Wood-Destroying Insect
Diagnostic Inspection

Category 12

Study Guide for Commercial Applicator

Jan. 2007 - ODA - Pesticide and Fertilizer Regulation- Certification and Training Section
Acknowledgements

The Ohio Department of Agriculture would like to thank the following entities that helped develop this study manual. Their time, effort, and expertise is greatly appreciated.

Authors

Susan Jones
The Ohio State University Extension – Entomology

Joanne Kick-Raack
The Ohio State University Extension – PAT

William Pound
Ohio Department of Agriculture

Members of the Ohio Pest Control Assoc.

Editors

Kelly Boubary – ODA

Stephanie Boyd - ODA
# OHIO WOOD DESTROYING INSECT INSPECTION PROGRAM

## TABLE OF CONTENTS

<table>
<thead>
<tr>
<th>Introduction</th>
<th>4</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chapter 1</td>
<td>Training and Licensing Requirements for WDI</td>
</tr>
<tr>
<td>Chapter 2</td>
<td>Understanding the Real Estate Transaction</td>
</tr>
<tr>
<td>Chapter 3</td>
<td>Reportable Wood-Destroying Insects of Ohio</td>
</tr>
<tr>
<td>Chapter 4</td>
<td>Other Insects and Fungi</td>
</tr>
<tr>
<td>Chapter 5</td>
<td>Understanding Basic Construction Terminology</td>
</tr>
<tr>
<td>Chapter 6</td>
<td>Inspecting Structures</td>
</tr>
<tr>
<td>Chapter 7</td>
<td>Reporting the Results of an Inspection</td>
</tr>
<tr>
<td>Chapter 8</td>
<td>Recommending Treatments</td>
</tr>
<tr>
<td>Appendix</td>
<td>Guidelines for Soil Treatments</td>
</tr>
<tr>
<td>Appendix A</td>
<td>Glossary of Terms</td>
</tr>
<tr>
<td>Appendix B</td>
<td>Chapter 921 of the Ohio Revised Code (ORC)</td>
</tr>
</tbody>
</table>
Ohio Wood-Destroying Insect Inspection Program

Introduction
The Ohio Department of Agriculture receives numerous inquiries and complaints each year from Ohio consumers and other interested parties with concerns about Wood-Destroying Insect (WDI) inspections and reports performed during the process of real estate transactions. Based on this fact, the Ohio Department of Agriculture and the Ohio Pest Control Association have partnered to develop and implement a mandatory training program that will establish training guidelines and provide uniform inspection procedures for all individuals performing WDI inspections and uniform guidelines for reporting the results of these inspections for real estate transactions.

This manual is to be used during the mandatory classroom portion of the training program. The trainer will be using a Power Point presentation for illustrating situations that an inspector will encounter during an inspection, and further to demonstrate how the guidelines for inspecting and reporting are to be considered and implemented. Completion of this program will be necessary before any individual can become licensed in the WDI category.

The presence of WDI in a structure can present a significant hazard due to structural damage if infestations are undetected and/or left untreated. Such damage could result in the devaluation of a property/structure or substantial costs for repairs. The professional WDI inspector has an important role in performing a visual inspection of open and accessible areas and accurately reporting their findings as part of the purchase and transfer of real estate. The goal of this training program, associated administrative rules, and subsequent licensing by the Ohio Department of Agriculture is to improve the proficiency of individual WDI inspectors in Ohio and provide improved services to consumers in Ohio.

This program is designed to train the inspector about the basic principles concerning the inspection, detection, and reporting of WDI. However, additional training in the field with a licensed inspector is helpful to gain experience and become more proficient. The inspector can learn more about WDI inspections, treatments and reporting by viewing videotapes and literature, as well as by attending training programs. Some of the resources readily available include:

- Mallis Handbook of Pest Control
- Scientific Guide to Pest Control Operations
- National Pest Management Association - Pest Management Library - Subterranean Termites, Other Wood-destroying Pests and Wood Decay in structures.
- National Pest Management Association - Field Guide
- National Pest Management Association - Introduction to Wood-destroying Insects
- Manufacturers Videotapes and Magazines
- The Ohio Pest Control Association - Training Seminars
- The Ohio State University - Training Seminars
CHAPTER ONE

Training and licensing requirements for individuals conducting Wood Destroying Insect (WDI) inspections for Real Estate transactions.

