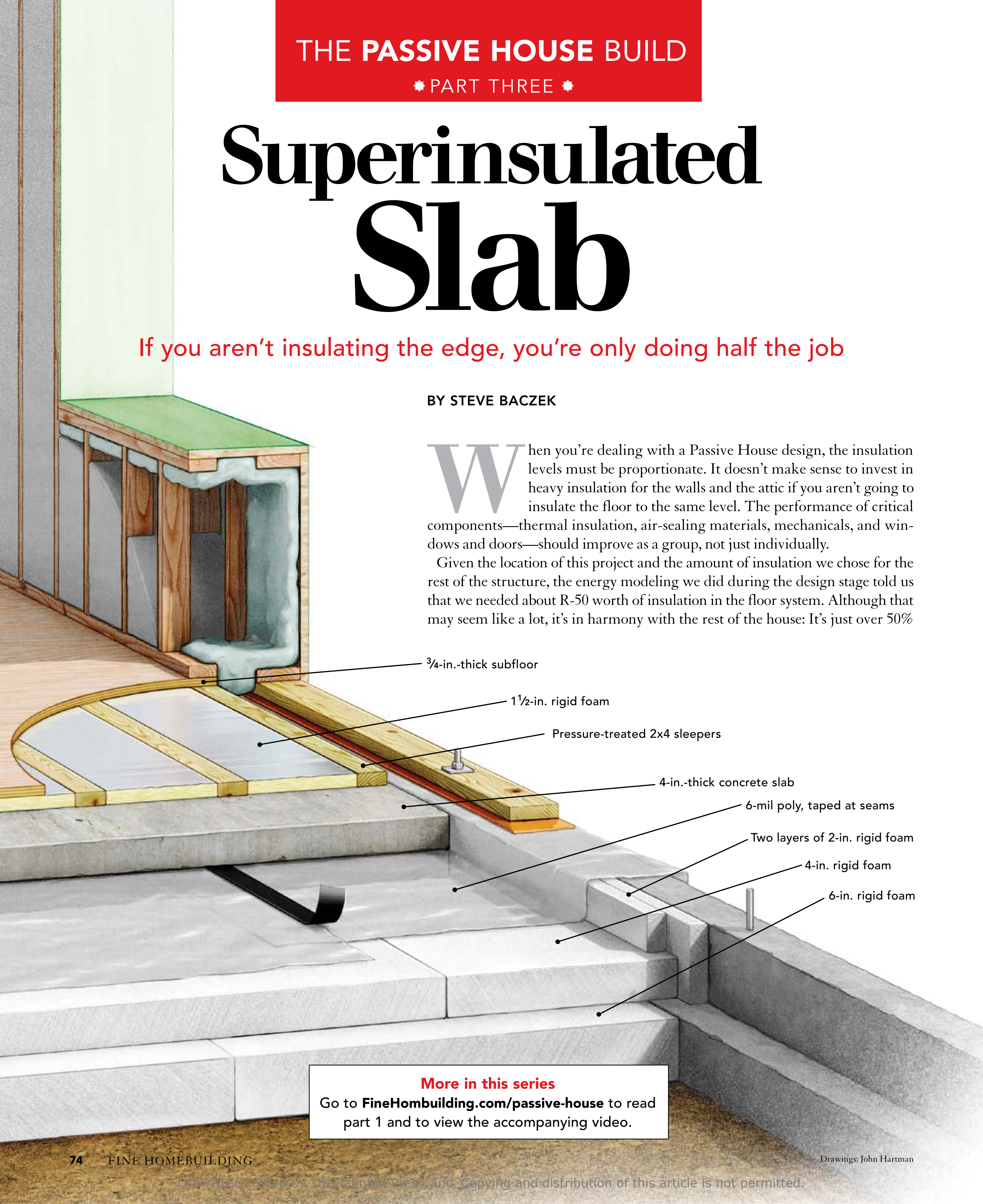
Superinsulated Slab

If you aren't insulating the edge, you're only doing half the job

BY STEVE BACZEK

When you're dealing with a Passive House design, the insulation levels must be proportionate. It doesn't make sense to invest in heavy insulation for the walls and the attic if you aren't going to insulate the floor to the same level. The performance of critical components—thermal insulation, air-sealing materials, mechanicals, and windows and doors—should improve as a group, not just individually.

