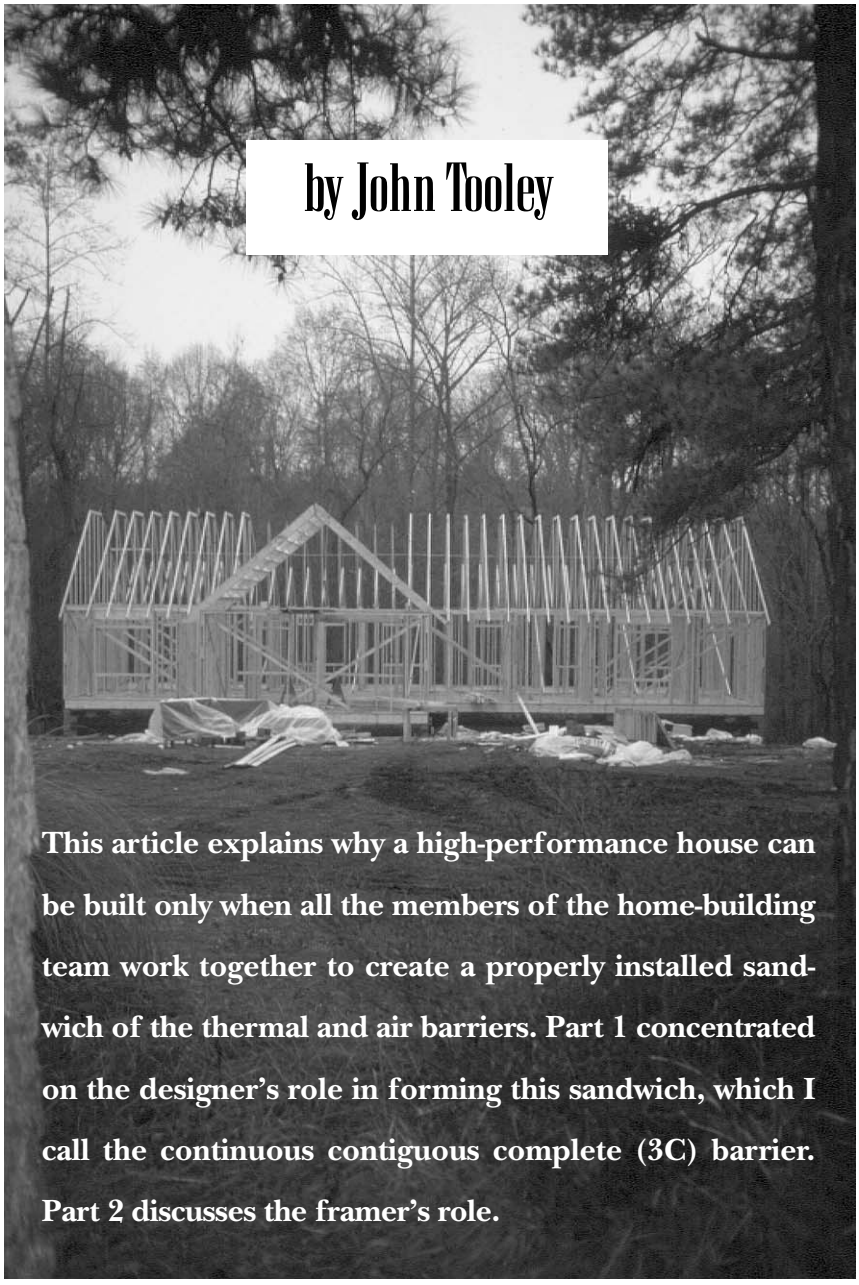
Handling Framing Details in High-Performance Homes

Home Energy magazine, May/June 1999

Handling Framing Details in High-Performance Homes

by John Tooley



This article explains why a high-performance house can be built only when all the members of the home-building team work together to create a properly installed sandwich of the thermal and air barriers. Part 1 concentrated on the designer's role in forming this sandwich, which I call the continuous contiguous complete (3C) barrier. Part 2 discusses the framer's role.

