit and ridge vents.

One last detail. One spot that often goes underinsulated in cathedral ceilings is where a short connecting wall drops to connect the cathedral ceiling to an 8-foot flat ceiling (see Figure 6). This connecting wall should have the same R-value as the house's exterior walls if you're to avoid cold spots and possible condensation there. Using an unfaced fiberglass batt doesn't work, because an unfaced batt works only if it's used in an enclosed space. You can enclose a batt behind the wall with foam or sheathing, but I've found the easiest way is to simply back the wall with the required depth of foam sheathing (usually 3 inches) to match the exterior wall's R-value.

Worth the Headaches

Building a cathedral ceiling that works requires constant attention to detail—one or two oversights and you can run into some serious problems down the line. But it's worth the trouble. The visual excitement and sense of space a cathedral ceiling generates make the client's home a greater asset almost instantly. And that, in turn, translates into the builder's greatest asset, which is another satisfied client. ■

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