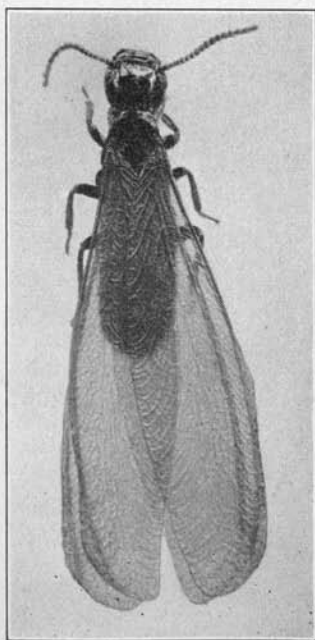


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Control of Termites in Buildings

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THE eastern subterranean termite (*Reticulitermes flavipes* Kollar) is a native insect and the only species of termite known to occur in Connecticut. These termites have infested buildings for many years, but it is only within the past eight that the large amount of damage they do here has been recognized. Since 1931 hundreds of infested buildings have been reported. The increase is due at least in part to changes in architecture of modern dwellings, such as use of filled masonry porches and building low to the ground, which have made the structures more susceptible to termite damage.

Buildings of all ages have been invaded, and the amount of injury has varied from destruction of a small piece of wood to extensive weakening of the entire first floor of a house. Some buildings are heavily infested and will be damaged seriously in the future. But there is no reason for exaggerated fears that *all* buildings are in immediate danger.

HABITS OF TERMITES

The termite colony is located in or near the soil. The workers are white, blind, sexless and about a quarter of an inch long (Figure 1). They do all the work of the colonies. The soldiers are similar but have large jaws used to attack enemies. The kings and queens are somewhat larger than workers. The queens lay the eggs, and are active throughout life. A single queen may deposit from 60 to 80 eggs a day, and there are many queens in a large colony.

Termites live entirely under cover. They eat the cellulose of dead wood or wood products, which they digest by means of bacteria and protozoa occurring in the digestive tract. They require an unfailing supply of water, usually obtained from moist soil. They are not intelligent, but are able to find food by constant searching.

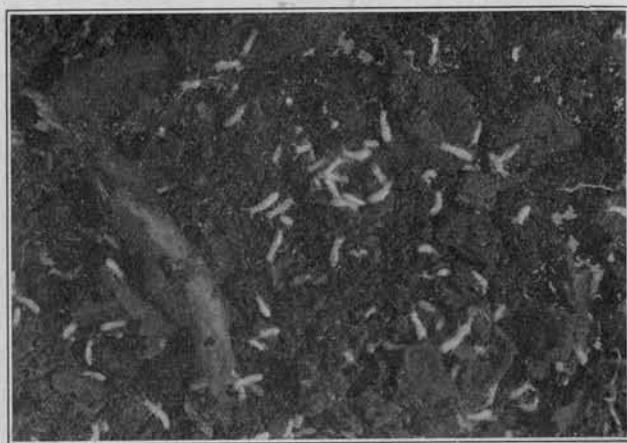


FIGURE 1. Some members of a termite colony: workers, supplementary queens and soldiers. Natural size.

During late winter and early spring swarms of dark brown or black winged termites may appear (see cover). They are sexual forms and attempt to start new colonies in moist soil. Swarms occurring in houses are considered harmless except as an indication that the building is infested.

HOW TERMITES ENTER BUILDINGS

Termites live in the ground and enter buildings: (1) through direct contact between wood and the soil; (2) through existing cracks or hollows in masonry or concrete (Figure 2); and (3) by covered shelter tubes built over the face of masonry or on pipes. In other regions they have attacked wood in partially excavated areas by building *unsupported* shelter tubes up from the ground. These are seldom more than a foot high and have not been seen in Connecticut buildings.

