SPECIAL REPORT

Insect Infestations in Buried Foam

Persistent termite and carpenter ant infestations have prompted pest control experts & code officials to rethink the use of foam board below grade

by *JLC* Staff

When building contractor David Damroth first discovered termites two years ago in his coastal home, a local pest control expert advised him to remove a section of the exterior rigid foam insulation that covered the foundation so he could see the extent of the problem. What he found was a network of tunnels in the foam full of termites on their way into his house through unsoldered corners and overlaps in the copper termite shield. To stem the tide, Damroth removed a 6-inch band of foam all the way around his foundation: "I thought if I removed the foam and destroyed the mud tubes, my problems would be over," Damroth says. "Was I ever mistaken: Within a few hours the mud tubes had been rebuilt."

Most readers wouldn't be surprised to hear this story from a builder or homeowner in the South, where termite infestations are a fact of life. But Damroth lives and works on the Massachusetts island of Martha's Vineyard, hundreds of miles north of what has been traditionally considered termite country. In fact, according to the National Pest Control Association in Dunn Loring, Virginia, termites of one kind or another are found in every state except Alaska, and carpenter ants and other destructive insects can pose a similar threat well into Canada.

Obviously, wood-destroying insects don't stop at the Mason-Dixon line, but they don't always find entry into the house through the wood mudsill at the top of the foundation either. In Damroth's case, an initial do-it-yourself treatment of the exposed foundation with Dursban, an off-the-shelf termiticide, lasted for just two weeks. Then, while putting bikes away in the basement, Damroth noticed new mud tubes, this time on the basement floor. The termites had found their way under the footing and into the house through cracks in the basement slab and the foam beneath it (see "Case Study," below).