ADVANCED ENERGY

The location and installed integrity of the 3C barrier will dictate the comfort, health, and safety of the home's occupants; the durability of the structure; and the amount of energy required to heat and cool the home. A correctly installed 3C barrier starts with the designer. As I discussed in the first part of this article ("The High-Performance House—What Does It Take?" *HE* Mar/Apr '99, p. 16), designers of houses should specifically and carefully design and draw the details of the 3C barrier on the elevation page of the house plan and on the floor plans. The designer should specify the location of the 3C barrier, the materials to be used, and—most important—how those materials should be joined at breaks in the floor, walls, or ceiling planes.

The builder's job is to ensure that the plan is followed. This means that the materials specified must be available at the job site, and that the framer must know the plan and how to achieve it. Next to plan drawing, the framing of the building is the point where comfortable and affordable living begins.

The Framer's Road to Success

Creating a high-performance house actually entails seven tasks, with a different person being responsible for each one (see Table 1). This article concentrates on the challenges posed by step 3. The framer's job, to "follow the plans and establish even planes when possible," is not an easy one. The framer is the one who begins the process that will ensure a barrier gets installed in its specified location (see "Back to the Basics," p. tk). All other trades should carefully adhere to the framer's established planes. They should be trained that whenever they break or penetrate a plane, they are responsible for sealing and reestablishing it.

If all houses were a simple box design, the framer wouldn't have much difficulty. But in most buildings, there are tricky corners, holes, protrusions, and gaps that must be bridged and properly sealed. Ceilings adjacent to attics, ceiling intrusions with reference to (WRT) the attic, exterior walls, floors

adjacent to outdoor air, and shafts, are five general areas where tricky details require special attention. What follows are some suggestions for how framers can handle those tricky details.

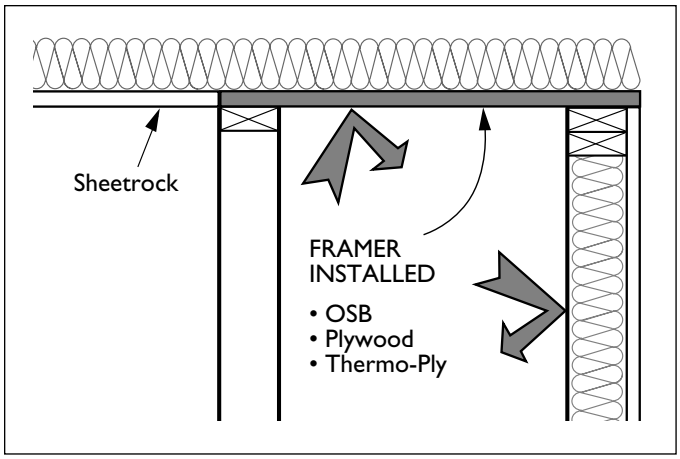
Ceilings Adjacent to Attics

When establishing the ceiling plane, the framer should consider the gypsum board or other ceiling surface as the 3C barrier location. This plane should be kept even and unbroken whenever possible. Dropped ceilings, chase ways and shafts, chimney cavities, and any other framing detail that creates a hole or protrusion WRT the attic should be capped with a sheet product, such as oriented strand board (OSB), plywood, or high-density cardboard such as Thermo-ply. If wiring, plumbing, venting, ductwork, or piping penetrates this cap, it should be air sealed with caulk, foam, or a gasket. This air seal can be established by whichever subcontractor penetrates the cap or by the insulation prep crew prior to installation of the insulation.

Whenever 1 x 3 cross furring strips and shims are used to provide a flat level ceiling base surface, it is best to use blown insulation to ensure full contact between the insulation and the Sheetrock. Batted insulation on strapped ceilings often leaves a ¾-inch air space between the insulation and the Sheetrock, which creates the perfect opportunity for air movement.

Ceiling Intrusions WRT the Attic

Wherever a ceiling creates a bump in the plane of the attic (as is the case with tray and raised ceilings, for example), the Sheetrock should be the 3C location. Care should be taken to ensure that the insulation is in full contact with all ceiling surfaces. One special case of intrusions WRT the attic is canned lights. The builder should be sure that these fixtures are fire rated (or preferably insulation contact rated) and that the insulating contractor insulates them properly. Often canned lights are all treated as though they were not fire rated, and insulation is unnecessarily placed too far from the light, creating an insulation void.