Direct contact with the soil includes wooden basement floors built over cinder or sand fill, wooden supporting posts and coal bin and partition studs set in place before concrete floors are laid, wooden basement window frames in contact with the soil, wooden porch steps, porch lattices and the like. The wooden framework adjoining earth-filled masonry porches and terraces is usually either actually in contact with the soil or separated only by a large crack. **Direct contact between wood and the soil is responsible for most of the termite infestations in Connecticut buildings. Termites have entered more than half of the infested modern dwellings through filled masonry porches and terraces (Figure 3).**

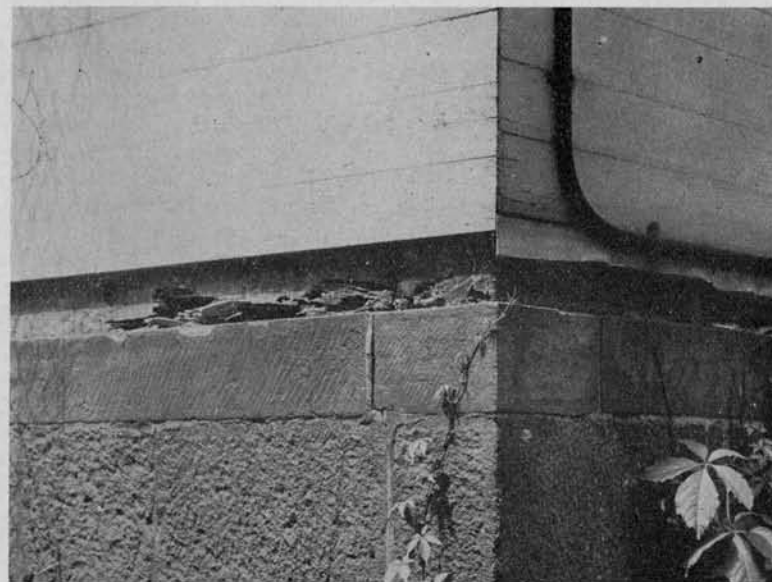


FIGURE 2. Sill of a house damaged by termites entering through a porous foundation. There was a large crack between the brownstone facing and the stone foundation.

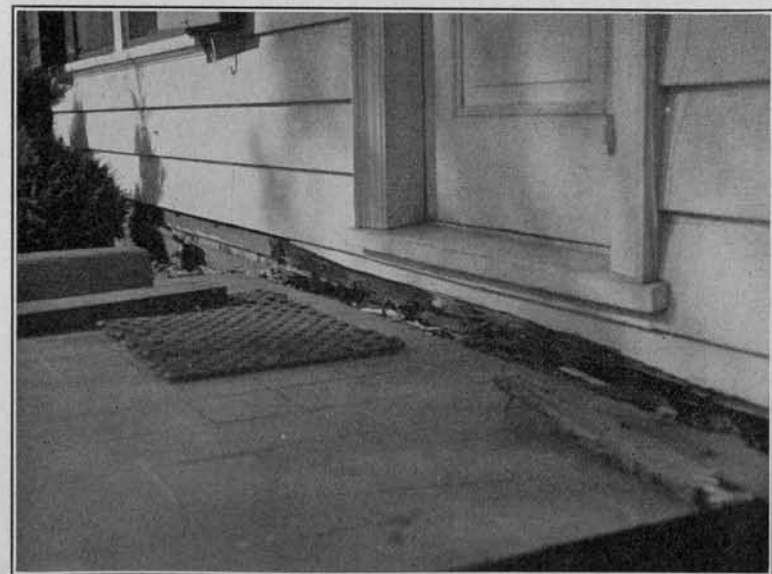


FIGURE 3. Termite damage to sill and sheathing adjoining masonry porch. Part of porch floor removed to make repairs.

Most masonry foundations—that is, those constructed of brick, stone or other units—have cracks or voids that will allow termites to enter. Occasionally concrete foundations have settling cracks large enough to admit termites, or wooden blocks used to hold the forms apart have been left in place and invite an infestation. Many old colonial houses were constructed on stone foundations which were little more than dry stone walls. In subsequent years the inside of the walls were “pointed” or plastered, so that the foundation appears to be well filled with mortar. Actually termites have easy access to the building through such foundations. In stuccoed buildings, the foundation stucco usually extends just below the ground. In many cases the stucco is either furred out or is loose enough to allow termites easy access to the woodwork above. Entry through cracks or voids in Connecticut buildings is common but occurs in fewer cases than through wood in direct contact with soil.