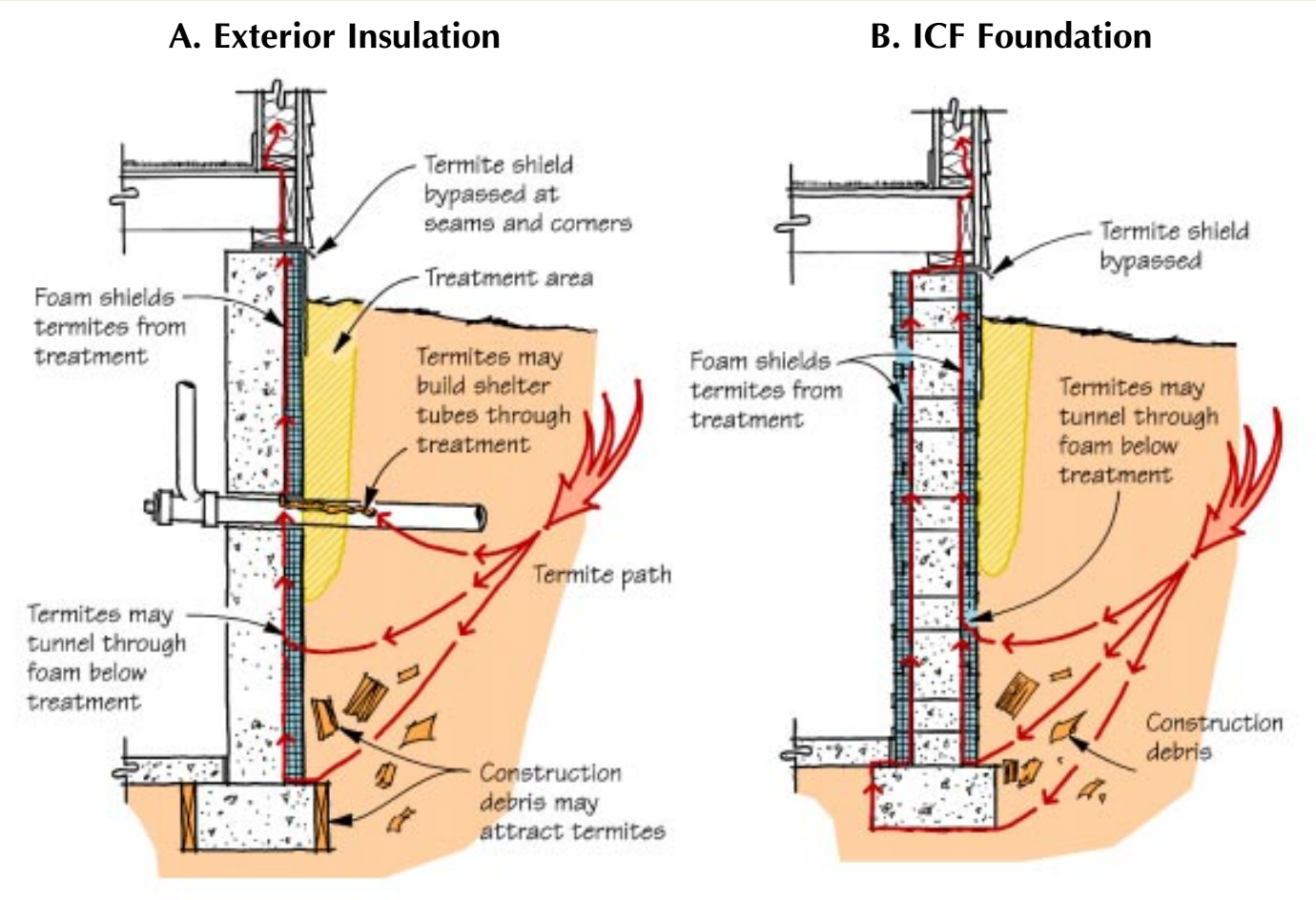
The Trouble With Foam

Wood structures have always been susceptible to damage from termites and other wood-destroying insects, but the presence of rigid foam appears to exacerbate the problem in two ways. First, once the insects tunnel through the foam, they are hidden behind it (see "Hidden Termite

Hidden Termite Entry Paths

Termite activity is hidden from view when a concrete foundation is insulated on the exterior with rigid foam (A) or when it is constructed of ICFs (B). The bugs can enter through tiny openings, such as where pipes penetrate the wall, but they can also tunnel directly through the foam at any point. Termiticides applied to the ground will not affect the foam, which acts as a shield for the termites.

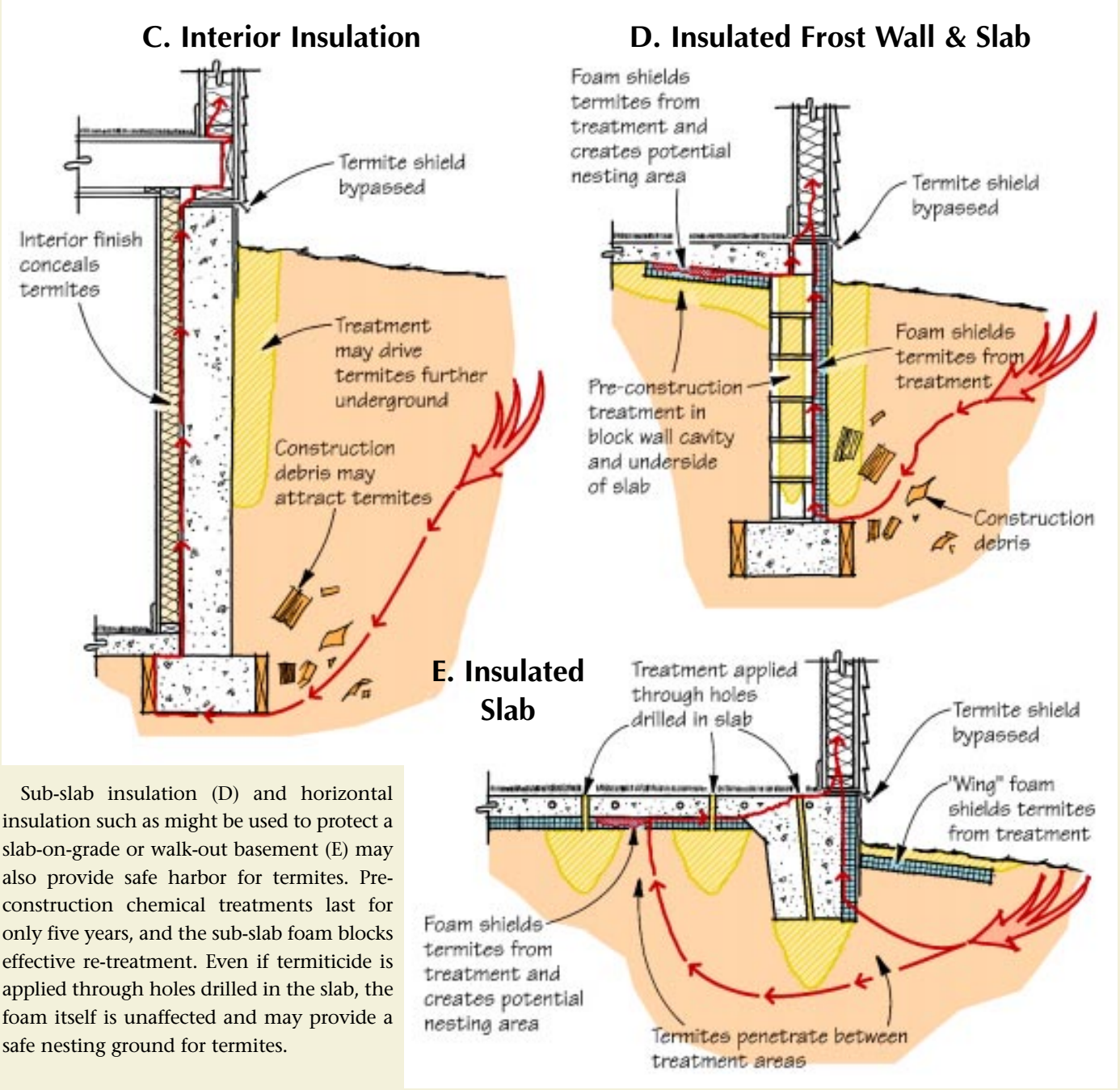
Homes without exterior insulation but with interior foundation insulation are not much better off (C). If shelter tubes along the exterior are spotted during regular inspections, termiticides applied to the ground may drive the termites further underground. By tunneling under the footing, the termites can enter through cracks and seams in the basement slab. Once inside, the interior insulation and finishes conceal the presence of an infestation. *continued*



