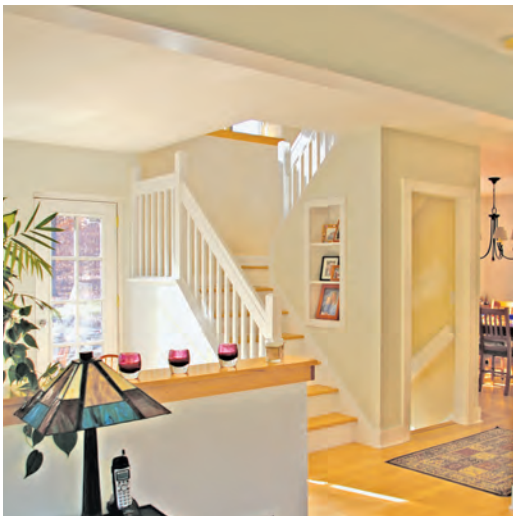
This 1980s colonial (left) was poorly insulated, uncomfortable, and expensive to heat. 2x3 studs were attached to the existing frame, but spaced off the house to eliminate thermal bridging. Three inches of closed-cell spray foam (R-20, plus existing R-11) was applied to insulate and air-seal exterior walls. The home is now Energy Star certified.

BPC added three wings to an old saltbox that was transformed into a LEED Platinum house. The walls of the master bedroom wing (above left) were framed with 2x6s, followed by horizontal 2x3s (above middle) to the interior face. This allowed for 7 inches of spray foam to achieve an air-tight R-31 wall (above right), with thermal bridging reduced because 1.5 inches of spray foam covers all of the studs.



The walls of this American Lung Association Health House (above) were framed with 2x4s (far left), but then a second wall made from 2x2s was added to the interior. The 10-inch wall cavity was then filled with blown cellulose to achieve super-insulation with zero thermal bridging.

By Dan Briody

SCIENTIFIC METHOD

BPC Green Builders adds science to the art of home building

MIKE TROLLE KNOWS THINGS ABOUT HOUSES THAT VERY FEW PEOPLE KNOW. He knows how much heat a flat-screen television throws off. He knows how much heat the toilet flushes of a family of four will suck out of the air. He knows the insulating properties of every conceivable material you might use to build and insulate the walls of your house. In short, Trolle, the founder of BPC Green Builders, knows the modern science of building. And along with his brother Chris, he is building some of the most energy efficient homes ever seen in this part of the world, including the only two LEED-certified Platinum homes in Fairfield County. "Building a good house has become a highly technical subject," says Trolle. "The days of one generation of carpenter/builder teaching the next on the job are over. Today you have to hit the books. You have to study and understand the science of building."

Trolle's passion for building efficient homes is plainly evident. He is a tireless advocate for green building, and he evangelizes the subject to anyone that will listen. In this respect, he is not interested in maintaining a competitive advantage over other green builders. He just wants people to know that there is a better way to build. BPC's building philosophy is very straightforward. The three imperatives are: Build air-tight; super-insulate; and eliminate thermal bridges. All three imperatives are closely related in that they are all ways of controlling the movement of air, heat and moisture around a house. For example, BPC goes to great lengths to ensure that its homes don't allow conditioned air to escape through joints, windows, walls or roofs. It uses two-by-six wall studs, spaced 24 inches apart (rather than the traditional two-by-four studs, spaced 16 inches apart), plus two-by-three studs nailed horizontally across the two-by-fours, to allow for thicker walls with more

PHOTO COURTESY OF TRILLIUM ARCHITECTS

A new product, insulated structural sheathing was used for this new home, which is awaiting LEED certification (left). This is yet another way to eliminate thermal bridging and to increase the level and quality of the insulation.

The solar thermal panels on the roof of this house (far right) heat a glycol solution that transfers the heat to water in an insulated 1,000-gallon hot water tank (right), which stores the heat until it is needed for space heating or domestic hot water. The solar photovoltaic panels on the poles (below) create electricity. During the first 12 months, more electricity was created than was used.

This new, award-winning, LEED Platinum home (above and opposite page) used an insulated, pre-cast foundation system. Note the insulation under the concrete slab (far left). Additional insulation was installed in foundation-wall stud cavities to achieve an R-44. FSC-certified and reclaimed wood was used on floors and kitchen cabinets.