Shafts on an exterior wall need to be carefully air sealed and capped.

Exterior Walls

The 3C location on exterior walls can be either the exterior sheathing or cladding, or the interior wall surface. In either case, it should be clearly specified on the house plans. It is good practice to use the interior cladding as the 3C location in cold climates and the exterior sheathing as the 3C location in warm climates. In either case, the objective is to restrict air, heat, and moisture movement at its source, reducing their entry into the assembly or conditioned space. This practice will help to reduce air infiltration, hidden condensation, mold growth, and rot, and to maintain the installed R-value.

Floors Adjacent to Outdoor Air

Of the three planes in a home, floors are the least broken, because homeowners tend to prefer flat floors. This makes it easier to create the 3C barrier for the floor plane. When the floor plane is broken—for example, in the case of a sunken floor—and exposed to exterior weather conditions, care should be taken to ensure that the insulation is installed in full contact with the bottom surface of the subfloor.

Contractors and subs must take particular care with floors that are above tuck-under garages. The 3C barrier location can be either the floor sheathing of the room above the garage or the ceiling surface of the garage itself. If the ceiling surface of the garage is chosen, the entire floor system should be air sealed to ensure that no air leakage can occur between the insulation and the room floor sheathing above it. When the room floor sheathing is chosen and the insulation is installed in full contact with the sheathing, it is usually not necessary to air seal the floor cavity.

Shafts Take Special Attention

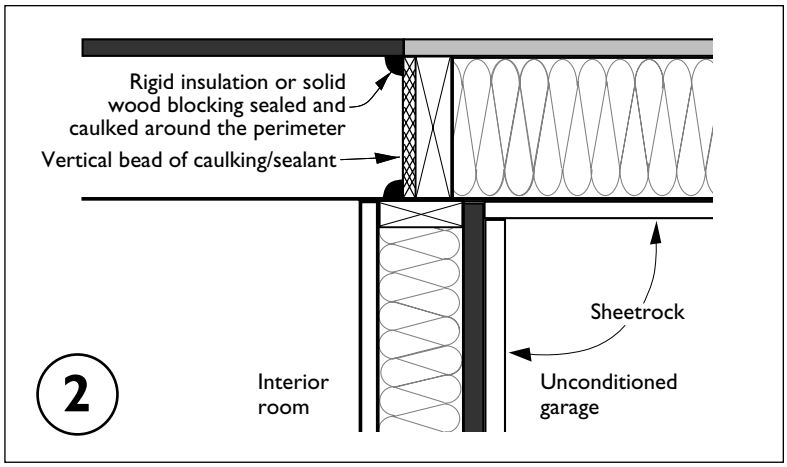
Shafts appear to be simple for the framer—he or she just caps them with a sheet product. However, the shaft is one of the most difficult construction features to handle, because it is usually not empty. A shaft may contain vents, ductwork, or electrical work. These items will often penetrate the cap or other places in the shaft. The end product should be air sealed, any vents penetrating the cap should be flashed with a noncombustible product (such as sheet metal), and the end should be air sealed with fire-stop caulk.

Table 1. Seven Critical Tasks

Step	Responsible Party	Task
1	Designer	Draw house plans identifying the location of the 3C barrier.
2	Builder	Ensure that the plans are followed.
3	Framer	Follow the plans and establish even planes when possible.
4	Mechanical contractors	Install the rough-in mechanicals.
5	Insulation contractor	Install the vapor retarder on the warm side of the assembly to reduce vapor diffusion and lower the moisture loads on air conditioning.
6	Drywall contractor	Install gypsum board to continue the plane.
7	Insulation contractor	Follow the air barrier location established by the house plans and the framer, ensuring that the insulation and the air barrier are in full contact.