Given the location of this project and the amount of insulation we chose for the rest of the structure, the energy modeling we did during the design stage told us that we needed about R-50 worth of insulation in the floor system. Although that may seem like a lot, it's in harmony with the rest of the house: It's just over 50%



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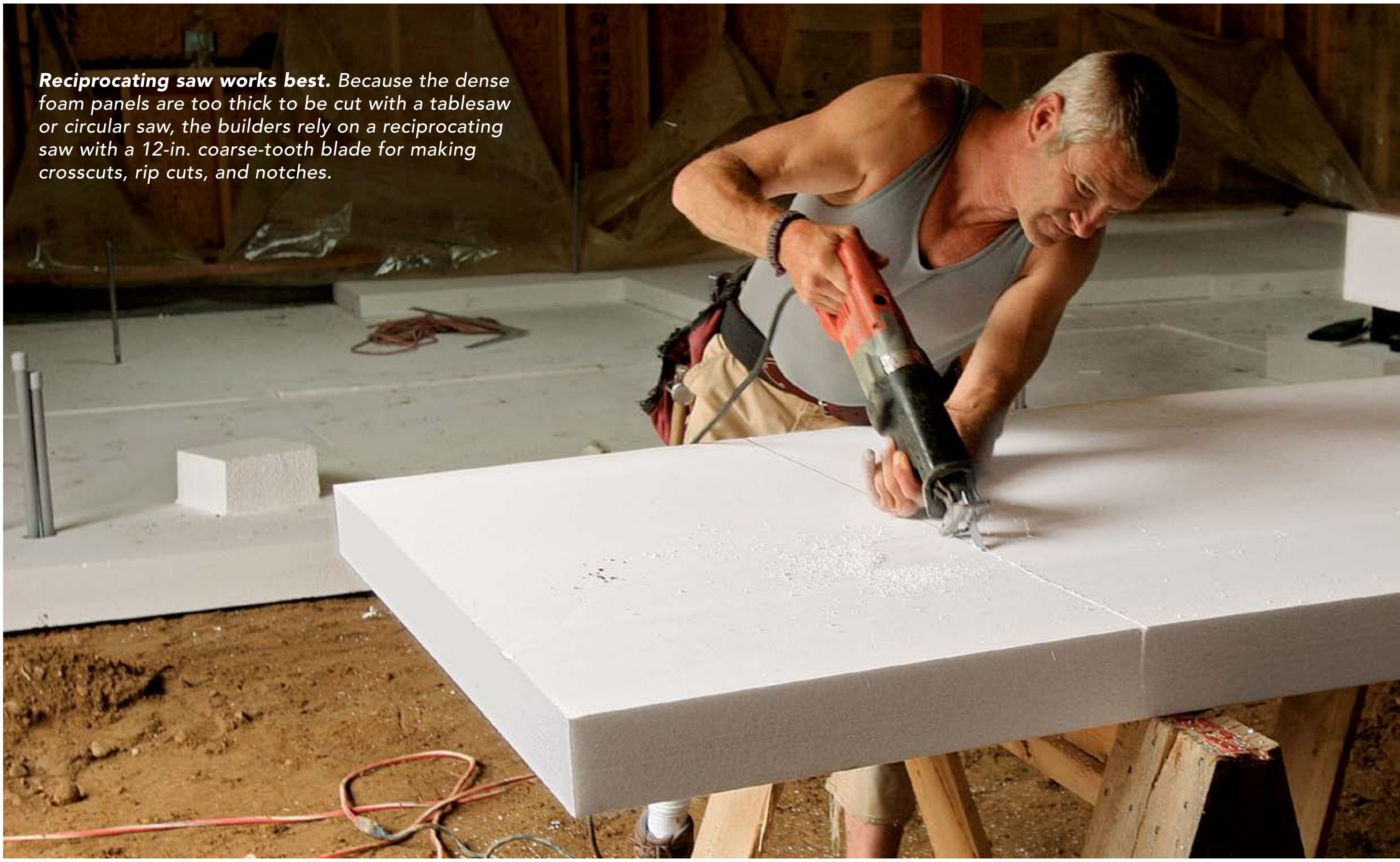
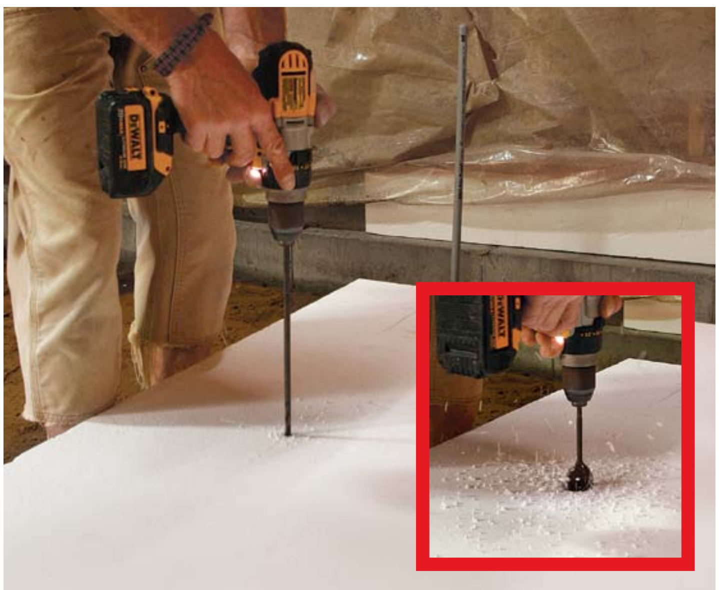
Drawings: John Hartman