Entry Paths"). This gives the bugs time to establish themselves before the infestation is discovered, and may increase the extent of the damage to the wood structure.

With an exposed foundation, for example, a termite infestation can often be discovered early by looking for the telltale mud tubes that the bugs use to protect themselves from light and air. If these tubes are hidden behind the foam, however, the first sign of trouble might not show itself till several years later, by which time the termites may have started satellite colonies in and behind the foam.

Second, regardless of when an infestation is discovered, the presence of foam insulation against the foundation can make complete chemical treatment impossible. Even if the soil surrounding basement walls or under slabs is treated, the foam, which itself remains unaffected, prevents the pesticide from reaching the concrete, effectively shielding insects that get behind or in it. According to Greg Baumann, director of field services at the National Pest Control Association (NPCA): "There is simply no way to treat below-grade foam insulation once it is infested with insects. The only cure is to remove the foam. That could mean digging up foundations and jackhammering out slabs, but it's the only recommendation we have at this time." For this reason, some national pest control firms, such as Orkin, now refuse to guarantee the effectiveness of treatment in houses with below-grade foam, a big



Sub-slab insulation (D) and horizontal insulation such as might be used to protect a slab-on-grade or walk-out basement (E) may also provide safe harbor for termites. Pre-construction chemical treatments last for only five years, and the sub-slab foam blocks effective re-treatment. Even if termiticide is applied through holes drilled in the slab, the foam itself is unaffected and may provide a safe nesting ground for termites.

problem in southern states where insect inspections are often necessary to secure bank financing when a home is sold.

What's the Attraction?

Wood-destroying insects don't actually eat rigid foam, but because they tunnel through and nest in it, some experts have begun to wonder if foam holds some special attraction for the pests. For example, studies conducted recently in a lab at Colorado State University seem to show that termites, like mosquitoes, might be attracted to low concentrations of carbon dioxide (CO_2). Since CO_2 is used as a blowing agent in some foams, the researchers concluded that the CO_2 may attract termites to foam.