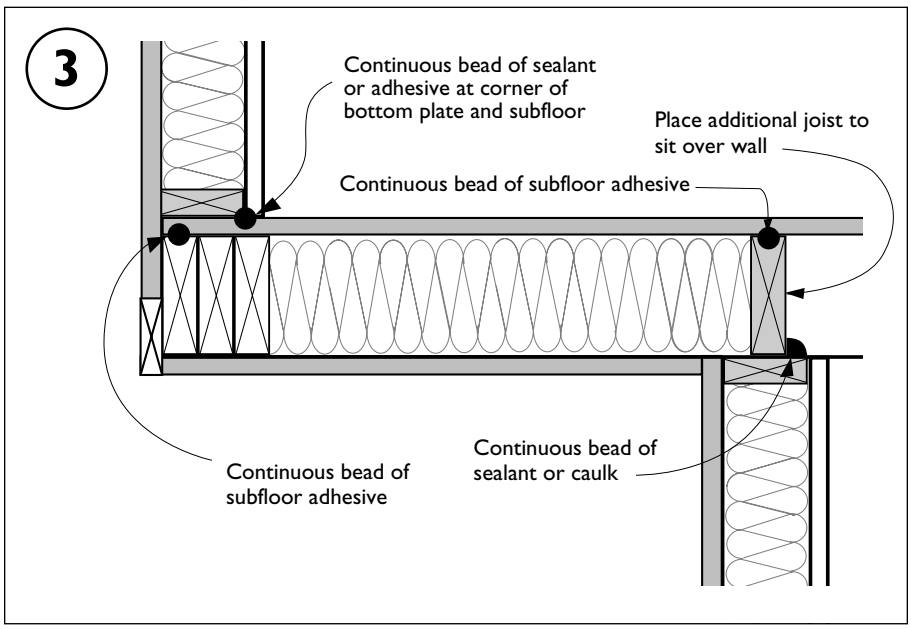
ADVANCED ENERGY

Before the garage is Sheetrocked, it is easy to see that this floor system is open to the garage. Without proper sealing, car exhaust and fumes from stored chemicals can seep directly into the house.



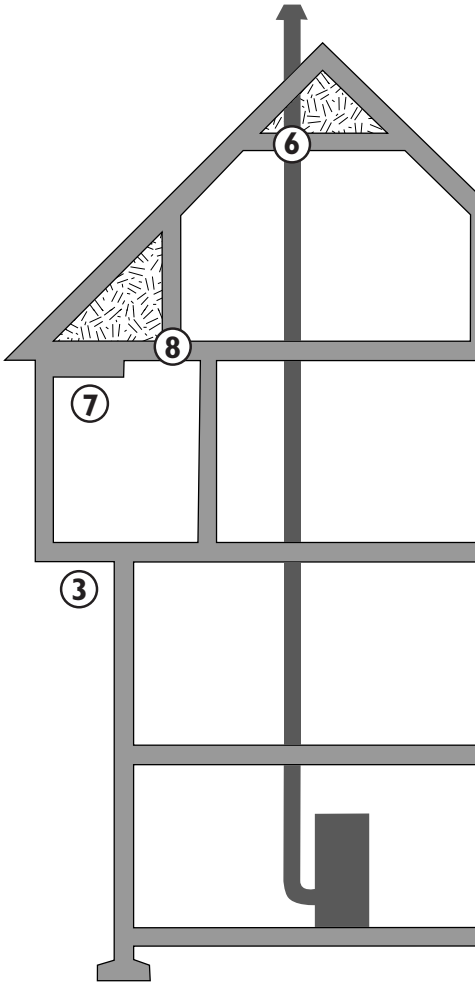
BETSY PETTIT, EXEMPLARY HOME BUILDER'S FIELD GUIDE, PUBLISHED BY ADVANCED ENERGY © 1995

The junction of the floor and garage should be blocked and air sealed in place.



BETSY PETTIT, EXEMPLARY HOME BUILDER'S FIELD GUIDE, PUBLISHED BY ADVANCED ENERGY © 1995

When a room is cantilevered over an exterior wall, both the floor-and-upper-wall junction and the floor-and-lower-wall junction should be blocked and air sealed in place.



There are eight potentially troublesome areas for framers wh
unconditioned spaces.)

