chapter 12. INSECT ATTACK

12.1 GENERAL

Wood-destroying insects are relatively unimportant in some geographic areas, but in many others, they cause substantial damage. Thus, the designer must understand the nature and the extent of the insect hazard and take appropriate steps to combat this problem. A wide variety of insects may damage wood in use. Some simply inhabit the wood but do not use it as food; carpenter ants and carpenter bees are of this type. Most, however, do use wood as a food source. The most important of these is the various termite species, but both the true and the false powderpost and deathwatch beetles also cause major losses. Other insects are important in limited areas.

One way to classify these insects is by noting whether they can reinfest wood in use at low-moisture contents. Those that cannot are generally found in the forest and require bark on the wood, a higher moisture content, or both for reinfestation. Of these forest insects, some have larvae that can survive and develop as the wood dries out. These insects may be incorporated into a building through the use of infested lumber or other wood products. In general, this group is of lesser concern since damage will cease after the first generation has matured and has emerged from the wood. The use of kiln-dried lumber assures that these insects will be eliminated.

Insects attacking wood in use are far more damaging, causing hundreds of millions of dollars each year in economic losses. Many species are limited by the material they can attack. For example, subterranean termites generally nest in the earth and must be able to reach the wood through protected passageways. The true powderpost beetles can lay their eggs only in woods containing large-diameter cells, thus limiting their attack to the large-pored hardwoods such as oak. Still others require a minimum level of starch or protein in the wood, thus limiting their attack to the nutrient-rich sapwood. Many wood destroyers have developed symbiotic relationships in which their development is enhanced in the presence of certain fungi. They often have special anatomical features to carry spores to assure infection, which adds to their destructive effects.

Virtually all the insecticidal chemicals used for field treatment to control insect attack in wood either have become restricted or are not available because of environmental concerns. Although many newer chemicals are being evaluated as alternatives, they, too, must face environmental reviews and undergo extended periods of evaluation to assess both their environmental acceptability and their ability to provide protection for extended periods of time. Further, there is a growing reluctance to use chemical treatment of the soil to provide protection, regardless of the level of environmental hazard, and the ability to control subterranean termite attack through insecticide use will probably continue to decline, making improved construction increasingly important.

To provide effective protection against insect attack, the designer should consider providing the following measures:

- Adequate separation from the soil to reduce the risk of attack by subterranean termites.

  Soil poisoning to provide an inhospitable barrier between termite nests and the wood environment. The designer must also realize that current soil poisoning agents do not have a life span exceeding five to seven years at best. For certain soils, it is considerably less.

  The installation of a protected sand barrier (grains 1.7 mm-2.4 mm diameter), which has proved remarkably effective in excluding termites.

- Careful detailing to exclude moisture from wood members, especially at joints.

- The use of kiln-dried lumber to avoid infestations that may have occurred in the forest and survived the manufacturing process.

- The use of preservative-treated material with appropriate quality control certification.

- Design and construction of concrete foundations without cracks, to prevent concealed termite entry.

- Careful inspection to assure that design and specification features are not abrogated during construction.

- Finally,--although perhaps not the direct responsibility of the designer--, adequate maintenance of the flashings, coatings, earth-wood clearance, and other protective features are all very important to long, trouble-free service.

12.2 TERMITE-RESISTANT DESIGN

Design is extremely important in the prevention of termite damage. There are many species of termites in the United States, but for this discussion, we will break them down into three basic types; the drywood, the dampwood, and the subterraneans.

12.2.1 Drywood Termites

Drywood termites do not need significant moisture to survive. They can, and do, infest wood that is properly protected from moisture. Fortunately, they do not usually develop large colonies, and their damage rate is slow. Also, they expose their presence by dropping pellets that look like wood grains similar in size to grains of fine sand. They tend to get their start in splits, checks, and cracks, and their damage tends to be near the surface, running parallel to the grain. Prevention of drywood termite infestations is difficult, short of using of pressure-treated wood. They are found in 15% of the sub-areas, 33% of the garages, and 45% of the attics inspected in Southern California, indicating that framing or other wood that is not enclosed should be treated.