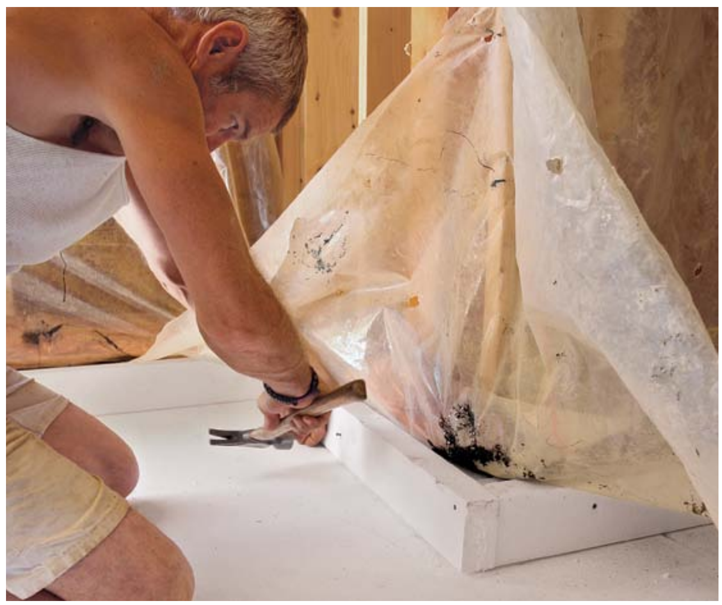
THICK FOAM MEANS NEW TECHNIQUES



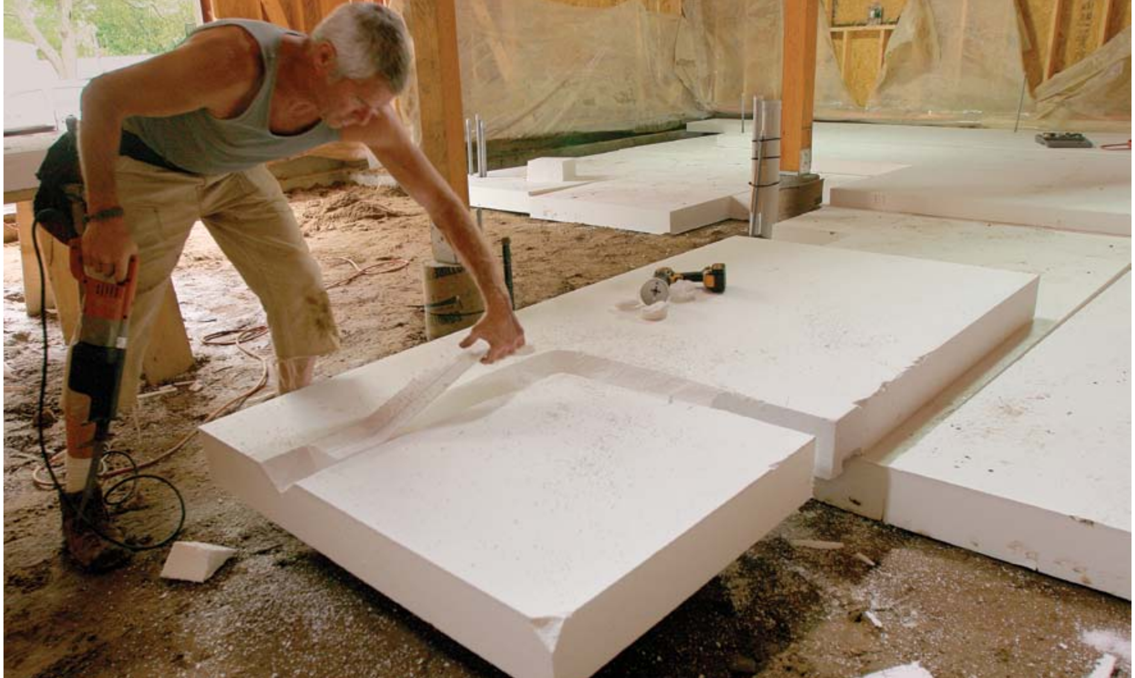
Reciprocating saw works best. *Because the dense foam panels are too thick to be cut with a tablesaw or circular saw, the builders rely on a reciprocating saw with a 12-in. coarse-tooth blade for making crosscuts, rip cuts, and notches.*



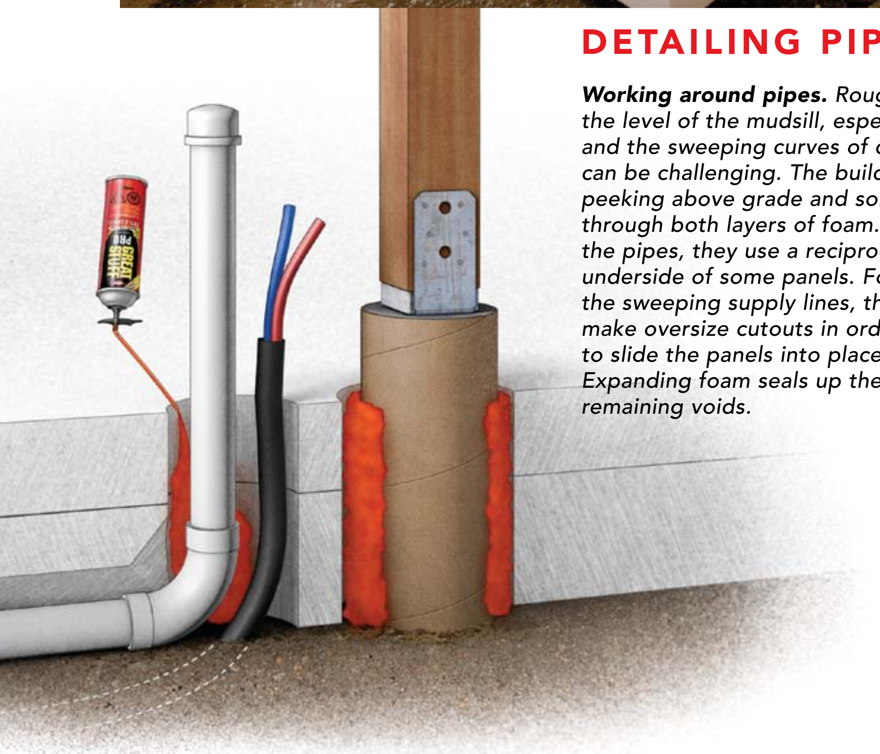
Drill from both sides. *When you need to drill holes for pipes and other penetrations in the thick foam, a standard spade bit or hole saw won't be long enough. Instead, use a long bellhanger-style drill bit to bore a pilot hole all the way through the foam. Then, using a standard spade bit, widen the pilot hole from both sides of the panel. For holes of a larger diameter, skip the drill bits and go right for the reciprocating saw.*