This chapter details the requirements and the processes necessary to become licensed to conduct WDI inspections for Real Estate transactions in Ohio. These topics include:

- Obtaining a Commercial Applicator (WDI Inspector) License
- Obtaining a Pesticide Applicator Business License (WDI Business License)
- Maintaining these Licenses

The legal authority detailed in Chapter 921 of the Ohio Revised Code and Chapter 901 of the Ohio Administrative Code used to administer the WDI inspection program is provided in Appendix B located at the back of this manual.

A. Commercial Applicator License

All individuals who intend to conduct WDI Diagnostic inspections are required to obtain a Commercial Applicator (CA) license. Despite the terminology, this license is required before individuals can perform WDI inspections. The steps to obtaining this license include:

1. **Filing A Pesticide License Application**
   The first step in the licensing process is to complete the “Ohio Pesticide License Application.” This application initiates the licensing process and provides the ODA all of the necessary contact information for you and your business. Page 2 of this application allows applicants to request study materials for the categories(s) for which they wish to become licensed. Following receipt of the application and payment, category-specific study material is sent to the applicant.

2. **Paying the Commercial Applicator License Fee**
   The current fee to become licensed to conduct WDI inspections is $35.00 per licensing cycle. This fee is valid only for the current licensing period (October 1st to September 30th of the following year) and must accompany the “Ohio Pesticide License Application.”

3. **Attending the Mandatory 5-hour WDI Diagnostic Training**
   All individuals who desire to become licensed to conduct WDI inspections are required to complete a mandatory 5-hour training program. This program is offered through cooperative programs by the Ohio State University and the Ohio Department of Agriculture 3-4 times each calendar year. These programs are the only programs approved for satisfying this training requirement.

4. **Passing the Exams**
   Once you have received and reviewed the Core study material, WDI (Category 12) study material and attended the 5-hour training program you should be adequately prepared to take the certification exams. To become licensed to conduct WDI inspections, applicants are required to pass the Core and Category 12 exams. If applicants desire to apply pesticides for the control of wood destroying insects, licensure
in additional categories is required. Categories can be added to existing licenses at any
time at no additional charge.

B. Business License
Effective July 1, 2004 all businesses with individuals conducting WDI inspections are required
to maintain a current Pesticide Application Business License (PABL). To process a PABL the
following requirements must be met:

1. **Filing a Business License Application**
   Businesses can apply for the PABL using the Ohio Pesticide License Application.

2. **Paying the Business License Fee**
   Pesticide Application Business License fee is $35.00 per licensing period and must
   accompany the PABL application. This fee is only valid for the current licensing
   period. The business-licensing period extends from October 1st to September 30th of the
   following year.

3. **Providing proof of Errors & Omissions Insurance**
   Businesses are required to maintain Errors & Omissions insurance for the PABL to be
   issued and remain valid. The applicant’s insurance agent is required to submit to ODA
   a Certificate of Insurance (COI) indicating a valid Errors & Omissions policy is in effect
   with minimum limits of $50,000 per occurrence and $100,000 aggregate.

C. Maintaining Your License
Once you have obtained your Commercial Applicator’s license and Business license, various
requirements must be fulfilled to keep these licenses active.

1. **Annual License Renewal**
   Inspectors are required to annually renew their Commercial Applicator and Pesticide
   Application Business Licenses. The licensing cycle on both extend from October 1st to
   September 30th of the following year. The ODA mails renewal notices to current
   license holders each year in late July.