Narrowing the Focus

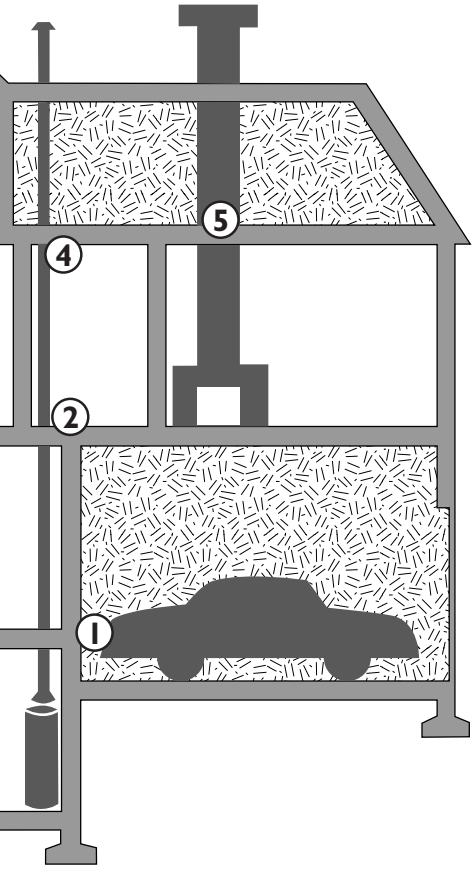
Theory is all well and good, but the real question is, How does a framer translate these ideas into practice? What follows are specific instructions on how to deal with problem areas when installing the 3C barrier.

① *Garage to Basement*

Wherever floor joists or trusses are connected to an attached garage, the floor or framing should be held back enough to allow room for a rim joist, band, or ribbon to be installed. This framing detail should be air sealed in place to preclude air movement, which could carry exhaust from the car or vapors from chemicals stored in the garage, into the house.

② *Interior Room Partially Cantilevered Over a Garage*

The junction of the floor and garage should be blocked and air sealed in



ADVANCED ENERGY

o are establishing a 3C barrier. (The shaded areas indicate the

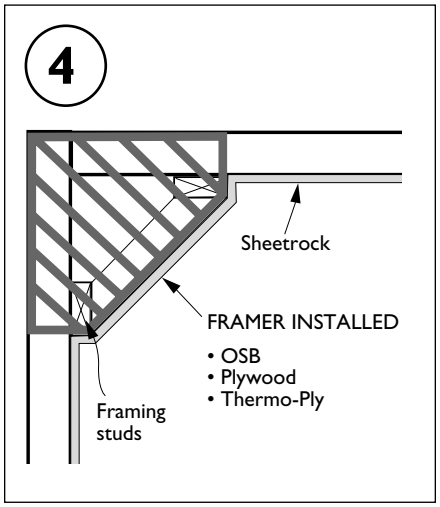
place. When I joists are used, be sure that the blocking fills the entire opening between the garage and the floor system. If this connection is a web truss, an upright 2 x 4 should be engineered into the truss where the truss crosses the exterior wall, so that the floor system can be blocked and air sealed.

③ *Exterior Cantilever*

The junction of the floor and wall should be blocked and air sealed in place.

④ *Corner Chase,* ⑤ *Chimney Chase, and* ⑥ *Shaft*

Corner chases, chimney chases, and shafts must be capped with sheathing during framing. Once the Sheetrock is installed, it will create an even plane and establish the location for the 3C barrier. Not one of these details can be left uncapped, because that would break the continuity of the 3C barrier.