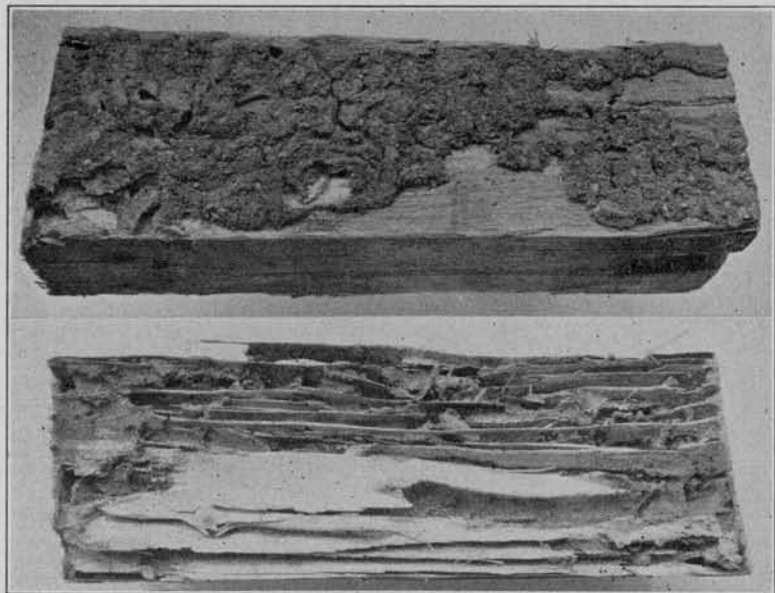


FIGURE 4. Above, external appearance of a block of infested wood. Below, section of the same block showing character of termite burrows.

Entry through shelter tubes constructed up over foundations is always a possibility, but to date we have observed only two cases, in a total of almost a thousand, in which the original entry was so made in Connecticut.

FINDING TERMITES IN BUILDINGS

Examination of wood in contact with the ground is the first step in finding whether or not a building is infested by termites. If present, some termites, or at least termite burrows, may be found near the ground line. Susceptible wooden construction may be examined by punching it with

a sharp instrument such as a screwdriver. Particular attention should be paid to wooden construction adjoining filled masonry porches. In termite burrows (Figure 4) the workers have removed the soft part of the wood, leaving the hard section of the annual ring. Termite burrows contain more or less wood paste resembling commercial wood putty.



FIGURE 5. Termites constructed this shelter tube from wood to the ground in a partly excavated area (formerly exterior).

The brown, earth-like shelter tubes of termites are frequently seen on infested wood or on the foundations of infested buildings (Figure 5).

The occurrence of swarms of winged termites during late winter or early spring is sometimes the first noticeable sign of an infestation.

PREVENTION OF ENTRY AND CONTROL OF TERMITES IN BUILDINGS

Methods of preventing termites from entering buildings and of controlling those already in are based on well-known facts about their habits. The use of ordinary insecticides to kill termites has not been successful. They are not attracted to poisoned baits, and they cannot be reached easily with sprays or dusts. The most effective preventive is to create a barrier between the soil and the wooden portions of the building. This same barrier serves to control the termites in the building by cutting them off from their usual source of moisture, the soil. As a result, they die.

To make a termite-resistant barrier it may be necessary to change the construction of a building. In many instances it is advisable to supplement the structural changes by use of chemicals.

There are certain materials that termites cannot penetrate and these are useful in such a job.

Termites can penetrate: (1) lime mortar; (2) ordinary masonry work of brick, stone or hollow blocks; (3) tar and asphalt compounds; (4) poisoned paint films; (5) roofing felt, and (6) cracks in solid concrete.

Termites cannot penetrate: (1) solid concrete without cracks or solid unit masonry laid solid in cement mortar, or (2) wood treated by a standard pressure process, using standard or equivalent wood preservatives. They can, however, construct shelter tubes over either of these. Termites cannot penetrate non-corroding sheet metal, and they cannot construct shelter tubes up over the edges of properly installed metal termite shields.

Each infested building must be considered as an individual case requiring individual treatment. The exact course to be followed depends on: (1) the number of termites present and the amount of damage done; (2) the type of construction; (3) the quality of construction and (4) the permanence of the building. It is unnecessary and unwise to spend large sums of money preventing termite damage to cheap buildings of temporary nature. Some buildings have so many possible points of entry that nothing short of a complete termite shield will prove satisfactory. The following procedure is suggested:

1. The extent of the termite damage should be determined. It is usually necessary to employ a carpenter to open up parts of a building for examination.
2. The damaged portions should be examined carefully to determine just how the termites entered.
3. Methods of blocking the points of entry and other susceptible places should be devised.

It should be understood that unless a building is actually in danger of collapsing there is no need for great speed in doing the work. Buildings dangerously weakened should be shored up temporarily until a decision is reached in regard to repairs and preventive measures.