2. **Recertification**
   All Commercial Applicator licensees are assigned a 3-year period in which to fulfill
   their recertification (i.e. continuing education) requirement. The ODA requires each
   licensed WDI inspector to complete 5 hours of recertification every 3 years. These 5
   hours must include:
   - Core Training – 1.0 hour minimum
   - Category Training – 0.5 hour minimum in each category on the license. Currently
     Category 12 (WDI) has no category specific training. WDI inspectors are encouraged to
     fulfill this requirement with Category 10b (Termite) training.
   - Total of 5 hours of approved training

   Licensing holders who do not complete 5 hours of recertification credits during their 3-year
   period are required to retest.
Chapter 921 of the Ohio Revised Code (ORC) and Chapter 901 of the Ohio Administrative Code (OAC) provide the guidance to administer the Wood Destroying Insect inspection program in Ohio. Key sections in these chapters specific to the WDI program are detailed in Appendix B located in the back of this training manual and are provided for your information.

### Wood Destroying Insect Inspection Report

#### Section I. General Information

<table>
<thead>
<tr>
<th>Inspection Company, Address &amp; Phone</th>
<th>Company’s Business Lic. No.</th>
<th>Date of Inspection</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Address of Property Inspected</th>
<th>Structure(s) Inspected</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
</tr>
</tbody>
</table>

#### Section II. Inspection Findings

This report is indicative of the condition of the above-identified structure(s) on the date of inspection and is not to be construed as a guarantee or warranty against latent, concealed, or future infestations or defects. Based on a careful visual inspection of the readily accessible areas of the structure(s) inspected:

- [ ] A. No visible evidence of wood destroying insects was observed.
- [ ] B. Visible evidence of wood destroying insects was observed as follows:
  - [ ] 1. Live insects (description and location):
  - [ ] 2. Dead insects, insect parts, frass, shelter tubes, exit holes, or staining (description and location):
  - [ ] 3. Visible damage from wood destroying insects was noted as follows (description and location):

**NOTE:** This is not a structural damage report. If box B above is checked, it should be understood that some degree of damage, including hidden damage, may be present. If any questions arise regarding damage indicated by this report, it is recommended that the buyer or any interested parties contact a qualified structural professional to determine the extent of damage and the need for repairs.

Yes [ ] No [ ] It appears that the structure(s) or a portion thereof may have been previously treated. Visible evidence of possible previous treatment:

The inspecting company can give no assurances with regard to work done by other companies. The company that performed the treatment should be contacted for information on treatment and any warranty or service agreement which may be in place.

#### Section III. Recommendations

- [ ] No treatment recommended: (Explain if Box B in Section II is checked)

- [ ] Recommend treatment for the control of:

#### Section IV. Obstructions and Inaccessible Areas

The following areas of the structure(s) inspected were obstructed or inaccessible:

- [ ] Basement
- [ ] Crawlspace
- [ ] Main Level
- [ ] Attic
- [ ] Garage
- [ ] Exterior
- [ ] Porch
- [ ] Addition
- [ ] Other

The inspector may write out obstructions or use the following optional key:

- [ ] 1. Fixed ceiling
- [ ] 13. Only visual access
- [ ] 2. Suspended ceiling
- [ ] 14. Cluttered condition
- [ ] 3. Fixed wall covering
- [ ] 15. Standing water
- [ ] 4. Floor covering
- [ ] 16. Dense vegetation
- [ ] 5. Insulation
- [ ] 17. Exterior siding
- [ ] 6. Cabinets or shelving
- [ ] 18. Window well covers
- [ ] 7. Stored items
- [ ] 19. Wood pile
- [ ] 8. Furnishings
- [ ] 20. Snow
- [ ] 9. Appliances
- [ ] 21. Unsafe conditions
- [ ] 10. No access or entry
- [ ] 22. Rigid foam board
- [ ] 11. Limited access
- [ ] 23. Synthetic stucco
- [ ] 12. No access or entry:
  - [ ] 24. Duct work, plumbing, and/or wiring

#### Section V. Additional Comments and Attachments

(These are an integral part of the report)

**Signature of Seller(s) or Owner(s) if refinancing.** Seller acknowledges that all information regarding WDI infestation, damage, repair, and treatment history has been disclosed to the buyer.