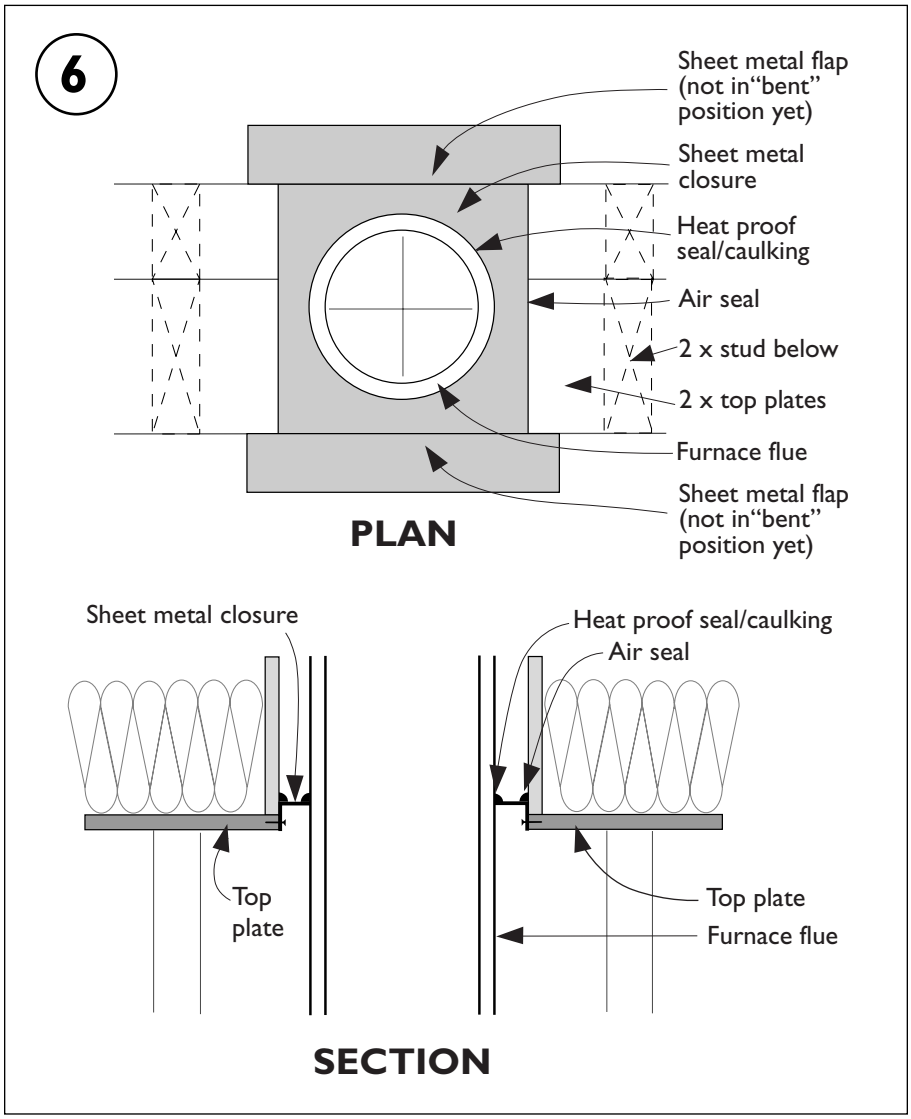


ADVANCED ENERGY

Any corner chase that contains vent pipes must be capped with sheathing during framing. When the vent is installed, it should be flashed and sealed.

ADVANCED ENERGY

Standing in the attic, one can look into the chimney chase and down into the house. When this cavity is heated, the air rises into the attic, turning the shaft into a chimney for the house's conditioned air.



BETSY PETTIT, EXEMPLARY HOME BUILDER'S FIELD GUIDE, PUBLISHED BY ADVANCED ENERGY © 1995

Any shaft that contains a vent must be flashed and air sealed in this manner.

Back to the Basics

Air, Moisture, and Heat Movement

Air moves from high pressure to low pressure, and it can change direction very quickly. Heat moves from warm areas to cold ones. Moisture moves from wet areas to drier ones, and from warm areas to cold ones. Changes in the direction of heat and moisture movement through solid materials take place very slowly (see Figure 1).

In the winter, we want to keep heated air inside the building and prevent interior moisture from penetrating the exterior assemblies. In the summer, we want to keep warm, moist outdoor air out of the house and its assemblies. Warm, moist air that comes in contact with cold surfaces can condense, which often results in moisture stains, damage, mildew, or rot. Insulation needs protection from uncontrolled air and moisture flow, both of which reduce insulation's ability to resist heat flow.