However, while the study established that termites will move toward a CO_2 source, no actual foam was tested. A company spokesperson for Dow Chemical Corporation, which uses CO_2 to expand foam in some of its products, disagrees with the CO_2 theory, because "any residual CO_2 would be long gone by the time the product reaches the job site." In addition, since the bulk of the foam in the ground today was produced before 1995, when CO_2 was first used as a blowing agent, it seems unlikely that CO_2 played a part in attracting insects to older homes where buried foam was used.

Most pest control experts also discount the theory. "It's true that CO_2 can be attractive to some insects," says Harold Harlan, a staff entomologist at the NPCA, "but we haven't been able to confirm CO_2 as the mechanism that

attracts termites or carpenter ants to foam products. If true, we'd be able to actually bait the insects away from the building with CO_2, and that's simply not the case."

On the other hand, Dr. Niel Ogg, assistant head of Clemson University's Department of Pesticide Regulation, is conducting studies of southern homes that have led him to believe that buried foam plays some role in termite infestations. "We don't understand the exact mechanism, but it's clear that foam products are not insect neutral in the environment," says Ogg. "Statistically, new homes built without below-grade foam should show a low rate of termite infestation in the first five years — 5% to 15%. By comparison, we found 85% to 90% of houses in South Carolina and Florida with below-grade foam to be infested after five years. So it's not 'if' but 'when.'" One possible explanation is that nearly all homes in areas of high infestation probability, such as Florida and the Carolinas, where Ogg's studies are being done, are treated regularly with pesticides. These chemical treatments may be more effective on bare concrete foundations than on foundations protected with a layer of rigid foam.

The question of whether foam acts as an attractant for wood-destroying insects is further complicated by the fact that many manmade chemicals can mimic the natural pheromones that attract insects, and one or more of these may be present in foam. According to Harlan, common inks and dyes or one of the many residual chemicals in foam and other building products could be to blame.

The plastic foam industry maintains that its products aren't at fault. Betsy DeCampos, executive director of the Expanded Polysytrene Molders Association, which represents approximately 45 manufacturers of foam products, told *JLC* that "the data shows EPS products have no nutritive value to insects... but we encourage our members to work on solutions to the insect problem within the limitations of building codes." Similarly, ABB corporation, makers of BlueMaxx ICFs, tells its dealers in a termite position paper to "...point out that ICFs don't 'attract termites,' but that if [the homeowners live] in a heavy termite area (as determined by the SBCCI Standard Building Code), they are advised not to install the ICF below grade until we come out with the appropriately configured solution to the problem and/or the codes are reversed."

When asked about ongoing research to find chemical solutions, DeCampos said that while most of the chemical research is being done by raw materials suppliers, "individual molders generally aren't going to have the financial resources to conduct their own [research], and at this time there is no industry-sponsored research." Studies of that type may cost millions of dollars, can take years to complete, and must involve the EPA.

Dow Chemical, when asked about its in-house research, would say only that chemicals incorporated into foam "show promise" in the battle with insects.

Are Borates a Solution?

One manufacturer, AFM Inc., has been incorporating borate in its line of foam building products since the early 1990s. Borate, a natural mineral compound, is known to be an effective deterrent for many destructive insects, including termites and carpenter ants (see "Controlling Termites and Carpenter Ants with Borates," 2/97).

AFM President Mike Tobin told *JLC* that the decision to make the borate

Foam or No Foam: Weighing the Cost

Considering the risk of termite infestation, why not leave out the below-grade foam? Presumably there's an energy penalty to pay, but how much? To get an idea, we looked at two common scenarios: a 2,000-square-foot ranch built over a full foundation, and the same house on a radiant slab.

The heating calculations assume the house is in Rochester, N.Y. (6,750 degree days), and is insulated to code. The cooling calculations assume the house is in Greensboro, N.C. We assumed the cost of fuel to be $1 per Therm (100,000 Btu) for natural gas. Oil heat might be a little less (around 80¢/T), propane a little more ($1.45/T), and electric resistance heat a lot more ($2.50/T). All costs are rounded to nearest $10. We ran the numbers both by hand and using several popular software packages available to heating contractors. Each package yielded slightly different results, so we took an average.

One trend is clear: Given the risk of infestation when you cover a foundation with foam, the money saved on fuel could easily be spent on remediation (see table below).