**Signature of Buyer.** The undersigned hereby acknowledges receipt of a copy of both page 1 and page 2 of this report and understands the information reported.

X

Form NPMA-33 9/9/04 © 2004 National Pest Management Association. All Rights Reserved. No reproduction of this form is permitted without the express permission of NPMA.

Form NPMA-33 is obsolete after 12/31/04.
CHAPTER TWO

UNDERSTANDING THE REAL ESTATE TRANSACTION FROM A WDI INSPECTOR’S PERSPECTIVE, INCLUDING PARTIES TO THE TRANSACTION, AND RESPONSIBILITIES OF THE PARTIES

An inspection for WDI which is requested as part of a Real Estate Purchase Contract has an inherent involvement of many parties. Each party and/or person involved has different reasons for their involvement, but all persons involved have responsibilities to several of the other parties.

While there are variations in the wording of Real Estate Purchase Contracts throughout Ohio, generally most refer to an “Inspection or Inspections” section wherein they state:

“The Seller shall, at Seller’s expense, have the property inspected for WDI by a qualified inspector and furnish a report of the findings.”

Some contract variations are as follows:

1. Report to be on an approved form – such as NPMA-33 (which is the current approved form by HUD FHA/VA)
2. Inspection to be performed by an Ohio-licensed applicator.

In the Central Ohio area, the Real Estate Purchase Contract, which has been adopted and used by the Columbus Board of REALTORS and the Columbus Bar Association, states:

“Buyer, at Buyer’s expense, shall have days (Not applicable if number of days is not inserted) after acceptance hereof to have the property inspected for WDI and furnish a report on FHA/VA approved form by an Ohio Certified Pest (Termite) Control Applicator and to secure a gas line warranty with a written guarantee from a gas line repair company or licensed plumber of Buyer’s choosing. Seller shall pay Buyer, at closing, for the first $ ______ of the cost of such inspection and gas line warranty.”

The Real Estate Purchase Contract provides the directive and therefore the requirement for a WDI inspection and report. Additionally, HUD (United States Department of Housing and Urban Development) requires WDI inspections and reports on a HUD approved form for any property for which HUD provides funding for or “guarantees” funding through private sources.

The WDI inspector is not a direct party as a signatory to the Real Estate Purchase Contract, but most likely the WDI inspector is a party to the contract as implied by the nature of the contract in which the Buyer and Seller have agreed, in writing, as to property to be purchased (and sold), specific provisions and considerations (costs) and the expectations of the parties of the services to be performed by the WDI inspector infestation(s) noted, based upon a careful and professional visual inspection of the areas which were open and accessible for visual inspection within or on the structure(s) listed on the Real Estate Contract on the day that the inspection was performed. In Ohio, the approved form for reporting the findings and results of WDI inspections is the NPMA-33 form. The inspector shall follow the instructions in Ohio Administrative Code rule 901:5-11-13 when completing the NPMA-33 form.

The purpose of the WDI inspection and report in a real estate transaction is to provide the parties with a factual report of
the inspector’s observations as to the presence or absence of visible evidence from WDI, damage due to any such infestation, and recommendation(s) for treatment(s) necessary for control of any infestation(s) noted, based upon a careful and professional visual inspection of the areas which were open and accessible for visual inspection within or on the structure(s) listed on the Real Estate Contract on the day that the inspection was performed. In Ohio, the approved form for reporting the findings and results of WDI inspections is the NPMA-33 form. The inspector shall follow the instructions in Ohio Administrative Code rule 901:5-11-13 when completing the NPMA-33 form.

The parties involved in a real estate transaction usually are: Buyers; Sellers; Real Estate Brokers/Agents for Buyers, Sellers or both; Inspectors such as - WDI Inspector, Gas Line, Home Inspector, Mortgage Company; Real Estate Appraiser; Title Company; Insurance Company/Agent; Attorney for Buyers and Sellers; Governmental Agencies such as HUD, FHA/VA, Zoning officials and others.