NECESSARY CONTROL MEASURES

It is difficult to prepare definite suggestions for termite control on account of variations in conditions. Some general statements can be made, however, to guide home owners in deciding what to do about an infested

building. The following outline takes into account many of the conditions, and is arranged according to the type of control measures suggested:

1. A complete metal termite shield should be installed in permanent buildings of considerable value
 - a. If the owner desires complete and permanent protection from termite attacks.
 - b. In buildings on dry stone or hollow concrete block foundations in which termites have caused serious damage.
 - c. In stucco, brick or stone-veneered buildings heavily infested by termites.*
 - d. In heavily infested buildings built low to the ground or with many masonry porches or terraces.
2. A combination of structural changes and chemical treatment in permanent buildings with reasonably resistant foundations and little termite damage. (This includes about 7 out of 10 infested modern buildings.)
3. A combination of necessary structural repairs for safety, and chemical treatment
 - a. In permanent buildings of small value such as summer cottages of light construction, garages, storage sheds, and barns.
 - b. In temporary buildings, with replacement expected within 5 to 10 years. In many cases it is advisable to do no termite control work in buildings of this type.
4. Chemical treatment only may be used in modern, fireproof structures in which little wood is present.

Some details of these types of control measures are given in the following paragraphs.

Metal Termite Shields

A metal termite shield (Figure 6) is a strip of copper or other non-corroding metal inserted over or through the foundation at least six inches above the outside grade level and below all first-floor framework. It is usually installed in sections joined by lock joints and forms a complete sheet of metal without holes or cracks. There should be a projection of at least two inches on interior walls and one and one-half inches on exterior walls. This projection is usually bent down at an angle of 45°. All permanent basement partitions are protected by shields which are attached to the main shield. In finished basement rooms or on the exterior walls of masonry buildings an extension of the shield is not always necessary.

Termite shields can be designed for any infested building. They are usually installed by taking the weight of the building on shoring, removing the top of a section of foundation, setting a section of shield in place, and replacing the foundation. This type of construction is expensive. The actual cost of setting shields in Connecticut dwellings has been from \$5 to \$10 a running foot of foundation. The cost is higher in brick- or stone-veneered, or stucco on wooden framework, types of construction. Obviously such costs are justified only in permanent buildings of considerable

*In buildings of this type it is sometimes necessary to open up plastered walls to allow the framework to dry sufficiently to kill termites.

value, or for those home owners who want to get rid of the termites permanently by proven methods.



FIGURE 6. Installation of a metal termite shield in an infested house. Susceptible cellar hatching shielded from the building.

It is evident that proper shield installation requires very careful work. In actual practice in Connecticut, construction companies specializing in shield installation have done more satisfactory work than the average contractor working without expert supervision.

STRUCTURAL CHANGES TO BE SUPPLEMENTED BY CHEMICAL TREATMENTS

Certain structural changes necessary to make termite entry difficult are believed essential in any building worth repairing. Most of them deal with breaking direct contact between wood and the soil.

1. Cut off any wood in contact with the soil and place on a concrete base extending at least 6 inches above the ground.
2. Provide at least 18 inches clearance between any pipes, air ducts, etc., attached to the floor above and the soil in any unexcavated areas.
3. Provide adequate ventilation for all partially excavated areas.
4. Replace wooden basement window frames with metal frames.
5. Replace wooden bearing posts in the basement with lally columns or place the posts on a concrete curb extending at least 6 inches above the floor.
6. Place all permanent wooden basement partitions on 6-inch concrete curbs.
7. Replace any wooden basement floors with materials not susceptible to termite damage.

8. Protect the woodwork adjoining masonry porches with metal termite shields* (Figure 8 B).

Not all infested buildings will require all these changes but the ones that apply should certainly be made. In addition there should be a thorough chemical treatment of the soil, particularly around the former points of entry, to assist in control. In 7 out of 10 infested buildings this course seems to be logical and in actual practice has been reasonably successful.

REPAIRS FOR STRUCTURAL SAFETY

In permanent buildings of small value and in temporary structures, expensive changes or chemical treatments are not considered economical. In such cases repairs may be necessary to keep the building safe for use. If possible they should be made with termite-resistant materials which will provide adequate structural support, although they will not prevent further damage. For instance, in summer cottages supported by wooden posts, brick piers may be used to replace the posts. In cheap houses built directly on the ground, any sill replacement may be of pressure-creosoted wood.