Cost of Termite Prevention Treatment

Pre-construction soil treatment:	$1,000 to $2,500
Annual follow-up inspection and periodic retreatment:	$150 to $500
Over life of mortgage (compounded, not adjusted for inflation):	$6,000 to $15,000 or more

Cost of Termite Infestation Treatment*

Remedial treatment plus baiting:	$5,000 (min.)
Fumigation:	$6,000 to $20,000 or more
Cost to remove buried, untreatable below-grade foam:	
At perimeter walls:	$7,000 (min.)
Under slab (unfinished basement, except mechanicals):	$10,000 (min.)

* Total cost should also include cost of periodic retreatment. Cost of pesticides will vary, because less expensive pesticides will soon be banned. Safer pesticides are less effective and may require more frequent application. Fumigation costs may also include the cost of interstate travel.

treatment a standard feature of its products "was more to limit company liability for what we knew was a growing problem than to be an across-the-board solution to termites." AFM is now conducting field trials on the products, using test methods similar to those used to check treated lumber: Samples are buried in high-termite areas of the southern U.S. and periodically checked for signs of infestation. So far, the results released by the company show promise, but AFM has yet to present its evidence to the scientific community or to the building code authorities.

While statements in AFM's marketing campaign for PerformGuard, a borate-treated foam, could be misread as claiming that the borate-treated foam is an insect deterrent, Tobin made it clear that the borates protect the foam, not the building. "Just like you wouldn't expect a pressure-treated sill plate to protect the whole house from termites," he said, "you can't expect PerformGuard to either. It's just one component in the building."

Clemson's Niel Ogg also warns against relying on borate-treated foams below grade to deter termites. "It's like going camping and hanging a steak up in your tent: Even if the steak is poison, the bears are going to come." While Ogg's analogy points to his hypothesis that foam somehow attracts termites, he explained that whether the foam is treated or not, once termites find it the basic problem remains unchanged: Any termites that find their way around the foam will be difficult to spot, and treatment of any infestation will be impossible with the presence of the foam. Echoing the opinion of most pest control experts, Ogg concluded, "The only sure fix if you have below-grade foam is to remove it."

What the Codes Say

The model codes have recently made some effort to address the problem of termites and other wood-destroying insects. Since 1997, the Southern Building Code Congress International (SBCCI) has banned the use of all below-grade foam products in states with a high-probability of termite infestation; later this year, the ICC (International Code Council, formerly CABO) will do the same in its *1998 International One and Two Family Dwelling Code* (see *Notebook*, 8/98). The ban includes all polystyrene foam — both expanded (EPS) and extruded (XPS) — as well as polyisocyanurate foam boards and ICFs.

Unfortunately, SBCCI's ban in areas of high probability for infestation leaves out other areas where infestations are less likely but still occur. Similarly, CABO's ban will draw a boundary line that is artificial at best. For example, CABO bans all use of below-grade foam in North Carolina, but approves the use of below-grade foam in shallow frost-protected foundation systems at sites ten miles away in Virginia, which is not named in the code's termite ban. The codes in many northern states don't address the termite problem at all. In fact, not only is the use of buried foam allowed, it is encouraged by the *Model Energy Code* (*MEC*), which many of these states have adopted.

It's also important to understand that code bans on buried foam are designed to prevent structural collapse due to termite damage to structural members. While this is in keeping with the code's goal of providing minimum public safety standards, it does little to prevent nuisance insect infestations. Both bans still allow the use of buried foam in buildings that contain some wood: SBCCI, in buildings that have no structural wood; CABO, in any building so long as the wood struc-

Case 1: Forced-Air Heat over Full Basement

(assumes 80% AFUE natural gas furnace, finished basement heated to 70˚F during heating season)

Heating Costs

A. Fully insulated basement (2-inch XPS foam on all exterior foundation walls from mud sill to footing): Baseline annual fuel costs approx. $1,400

B. Insulated basement with 6-inch inspection strip: Annual fuel costs approx. $,1510 — Penalty $110

C. Uninsulated foundation: Total annual fuel costs approx. $2,000 — Penalty $600

Cooling Costs: See Case 2

Case 2: Forced-Air Heat over Unheated Full Basement

(assumes 80% AFUE natural gas furnace, basement temperature maintained at 50˚F)