Buyers are considered to be persons or an entity purchasing the subject real estate property. The buyer is expected to negotiate in a manner of good faith and to provide accurate information to parties such as mortgage companies, real estate brokers and agents and involved government agencies. In some real estate transactions, Buyers are not directly “represented” by a broker, agent or attorney. However, it is becoming more common for buyers to be represented in the negotiations and at closing by an attorney and in some areas of Ohio “Buyers Brokers and/or Agencies” are becoming common place for the benefit and representation of the Buyer. The Buyer may or may not be a qualified expert on houses, real estate, and certain conditions and risks related to a real estate purchase transaction, thus the level to which they rely on information provided by the other parties in the real estate transaction can vary thus, it is crucial for the WDI inspector to clearly and fully disclose all pertinent information known by the inspector based upon his visual inspection. As instructed on the NPMA-33 form, the Buyer is to sign the form “as acknowledgment of receipt of a copy of the report.”

Sellers are generally represented by a Broker and/or Listing Agent. Sellers are also expected to negotiate and act in good faith and to provide adequate and accurate information to the parties involved. In certain areas of Ohio, Seller(s) must complete “Seller Disclosure Forms” in which the Seller discloses and reports material information such as roof leaks, drainage problems, structural problems/defects, and past or current WDI infestations and/or treatments. These Seller Disclosure Statements may be of value to the WDI Inspector, prior to the inspection being made and may be requested from the Seller and/or Seller Broker/Agent before inspecting the property. Some WDI inspection firms have their own Seller Disclosure Forms which must be completed prior to the inspection and some require a personal interview with the Seller by the inspecting company. The NPMA-33 form instructs the Seller to sign the form and commits the Seller to agree that all known property history information regarding WDI infestation, damage from infestation, and treatment history has been disclosed to the Buyer.

Real Estate Brokers and/or Agents represent the interests of the party they have contracted to represent and have a “duty” to those parties. Brokers/Agents commonly handle many or all of the details in negotiating and finalizing the Real Estate Purchase Contract and the actions, services and inspections that are necessary to get the transaction ready to close, including in many cases “ordering” the WDI inspection and report on behalf of the party that they represent.

Mortgage Companies or Lenders are those entities that provide financing for the purchase of real estate. Since these firms are providing the financing, they have a vested interest in the condition of the subject property in all aspects, including the condition of and reporting of the WDI Inspection.

Title Companies are involved in the transaction to review the Title of subject property and to ensure it is clear and legal for transfer. Title Companies usually will perform the “closing” of the transaction.
CHAPTER THREE

REPORTABLE WOOD-DESTROYING INSECTS OF OHIO

The insects discussed in this chapter are required to be reported on the NPMA-33 inspection form in Ohio. These wood-destroying insects that must be reported include subterranean termites, powderpost beetles, carpenter ants, carpenter bees, and drywood termites.

Correct identification of these insects and others is important not only for an accurate inspection, but also for reducing the liability resulting from the misdiagnosis of a problem. Later in this program, especially with the use of audiovisual aids, you also will learn to identify insect evidence in wood when there are no insects present to identify.

It is important to understand insect biology because it greatly determines where a wood-destroying insect is most likely to occur in a structure. As a WDI inspector, you should expect to receive a variety of insect specimens from customers. Hence, it behooves you to have a general knowledge of insects.

The General Structure of Insects

All insects share a number of characteristics, including a segmented body with three distinct regions (head, thorax, and abdomen) (Figure 3.1); one pair of antennae; and three pairs of legs. The head bears the eyes, antennae, and mouthparts. The thorax bears the appendages for locomotion--legs and wings (if present). Wings occur in one or two pairs and are present only in the adult stage. Immature insects may have evidence of developing wings such as wing buds or wing pads, but immatures never have fully developed wings. The abdomen typically has no appendages except at the tip; abdominal appendages often are sensory or used in mating/reproduction.