If the building is valuable enough a chemical treatment may be used. In such cases chemical treatments may not be entirely successful, but they should at least retard damage from termites.

CHEMICAL TREATMENTS

The use of chemical treatments to kill termites or to prevent their entry into buildings has not been entirely successful. Two types of treatments have been used: (1) chemical treatment of the soil around the foundations of a building and (2) chemical treatment of the timbers of a building, particularly those near the foundation. The soil treatments are either poisonous chemicals such as arsenicals, or repellents such as creosote. The timber treatments are usually made with materials known to have value as wood preservatives and diluted in a penetrating carrier. Both types of chemical treatments are available to home owners. As a rule the companies making them insist on certain structural changes which approximate the minimum changes listed on page 8.

The standard method of applying a soil treatment is to dig a narrow trench, from one to three feet deep, around the foundation. The treating material is placed in this trench and is expected to penetrate the soil to the bottom of the foundation. The trench is then filled, the fill being treated as it is added. If arsenical materials are used, it is expected that the termites will consume arsenic when they take in moisture and will be killed. If repellents such as creosote are used, it is expected that termites will not go through the treated soil.

Sodium arsenite is one of the common materials used for soil treatment. The rate is one pound in 12 to 25 gallons of water, in such volume that one

*Some termite operators tunnel underneath masonry porches and break the contact between wood and the soil. The soil is then treated with a soil poison and the tunnel left open for inspection. If this procedure, which is really a combination of excavating, soil treatment and inspection, is followed, it should be satisfactory.

pound of sodium arsenite is applied to each 8 or 10 linear feet of trench. Sodium arsenite is very poisonous, and is water-soluble. It should not be applied near any well or spring which is used for drinking water.

Creosote is usually mixed with an equal volume of kerosene, and the mixture applied at the rate of one gallon in 5 linear feet of trench.

Shrubbery might be protected from soil-treating chemicals by lining the outside of the trench with roofing paper. However, there have been reports of damage to shrubbery even after this precaution.

Soil treatment is a valuable aid in termite control, but it has its limitations. In actual practice it is difficult to saturate the soil around a building. Many attempts have been made to poison the soil under masonry porches by punching holes either through the porch floor or the foundation. The results have not been satisfactory.

Treatment of timbers in place in a building also has its limitations. It is difficult to penetrate some kinds of wood, such as Douglas fir. Moreover, the petroleum carriers used will not penetrate damp wood. Some of the treating materials used are inflammable. Every home owner should insist on non-inflammable materials for timber treatment.

As stated above, chemical treatments are of most value when accompanied by structural changes to exclude termites. They may be used alone in temporary buildings of small value or even in permanent structures lightly infested by termites. In fireproof masonry buildings soil treatments should be very effective.

ARE TERMITE "EXPERTS" NEEDED?

In making repairs to infested buildings and in installation of termite shields it is advisable to employ concerns familiar with termite-resistant construction or to have the work done under supervision of an experienced man. Soil treatment is less technical but must be done properly to be effective. Treatment of timbers in place requires special equipment and preferably well-trained men.

TERMITE "GUARANTEES"

Much of the control work done with chemicals is accompanied by "guarantees", sometimes covered by "insurance". These guarantees as a rule give no assurance that termites will be eliminated. They simply state that if termites appear in the building within a specified time further treatment will be made without additional cost. In effect, this means that the home owner is paying in advance for reinspection of his property and any further treatment necessary.

REINSPECTION OF INFESTED BUILDINGS

After any termite control work has been done it is always advisable to reinspect the building periodically. This may be done twice during the first year and annually thereafter. Especially in heavy infestations, the termites make every effort to re-enter the building. If they are found, further chemical treatment or more reconstruction may be necessary.

OTHER INSECTS DAMAGING WOOD OR RESEMBLING TERMITES

Several insect pests either damage wood in buildings or are frequently confused with termites.

The European pavement ant (*Tetramorium caespitum* L.) has winged adults about the size and color of termites. These adults come out of ant nests located under basement floors or alongside of foundations. They have a "wasp-waist" not present on termites and usually appear in much smaller numbers than termites. They do no damage to wood in buildings.

The carpenter ant (*Camponotus herculeanus pennsylvanicus* DeG.) frequently nests in wood in buildings. These ants cannot digest wood, and they cast away the "sawdust" from their burrows. The accumulation of this sawdust is frequently the first indication of carpenter ant infestations.