Heating Costs

A. Fully insulated basement (2-inch XPS foam on all exterior foundation walls from mud sill to footing): Baseline annual fuel costs approx. $1,100

B. Insulated basement with 6-inch inspection strip: Total annual fuel costs approx. $1,190 — Penalty $90

C. Uninsulated basement: Total annual fuel costs approx. $1,580 — Penalty $480

Cooling Costs

Located in Greensboro, N.C, the house in Cases 1 and 2 would require approximately 36,000 BtuH (3 tons) of cooling. The case could be made that 2 feet of exposed uninsulated foundation wall would add 1/4 to 1/2 ton to the cooling load. In reality, the below-grade basement helps to naturally cool the home, and would offset any gain from the above-grade wall. Most hvac contractors would neither add nor subtract for the basement with a 2-foot exposure. Foundation wall insulation would become more critical to the cooling load if there were a walk-out basement, garage, or other highly exposed area.

Case 3: Radiant Slab with Frost Wall

(assumes 80% AFUE boiler, 6 inches of foundation exposed above grade)

Heating Costs

A. 2-inch XPS insulation from mud sill to frost wall footing: Baseline annual fuel costs approx. $1,160

B. 2-inch XPS insulation with 6-inch inspection strip removed: Total annual heating cost approx. $1,485 — Penalty $325

C. No insulation at all at slab edge or under slab: Total annual heating cost approx. $1,660 — Penalty $500

Cooling Costs

A 6-inch section of exposed foundation would add about 1/4 ton (3,000 BtuH) to the cooling load; however, this minor gain would be more than offset by the ground cooling effect of the slab. Hvac contractors would typically omit the slab from the calculations altogether. No case can be made for insulating the slab edge to lower cooling costs.

Case Study: Foundation Foam Conceals Termite Infestation

A letter from building contractor David Damroth was the original impetus for this article. The letter arrived with photographs and a box containing samples of the foam removed from Damroth's Massachusetts home. Here are excerpts from Damroth's description of his battle with the bugs.

"During the course of the summer, I tackled the removal of 6 inches of foam insulation around the entire perimeter of my home. Within the first 3 feet I observed tunnels throughout the foam crawling with termites.

"At the termite shield, the termites had built corridors along the top edge of the foam, apparently in an effort to find a point of entry in the house. Eventually, they found the corner of the building where the copper shields overlapped. The overlap was not soldered, because I assumed the pressure of the house and sill sealer would keep the joint tight. But my idea of tight was a termite's idea of a doorway, and they squeezed through the tiniest cracks. In one instance, the industrious little pests had built a tube that angled away from the foundation into midair, then went up and over the edge of the termite shield.

"I thought that if I removed the foam and destroyed the mud tubes behind it, my troubles would be over. Was I ever mistaken. Within a few hours, the mud tubes had been rebuilt. Again I scraped the rebuilt tubes off, but they reappeared. I had hoped to avoid using chemicals, but now it

continued

David Damroth discovered the extent of a termite infestation in his home by removing a 6-inch band of insulation from the perimeter of the foundation (left). He found a dense network of termite shelter tubes behind the foam, as well as along the top of the foam (right), where the bugs had traveled around the house looking for a point of entry.

ture is pressure treated. But even steel-studded houses and those with ICF walls and steel rafters contain wood in millwork, cabinets, flooring, and furnishings. In addition, termites actually prefer non-wood sources of cellulose, such as drywall paper and insulation backing, which are not mentioned in the bans.

Foam under slabs. None of the codes bans foam under interior slabs, which is used in heating climates to protect walk-out basements from frost and to insulate radiant slabs. The pest control industry recommends chemically treating the soil before installing the sub-slab foam, but the treatment may only be good for five years. If termites are then found entering from beneath the slab, there is no good solution. Removing the slab and the foam to treat the soil again is expensive, and treating the subgrade through holes drilled through the slab and foam leaves the foam unaffected, because it can't absorb the waterborne chemicals. Termites can still nest in the foam and travel along the surface where the foam and slab meet or through the foam itself.