12.2.2 Dampwood Termites

Either moisture control or preservative treatment is effective in controlling damp wood termites. Because these treatments are essential to building protection, they are not discussed further here.

12.2.3 Subterranean Termites

There are several species of subterranean termites in the United States. We have chosen to discuss them by commenting on the Formosan. Control measures for it are effective for other species. The Formosan (subterranean) termite is without a doubt the most destructive wood-destroying insect we have to deal with. It is the most voracious of all termites in the United States, and is now established along the Gulf and Southeastern coasts as well as Hawaii. Its colonies are huge, often numbering in the millions of termites. These termites have a voracious appetite and will do extensive damage in short periods of time. They will also penetrate most common barriers to get to wood or cellulosic products. These termites have even been known to tunnel through cracks in concrete and eat through lead shielding. Their normal habitat is in underground nests. They require constant moisture to survive, but they can establish aerial nests if a continuous moisture source is available. A common method of termite attack is to build mud-walled shelter tubes up to the wood elements. They can totally destroy the interior of a wood member without any external sign of infestation. They also seem quite willing to sacrifice a significant portion of their colony to penetrate most wood treatment systems to reach the unprotected wood.

Formosan termites in urban centers will build aerial nests completely separated from the ground. In Honolulu, it is now common to find high-rise roof infestations, where they survive by collecting moisture from the rain and, in one documented case, by extracting the moisture from a bathroom exhaust system. As the range of these termites on the Mainland continues to expand, designers must heed this building terror.

To date, the best solution to the termite problem is effective (proper) pressure preservative treatment of the wood. Unfortunately and as discussed further in Chapter 13, preservative treatment has many variables: the chemicals, the wood species, heartwood content, moisture content when treated, and the treating process itself. In our view, the current standard recommendation for protection of wood from the Formosan termite is inadequate. We believe the chemicals must either repel it or kill it with enough speed to cause the termite to leave the treated wood. The Formosan is very efficient in locating points of entry through splits, checks, boltholes and field cuts. Once inside the treated zone, it will consume the untreated interior quite rapidly. Accordingly, treated wood must have an effectively protected shell that is thick enough so that it can, if necessary, provide minimal structural support and allow load transfer to redundant undamaged members. The ideal solution, of course would be to have the treatment fully penetrate the wood. This is obtained with most treatments in dry sapwood, but all sapwood boards are rare except in southern pine. The heartwood of many species is at best difficult to treat, but some pressure treating systems are more effective than others in this regard. Keeping these variables in mind, when the Formosan termite is, or may be, a risk during the structure's life the best readily available commercial standard is the treatment established for use in wood foundations, American Wood Preservers Bureau standard AWPB FDN. Unfortunately, this treatment is usually unavailable in the areas where the Formosan termite is a threat.

In a practical sense, the only currently available preservatives that might be used are CCA and ACZA. There is an accumulating body of evidence that suggests that ACZA is in some way repellent and/or has an enhanced toxicity to Formosan termites. Consequently, the authors suggest the following considerations that are possible and practical, but differ somewhat from the usual recommendations.

- **Penetration:** When possible, the treatment should penetrate the wood a significant depth. We believe 1/2 inch should be the minimum, although current standards require this depth only in material 5 inches and thicker.

Retention: Different pressure preservative systems need different levels of chemical retention to be effective. We will discuss only the two systems that are, to date, the most widely used in construction. Assay zones in commercial standards are misleading in that a heavy surface concentration of chemicals, with little penetration, can meet these standards. Accordingly, we believe the assay zone should be between 1/8 inch and 3/4 inch from the surface of the wood member. For wood above ground in typical wood frame construction, we believe the retention specified should be as follows:

- CCA: For minimal Formosan termite protection, the authors believe that 0.40 pounds per cubic foot (pcf) retention is required. The designer should be aware that recent tests indicate that as much as 0.60 pcf or 0.80 pcf may be required to stop the Formosan termite.