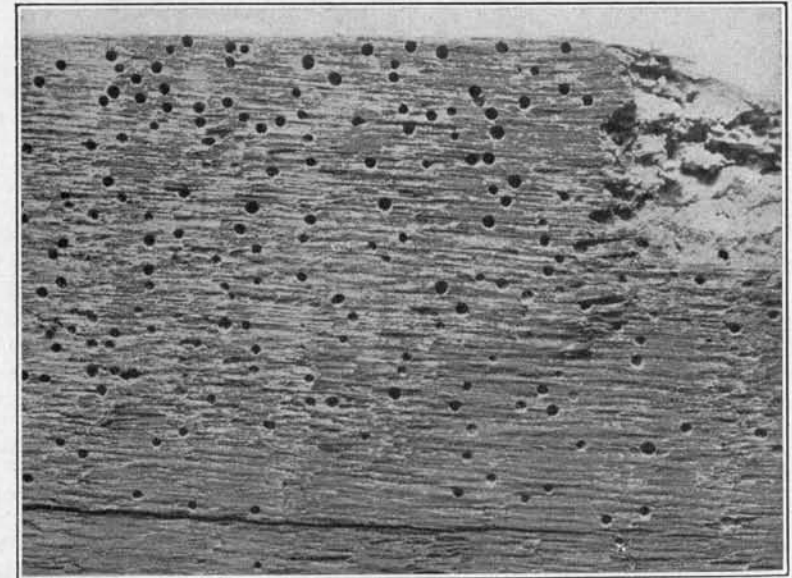


FIGURE 7. Wood damaged by the furniture beetle (*Anobium punctatum* DeG.). Natural size.

Carpenter ant burrows are cleaner than termite burrows. Carpenter ants do not deposit any material in the burrow, while termite burrows always contain some partially digested wood resembling wood putty. Carpenter ants are easily killed by use of a thallium sulfate ant bait.

Powder-post and Anobiid beetles occur in many Connecticut buildings. These insects feed in the wood and reduce it to a fine powder. The adult beetles emerge through round holes in the surface of the wood (Figure 7). Some species are capable of causing serious damage. They can be controlled by painting the infested wood with any one of several available materials. A mixture of 10 parts kerosene and 90 parts spirits of turpen-

tine has been suggested by English authorities. The following formula was developed for use in old buildings in England:

Orthodichlorobenzene	50 percent
Kerosene	47 percent
Barium oleate	3 percent

This mixture should be sprayed or brushed on unfinished surfaces of infested wood as long as it will soak in.

The weevil *Hexarthrum ulkei* Horn has been found in several buildings in Connecticut. The damage resembles that of powder-post beetles and the control measures are the same.

Wood attacked by fungi (erroneously called "dry rot") is much different in appearance from wood attacked by termites. Rotten wood contains no burrows although the surface may be checked. Wood kept constantly wet and in an advanced stage of decay may be tunneled by sowbugs. These tunnels do not resemble termite burrows.

Under some conditions the old tunnels of powder-post beetles and even the chambers cut by carpenter ants closely resemble termite burrows. The Experiment Station will examine any samples of damaged wood and give an opinion as to the cause of the damage.

ADDITIONS TO EXISTING BUILDINGS

It is advisable to make any additions to existing buildings, whether infested by termites or not, of termite-resistant construction. Practically all of the suggestions made for such construction are in accord with the best building practices. In most cases the adoption of these suggestions adds little to the cost of construction. Furthermore, any extensive alterations or repairs to buildings might well be made using termite-resistant materials and methods.

CONSTRUCTION OF NEW BUILDINGS

It is evident from the facts given in this publication that the logical time for termite control is during construction of a building. At that time the relative cost of termite-resistant materials and methods is at a minimum. Furthermore, the expense is readily justified in longer life of the building and less cost of upkeep, because many of the methods aid in controlling wood rots. The continuing reports of termite infestations in buildings from one to five years old are sufficient proof that termite resistant construction is a necessity. It is believed that Connecticut home owners will save thousands of dollars by the adoption of such construction.

PREVENTIVE MEASURES

Preventive measures should be used on every building site. **All stumps, old fence posts, waste wood on the ground and the like must be removed and destroyed. During construction all form boards on footings and foundations and all grading stakes should be removed and all wood kept out of the backfill.** This is very important and yet adds little to the expense of building. Many buildings have been infested from stumps and boards buried on the premises.