How you heat your home is far less important than how you construct your home

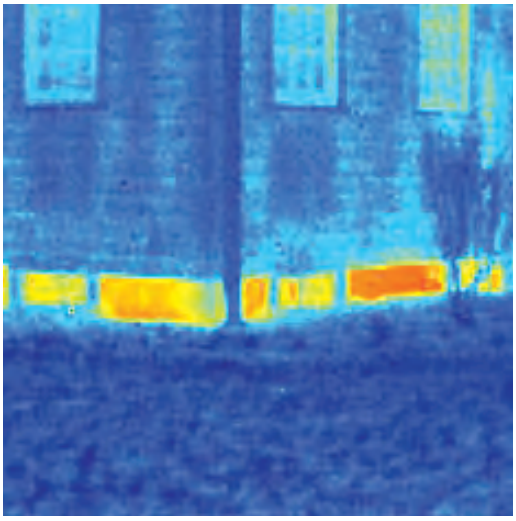
insulation, and to eliminate "thermal bridging" through the wood framing. Wood loses heat more quickly than the insulation that surrounds it. So when neither side of a wood stud is insulated, the stud becomes a bridge, conducting heat through the wall.

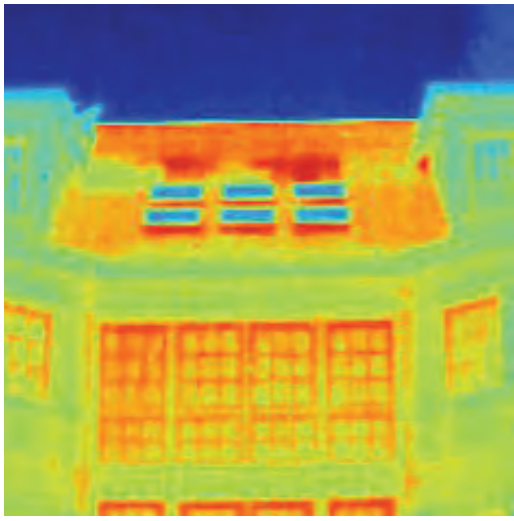
"People complain about different kinds of heating systems in their homes and the unevenness of the heat," says Trolle. "But how you heat your home is far less important than how you construct your home. When you build air-tight, well insulated, thermal-bridge-free homes, they heat evenly and hold the heat. In effect, you shorten the heating season by three to four months, and the homes are exceptionally comfortable."

Trolle's philosophy is that air and moisture should only enter or leave the house under the homeowner's terms. One way to accomplish this is by using something called an Energy Recovery Ventilator. This relatively inexpensive device is, essentially, a fan in a box that introduces fresh air to the home. But while doing this, it transfers residual heat and moisture from the exhaust air to the incoming air, recovering about 70 percent of the energy.

This is just one example of how BPC Green Builders is dramatically reducing the amount of fossil fuels needed to heat and cool homes. "There are literally thousands of variables in cooling and heating a home," says Trolle. "You need to understand them all to properly calculate the load." In one recently completed five-thousand-square-foot home in Ridgefield, Trolle used just two 400-foot geothermal wells to heat radiant floors, feed energy to a forced-air heating/cooling system and

This Litchfield County country home features timber framing and is Energy Star certified. All BPC homes are tested for air-tightness and are equipped with energy recovery ventilators to ensure that fresh, filtered air is delivered throughout the house while retaining valuable heat and moisture.





Infra-red images reveal that these homeowners are helping to heat their neighborhoods. The left house: heat is bleeding from the floor framing above the foundation wall. The right house: heat is bleeding from the roof rafters, which are likely insulated with fiberglass batts with ventilation chutes allowing heated interior air to escape.

BPC performs a blower door test, the best way to determine the air-tightness of the exterior envelope of a home. The test can be used to diagnose problems in an existing home and is required for all Energy Star and LEED home certifications.

provide all of the domestic hot water. "So many contractors oversize these things. I've seen similar homes with four or more wells."

The future for BPC is something called the Passive House, or a home in which the construction is so thoughtful, so thorough, that a central heating or cooling system can be eliminated. According to the Passive House Institute US, a PH is a virtually air-tight building that is primarily heated by internal gains from people, electrical equipment, etc., along with modest passive solar gain. Energy losses are minimized. Any remaining heat demand is provided by a small source. Avoidance of heat gain through shading and window orientation also helps limit any cooling load. An energy recovery ventilator provides a constant, balanced fresh air supply.

This is accomplished by using a combination of building science knowledge and cutting-edge technology, such as high-performance, triple-glazed windows; EPDM gaskets to air-seal wood framing connections; and aerated concrete to eliminate thermal bridging in masonry. In the last ten years, more than 25,000 Passive Houses have been constructed in Europe. Within the next ten years, the European Union will require all homes to be built to this standard. Interest in the United States is growing rapidly.

Listening to Mike Trolle, it's impossible not to get excited about the future of home construction. "The market for green homes is not a niche anymore. It's gone completely mainstream," says Trolle. "You don't have to be concerned with saving the planet to appreciate the science. It's about saving money. It's about living more comfortably. And it's about a better way to build." ■