- ACA and ACZA: Recent studies of utility poles in use along with controlled field tests by the University of Hawaii, indicate that these treatments may be more effective than the more common CCA. However, we do not believe it prudent to accept the lower levels of these test results. Accordingly, a minimum of 0.25 pcf retention is recommended. Higher retentions should be required for more severe conditions of exposure.

- The designer's only other option is to keep termites from getting started. Since subterranean termites require either ground access to structures or moist wood conditions for airborne nesting, soil barriers and dry structures are essential. Most of this manual has dealt with keeping buildings dry and it is redundant to restate (recover) that topic here. Soil poisoning is still an option provided the soil is dry while being treated and also will be available for retreatment at periodic intervals. Another soil barrier technique has recently received new attention as the result of work by Tomashiro of the University of Hawaii. It consists of a layer of sand with individual grains between 1.7mm and 2.4mm in size. These grains are too large for the termite's jaws to grasp and the grains nestle too closely together for the termites to burrow between them. A 4 inch layer of this sand has proven to be an effective and permanent barrier, provided that it remains unbroken (See **Figures 12-1** and **12-2**).

  Control methods for the Formosan termite are also effective in controlling other subterranean species.

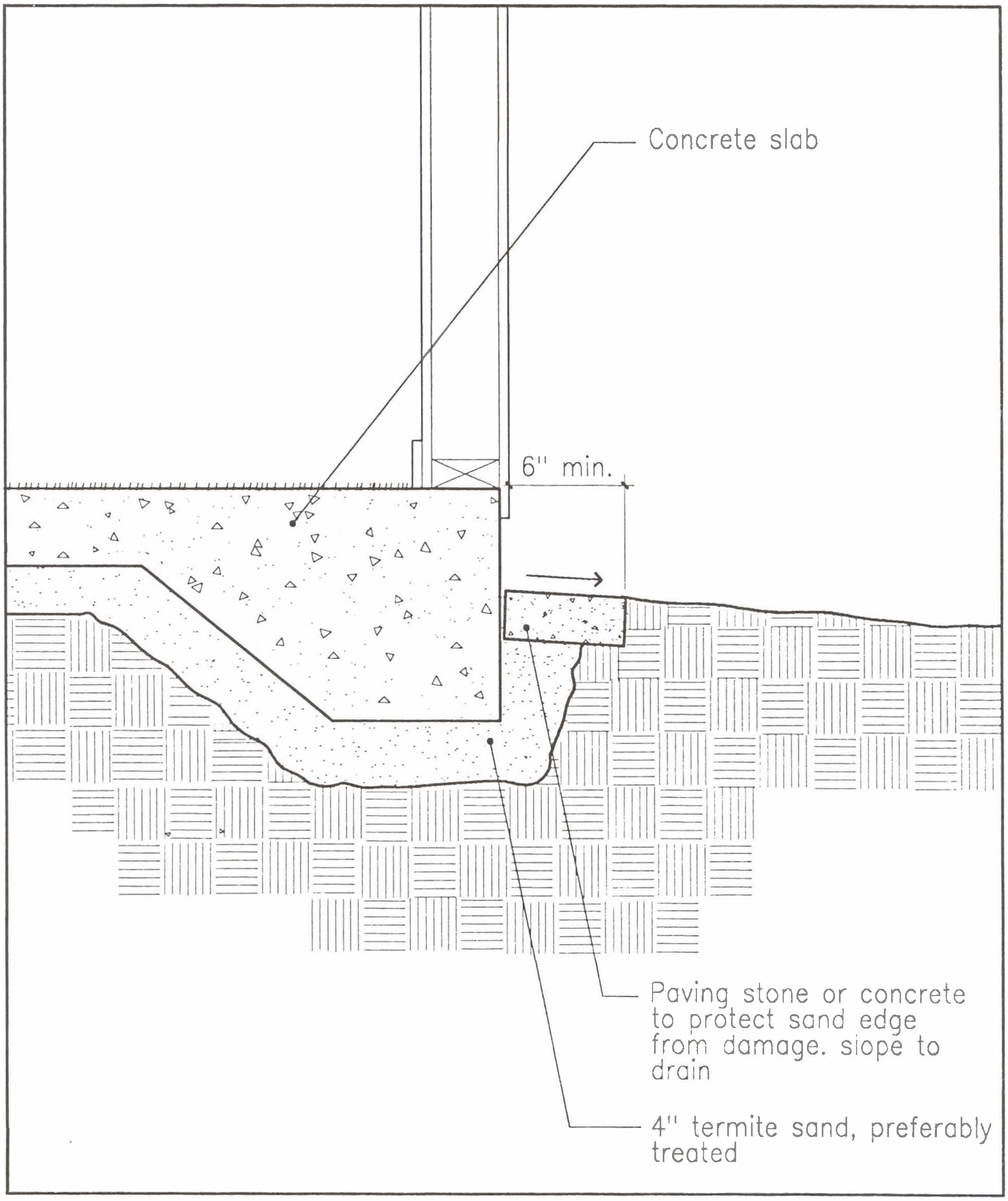
12.3 FOREST INSECTS

As noted earlier, these insect infestations are sometimes carried over into the finished lumber and are built into structures. This carryover usually can be traced to fire-killed or other salvage timber that is manufactured into lumber and sold without kiln drying. Occasionally, the infestation occurs during the storage of logs, after harvesting but before sawing into lumber. Again, normal kiln drying is effective in eliminating the pests. This infestation problem is limited to lumber; it does not occur in plywood, hardboard, particleboard, and similar products. A practical way to avoid it is to use lumber grade stamped "SDRY."