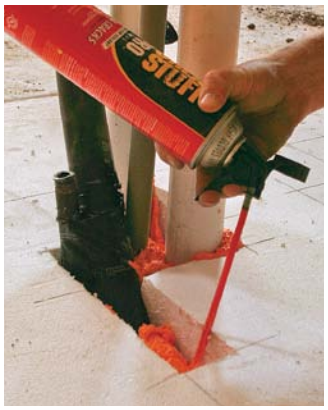
Tack on the edge. *The innermost pieces of perimeter foam come last and act as the screed level for the concrete slab. After applying a bead of spray foam to the outer perimeter foam, a worker tacks the inside pieces to that first layer of foam with nails every few feet to keep them from shifting until the spray foam sets up.*



DETAILING PIPES AND PIERS

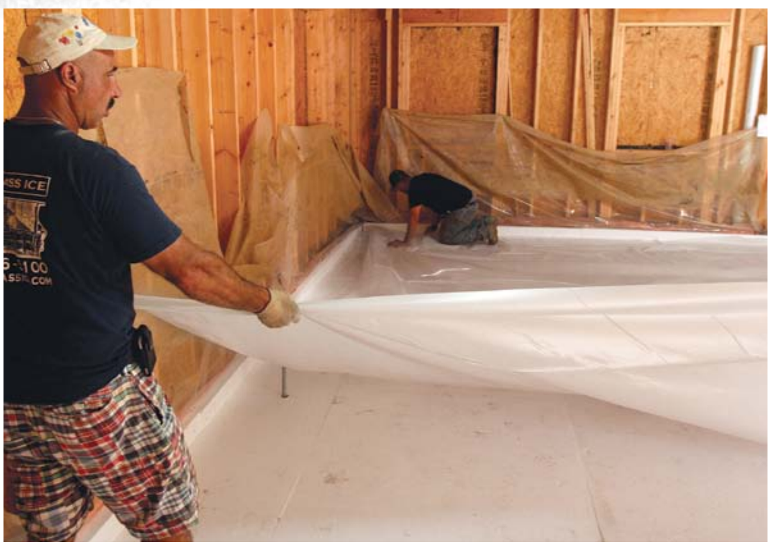


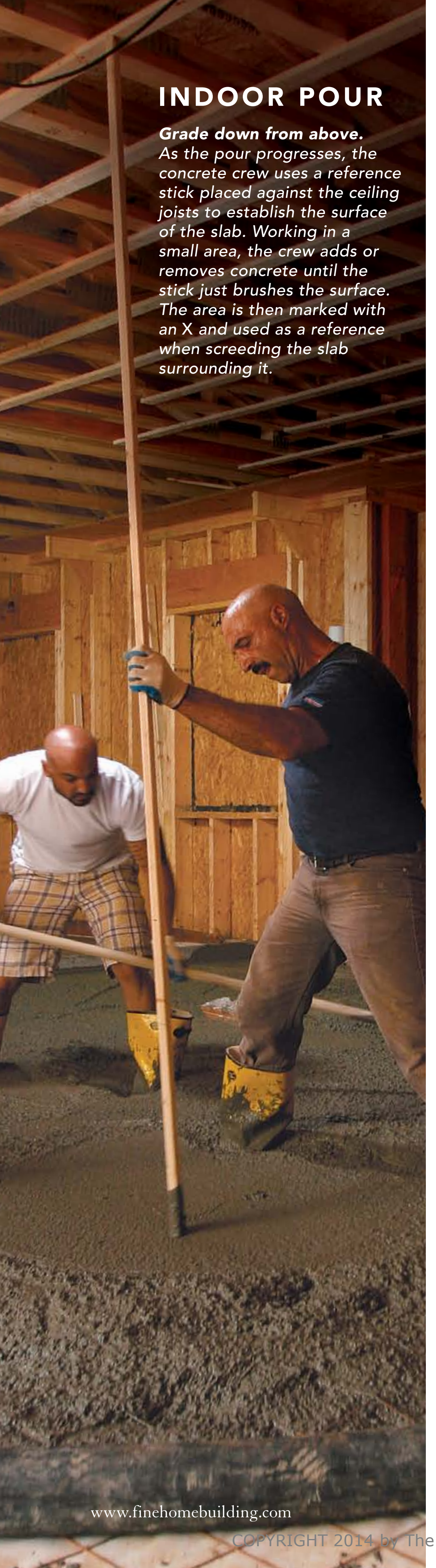
Working around pipes. *Roughing in mechanicals 14 in. below the level of the mudsill, especially with the pitches of drains and the sweeping curves of continuous runs of PEX tubing, can be challenging. The builders are left with a few drain pipes peeking above grade and some supply lines that angle up and through both layers of foam. In order to lay the foam over the pipes, they use a reciprocating saw to cut a V-notch in the underside of some panels. For the sweeping supply lines, they make oversize cutouts in order to slide the panels into place. Expanding foam seals up the remaining voids.*