Termite-Resistant Construction

The following specifications are suggested for Connecticut buildings:

1. Foundations shall be of monolithic concrete construction or of solid unit masonry laid solid in cement mortar and capped below woodwork with at least one inch of cement mortar.
2. The top of the foundation shall be at least 12 inches above the final grade level.
3. Foundations adjoining masonry porches or terraces shall be of monolithic concrete with an extra thickness to avoid a crack between the fill and wooden portions of the building (Figure 8C).

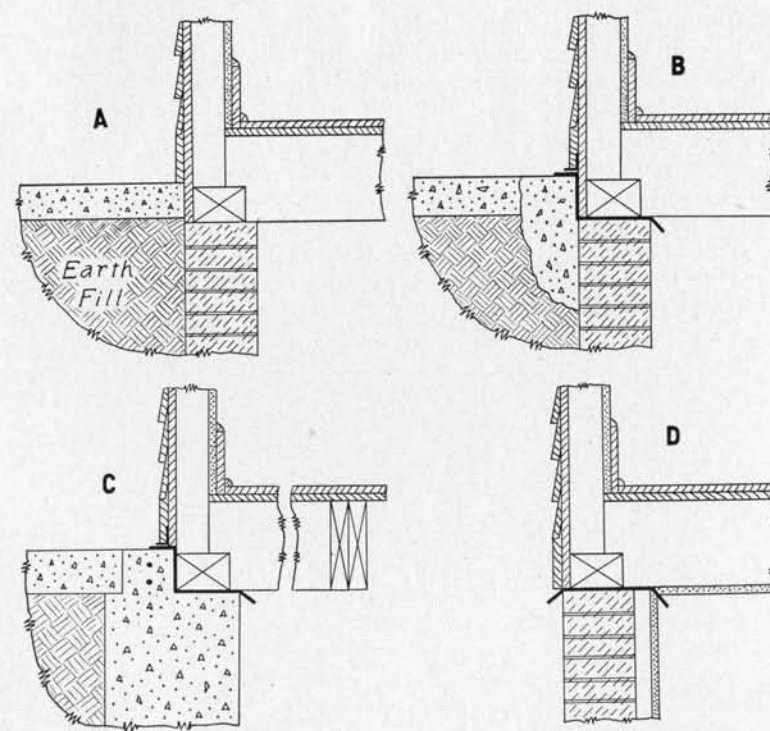


FIGURE 8. A. Cross-section of usual type of filled masonry porch which allows termites to enter the sheathing and sill. B. Reconstruction of usual type of porch, showing in cross-section the metal shield protected by a layer of concrete. C. Cross-section showing foundation with extra thickness adjoining masonry porch. May be used without shield. Also illustrates use of short joists at right angles to the sill to facilitate inspection. D. Metal shield used to protect woodwork above furred-out basement walls.

4. There shall be at least 18 inches clearance between the ground and any pipes, air ducts, etc., attached to the floor above in any partially excavated areas.
5. Partially excavated areas shall be provided with ventilation either from the basement or from the outside.

6. No wooden construction shall be used below the first floor framework with the following exceptions:
 - a. Basement stairs may be wooden and shall be set *on* and not in the concrete floor.
 - b. Basement partitions may be wooden provided they are set on a concrete curb extending at least 6 inches above the basement floor and are separated from basement walls by a 3-inch concrete plinth.
7. If specifications of items 1, 2, 3 or 6 are altered, a metal termite shield (described on page 7) shall be installed. No alterations allowable in items 4 and 5.

In the average six-room house, the extra cost of the changes from usual construction methods should not exceed \$50. Even in more pretentious dwellings the extra cost will not be large unless the house is closer than one foot to finished grade, or unless hollow masonry units are used in foundations. In such buildings a properly installed termite shield should provide protection for the useful life of the building. Even if such a shield cost 5 percent of the total building estimate, its use would be good insurance.

Basement game rooms and the like present a problem for which no easy solution has been proposed. Covering basement walls and floors with untreated wood invites termite damage because of the difficulty of eliminating all cracks in floors and between floors and walls. Probably the least troublesome solution is to use pressure-treated lumber as much as possible and provide a shield between the basement construction and the framework of the house (Figure 8D).