Air moves by wind and heat, or fans can drive it. In order for air and moisture in the vapor state to leak into or out of a house, there must be holes between the inside and the outside. In contrast, heat transfer by conduction does not require holes in order to enter or exit. Conduction loss or gain can cause convection air movement, but air movement within cavities that are airtight does not necessarily cause air exchange between the inside of the house and the outdoors.

Convection air flow paths pose a major problem. Whenever air within a cavity is heated or cooled where the insulation and air barrier are not continuous or in contact, there is an opportunity for heating or cooling loss. A cavity can be airtight to the conditioned space and have a void or gap in the insulation. This creates an air space in the cavity, which sets convection air flow in motion. Heated or cooled air will escape if there is an opening in the cavity to the outside. The escaping air carries with it energy that was intended to either cool or heat the house.

The air inside the house next to the cavity is cooled by the convection loop in the cavity and causes it to fall. Often this results in a comfort complaint, because the homeowner feels that the house is drafty. In the summer, this cavity would radiate heat to the conditioned space.

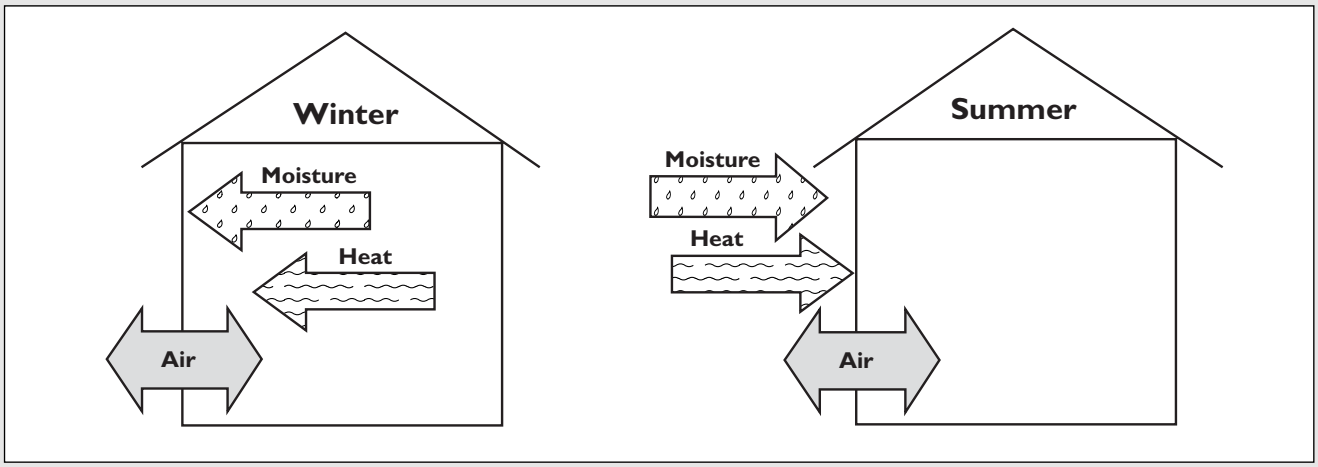


Figure 1. Moisture and heat generally travel together.

Barrier Location

The location of the air barrier will establish the location of the vapor retarder and the thermal barrier. In fact, the products that are used to create the air barrier, such as poly, Styrofoam blue board, often also form the vapor retarder. The thermal barrier, or insulation, should be installed in full contact with the air barrier. The only exception to this rule is when the insulation is installed in an airtight cavity; then the thermal barrier can be installed in contact with either side (see Figure 2).

Penetrations in the air barrier enable outside air, conditioned inside air, and moisture vapor to travel from inside to outside or vice versa—a process that is known as a thermal bypass. When this takes place, the entering or exiting air and moisture vapor must pass through or around the insulation, rendering it less effective. Condensation may form if moisture vapor comes in contact with any material that is cold.