Foam at slab edge. Homes built with radiant slabs pose a special problem, because they often rely heavily on insulation at the edge of the slab. The warmth from the slab is inviting to ants and termites, which can make their way through cracks as small as 1/32 inch. Joints of this size and larger typically occur under wall plates at the edge of the slab, where termite traffic is hidden from view. The same techniques used to control radon — meticulous detailing of control joints and pipe penetrations — combined with chemical soil treatment before and after construction may be necessary to keep insects at bay. If foam must be used for perimeter insulation, placing it on the inside of the frost wall keeps the concrete or block accessible for chemical treatments outside.

Interior foam. Both SBCCI and CABO allow the use of foam on the inside of basement walls, because it is accessible for treatment. But interior foam will still shield termites from sight and should an infestation occur, completely dismantling a basement family room to remove infested foam can be as destructive and expensive as digging up the foundation. Interior basement insulation with fiberglass batts is not a solution either. Whether the studs are wood or steel, the insulation will still hide termites traveling along the concrete wall, and getting rid of an infestation will still be difficult and expensive.

was clear I had no choice. I treated the area with a light application of Dursban. No new tubes appeared that day or for the next two weeks.

"I had almost forgotten the entire problem until I went into my basement to put my daughter's bike away for the winter. As I descended the stairs, I saw new mud tubes, not just on the floor, but extending all the way up the wall to the rim joist. Those darned creatures had moved down under the footing and back up into my home. I removed the mud tubes, hoping to at least slow down the occupation, but within four hours, the tubes reappeared, rising like stalagmites into the air. I never imagined that termites would be quite that persistent.

"My respect for the tenacity of these insects has grown dramatically. I've decided that the only way to protect the house in the long term is to preserve the ability to inspect the foundation. I don't want to excavate and remove the foam, because it holds in the heat and keeps the basement dry. Instead, I plan to leave the top 6 inches of the foundation exposed, capped with a custom piece of metal flashing to hold it in place. If I have to use chemicals again, however, this cap will have to be designed so I can apply termiticide behind the foam. And I'm still concerned about the potential for human exposure to the chemicals."

The termites were hidden from view by the foam, through which they carved numerous tunnels (left). They eventually entered the house between overlapped layers in the copper termite shield at the house corners; in some cases, they built shelter tubes around the termite shield (middle). Damroth removed the tubes, but within hours, the termites had begun to build new tubes (right).

The soundest course is to leave out interior basement insulation and finishes to begin with. In the South, the energy loss is negligible; in a typical northern city, a completely uninsulated basement might add between $400 and $600 to the annual heating bill per year (see "Foam or No Foam: Weighing the Cost"). Given the cost of treating a termite infestation, this trade-off is probably worth it.

Inspection strip. In response to industry outcry, North Carolina state codes allow the use of foam below grade if there is a 6-inch inspection strip at grade around the perimeter of the building. The reasoning behind this exception is that the vision strip enables homeowners and pest control inspectors to see termite tubes on the concrete.

Some experts believe, however, that this approach is flawed. "So what if we can see them? We still can't treat them," says Jerry Held, a pest control operator in York, Pa. "There is no known way to administer termiticides into the below-grade foam after the fact. All the inspection strip tells us is that we have to call in the backhoe to dig out the foam."

An Ounce of Prevention

Despite their shortcomings, the code bans on below-grade foam have focused attention on the problem in areas where the likelihood of insect infestation is highest. Perhaps the light at the end of the termite tunnel is the newly formed Joint Industry Termite Committee (JITC), an alliance between the National Pest Control Association and the Society of the Plastics Industry whose goal is to study the problem and make recommendations for the safe use of buried foam. Greg Baumann, director of field services at NPCA and co-chair of the JITC, predicts that the committee will have preliminary recommendations within a year. "We're looking at all the available options, including borate or other chemical treatment of the foam, physical and chemical barriers such as those used in Australia, and new construction guidelines." The Australian solutions include protecting below-grade insulation with physical termite barriers, such as fine stainless steel mesh, plastic membranes, and other mats, with and without termiticide treatment.

Unfortunately, it could take years to field-test any proposed cures. For now, the best solution is to steer clear of below-grade foam altogether.