LESSON LEARNED

Tape to avoid "icebergs." *After laying out the poly vapor retarder over the foam base, the inner flap of the poly that was installed as part of the mudsill assembly is folded down and taped along all edges. This taped seam prevents concrete from getting under the foam panels and causing them to float—a hard-learned lesson from one of the architect's previous projects.*





INDOOR POUR

Grade down from above. *As the pour progresses, the concrete crew uses a reference stick placed against the ceiling joists to establish the surface of the slab. Working in a small area, the crew adds or removes concrete until the stick just brushes the surface. The area is then marked with an X and used as a reference when screeding the slab surrounding it.*

INSULATED SUBFLOOR

Capitalize on empty space. *Using powder-actuated nails, the builders fasten pressure-treated 2x4 sleepers to the slab at 16 in. on center. To increase the overall R-value of the floor system, they fit pieces of rigid foam between the sleepers and fill remaining gaps with expanding foam. Finally, they fasten the ¾-in. subfloor.*

of the R-value in the walls and 30% of the R-value in the attic.

Because this house was built on a slab, I relied on layers of rigid foam set below the concrete to reach my required level of insulation. Of the three commonly available types of rigid insulation—polyisocyanurate (polyiso), extruded polystyrene (XPS), and expanded polystyrene (EPS), I chose EPS for its reliability below grade and its low environmental impact.

Although the plans showed this subslab insulation built up in 2-in. layers, the builder was able to source thicker 4-in. and 6-in. panels, which sped up the installation. When it comes to the foam under the slab, you don't need to worry as much about air movement complicating the issue. In this case, the concrete is the air barrier, so R-value is R-value, and whether you achieve the desired number by stacking five layers of 2-in. foam or using a layer of 6-in. foam followed by a layer of 4-in. foam as was done here, the result is the same.

Limit the chinks in your thermal and air-sealing armor

With any building project that sets a high bar for energy efficiency, the air-sealing and thermal barriers should be continuous. That means you should be able to look at the building plans and trace the barrier continuously around the entire structure from footings to attic. In doing so, you can highlight weak spots in a structure's outer shell.

One spot that typically is overlooked is the edge of the slab. On this project, rather than just insulating under the slab, I designed the foundation so that the subslab insulation wraps around the edges and then is connected to the spray-foam wall insulation. This seamless transition of insulation materials allows for total thermal isolation of the interior of the house.

Likewise, to minimize the potential for short circuits in the underslab airtightness and thermal performance, the plumbing and electrical systems were laid out so that only the necessary pipes and conduits run under the floor. The electricians and plumbers responsible for these installations gave prior approval to the plan, including carefully planned entrances into and exits from the house, all of which were strictly enforced. □

Steve Baczek is an architect in Reading, Mass. Photos by Justin Fink.

Next in the series

Part 4: Double-stud walls and insulation

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