12.4 WOOD BORING BEETLES (powderpost, including false powderpost and deathwatch)

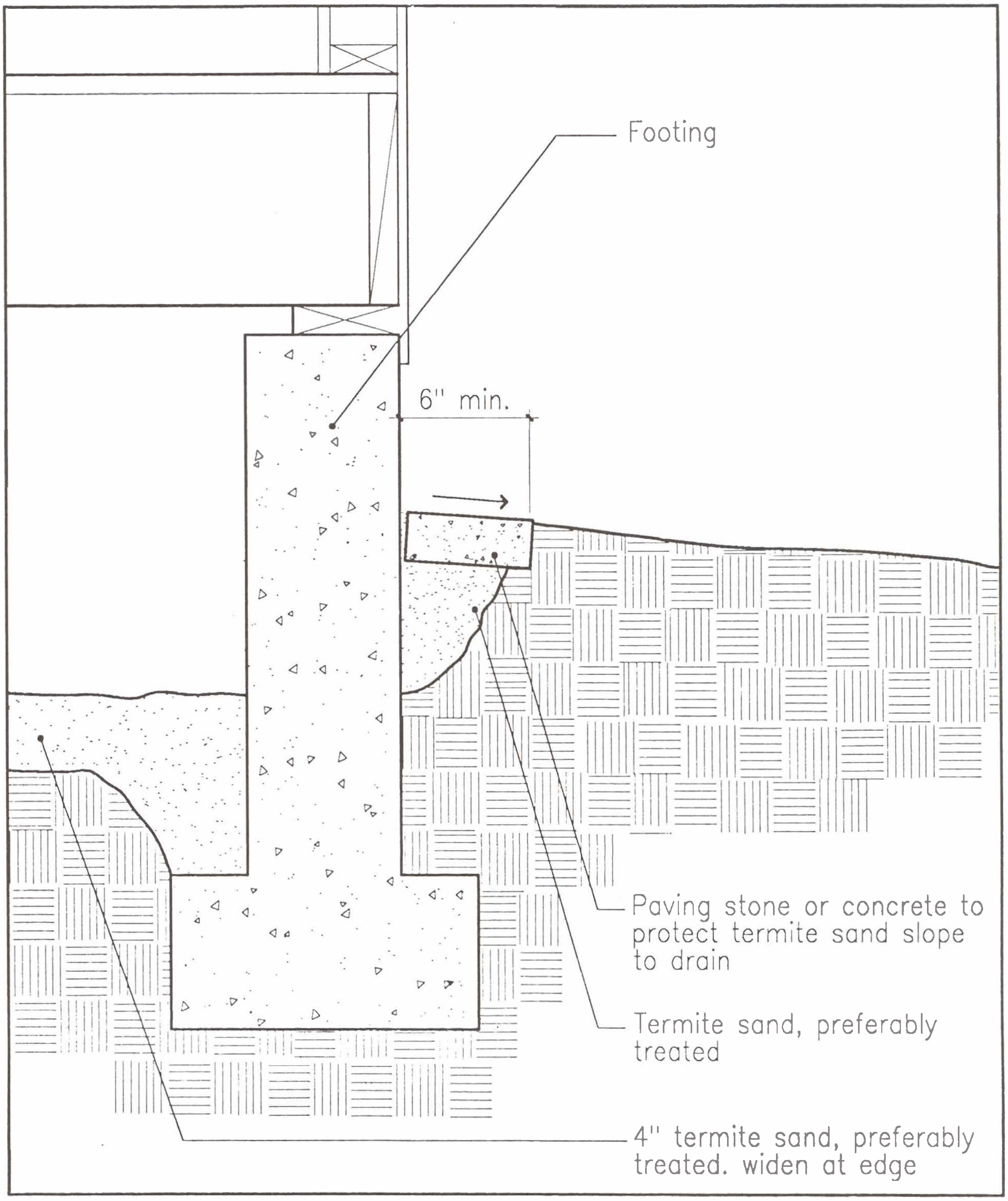
These insects comprise many species. The most common and most damaging is called the powderpost beetle, or sometimes the shothole borer, because of its ability to reduce wood to fine sawdust and because of the appearance of its exit hole. It can cause complete destruction of the wood because of its ability to reinfest the same area over and over again. The initial infestation may be built into the home, as with forest insects, or it may be brought in with household items such as furniture, baskets, carvings, or firewood. They may also fly in from nearby insect populations living in dead trees.

Control can be difficult. Infested wood for use in construction, such as cabinets, can usually be spotted by careful inspection during manufacture. Some insects require elevated humidity, so a vapor barrier film on the soil may be effective. The best possible control measures require knowledge of both the type of beetle involved and the extent of potential damage. Experts can often determine whether an infestation was introduced with construction materials or began after occupancy.



TERMITE PROTECTION DETAIL
SLAB FOUNDATION

Figure 12–1



TERMITE PROTECTION DETAIL
PERIMETER FOUNDATION

Figure 12–2

12.5 OTHER WOOD-DESTROYING INSECTS

Only a few other insects that use wood for food cause significant damage to structures. The old house borer has been identified in only one infestation in the West, in Stockton, California. The pest control specialists involved are confident that it was an isolated infestation which they completely eradicated. It does cause major losses in the East and elsewhere throughout the world and it is probable this insect will become established in the West sometime in the future. The old house borer depends on a minimum level of protein and on Vitamin B in the wood. Both can be destroyed by gamma radiation (although they may also be replenished by fungal growth), but this is not suggested as a method of control.

Some flatheaded borers, at least the golden buprestid, can occasionally reinfest wood in use, but this is apparently rare. Using kiln-dried wood will avoid this problem.

Two types of insects bore into wood for shelter but not for food. Carpenter ants are common and may cause extensive structural damage. Carpenter bees are less common and seldom cause structural damage, but may be noisy and their holes unsightly. Localized treatment of existing infestations is the usual method of control.