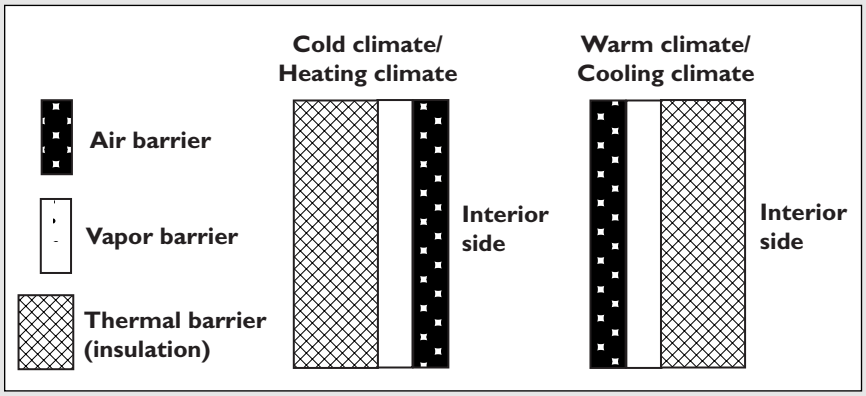
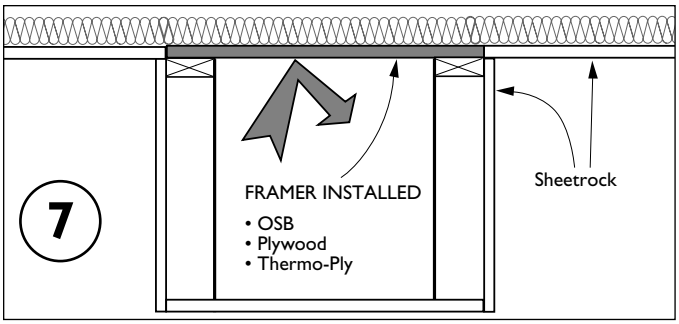
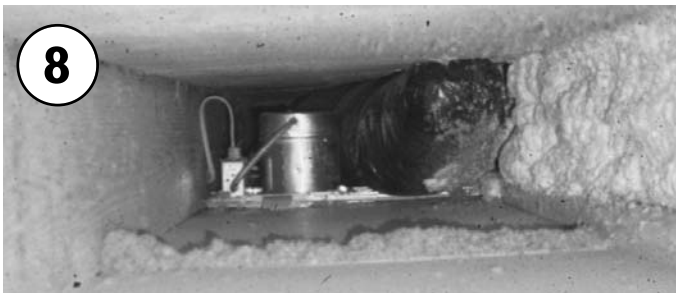


Figure 2. The climate and the location of the air barrier determine the locations of the vapor and thermal barriers.



ADVANCED ENERGY

Soffits to unconditioned spaces also require capping with sheathing.



ADVANCED ENERGY

Often when the insulation is removed, you can see from one side of the house to the other. When this is the case, the floor space, and the plumbing pipes, ductwork, and lighting inside the floor, are now in the attic. They are exposed to the extreme temperatures of the attic.

⑦ *Soffit to Unconditioned Space*

A soffit to unconditioned space can be a dropped ceiling in the kitchen, added to the design for aesthetics reasons, or it may contain ductwork running from one side of the building to the other. These types of soffits create a hole in the attic or a protrusion WRT the interior of the house, and must be capped with sheathing and insulation.

⑧ *Floors to Sidewall Attic*

In many houses, the floor framing is left open to sidewall attic spaces. Insulation is often placed over the opening. This practice does little to stop air movement from the floor system into the adjoining attic. However, it does act as a fine air filter. Heat loss and air leakage near this connection can cause ice dams, moisture damage to the roof deck, comfort problems, backdrafting, spillage from combustion appliances and fireplaces, and, not surprisingly, increased energy use. To prevent these hazards, fire and draft blocking should be installed and air sealed in place.

On the Road to Completion

All these examples show how framers and other trades need to work together to ensure that the 3C barrier really is continuous. The framer's job, after all, is just step 3 on the path to a high-performance house. But the contractors can't make their contributions to the installation of a 3C barrier unless the framer successfully masters the bumps and holes in the house's planes. With the tricks I've enumerated in a framer's tool kit, building a high-performance house is just a few steps from completion.

John Tooley is a building science consultant and senior trainer at Advanced Energy in Raleigh, North Carolina.