![Figure 3.1. A termite worker, with the three body regions depicted. (Illustration courtesy of the National Pest Management Association)](image)

the outside of its body and the muscles attach inside, hence, it is known as an exoskeleton. As an insect grows, it sheds its exoskeleton, which is made of chitin. This process is known as molting. Some termite bait toxicants kill termites by interfering with the molting process.

Insect Development

Insects develop from egg to adult by a process known as metamorphosis. In some insects, the developmental stages are egg to nymph to adult. This type of metamorphosis is known as gradual metamorphosis. Most of the insect’s growth occurs in the nympha stage. The nymphs usually look like small versions of the adult. Termites are an example of an insect that undergoes gradual metamorphosis.
Some insects develop by a process known as complete metamorphosis. The insect egg hatches into a larva that then molts several times before becoming a pupa, which finally molts into an adult. In this type of metamorphosis, the larval and pupal stages look and behave much differently than the adult. Examples of insects with complete metamorphosis include ants, bees, and beetles.

Insects are cold-blooded so their body temperature very closely follows the temperature to which they are exposed. Their development rate slows considerably in cold conditions. During the winter, many insects become inactive and hibernate in a protected site so they can survive the cold.

**SUBTERRANEAN TERMITES**

Subterranean termites are the most common type of termites found in the United States. Native termites in the genus *Reticulitermes* are the most widespread, and these are the most prevalent termites encountered in Ohio. The eastern subterranean termite, *Reticulitermes flavipes*, is widely distributed throughout the state.

Termites feed upon materials that contain cellulose such as wood. Many species of termites cannot digest cellulose to extract the sugar content, but they rely on protozoa in their gut to do the job. In nature, termites are very beneficial insects because they return dead trees to the soil as nutrients. Unfortunately, termites do not distinguish between wood in a structure and wood in a dead tree in the forest. Termites are considered to be pests when they attack human structures. Subterranean termites are one of the most potentially damaging insect pests of structures in Ohio.

Subterranean termites are species that primarily nest underground. They excavate an extensive network of galleries/tunnels in the soil that allow them to travel far distances to locate food. Subterranean termites readily transport soil and water to aboveground sites. Soil provides an environment that satisfies the high moisture requirements of subterranean termites. In order for these soft-bodied insects to keep from drying out, they must be surrounded by relatively high humidity not only when they are in the soil, but also when they are foraging above ground.
Termites construct aboveground earthen runways, called shelter tubes or mud tubes (Figure 3.2), that serve as protected passageways for the termites. Shelter tubes are composed of soil and wood particles cemented in place with fecal material and saliva produced by the termites. This earthen construction material is called carton. Shelter tubes are constructed in exposed areas where the termites need protection from predators and the drying effects of air. Termite shelter tubes are one of the best clues for the WDI inspector. Often termites may go undetected if not for the presence of a mud tube on a foundation or a wooden beam. Alternatively, it is possible that the WDI inspector may find evidence of termites in a structure yet find no evidence of mud tubes.

Although subterranean termites usually locate their nest(s) in the soil, there are situations where termites can survive without soil contact if their requirements for food and water are met. Termites have been known to maintain an active, viable colony solely in the structure without soil contact if an aboveground moisture source is available. This situation may occur from a plumbing or roof leak that goes uncorrected.

**Castes**

Termites are social insects that live in colonies. The social exchange of food (trophallaxis) and mutual grooming are important aspects of colony life. Termite colonies are comprised of various types of individuals (castes) that have distinct physical and behavioral characteristics. The proportion of each caste is regulated by a variety of environmental factors as well as the presence or absence of caste-regulating chemicals (pheromones) produced by the termites themselves. These castes include workers, soldiers, and reproducitives (queen, king, neotenics). Each caste has different duties in the colony.

**The Worker Caste.** Workers (Figure 3.3) are the most numerous individuals in the termite colony, and they typically are the first termites seen when a shelter tube or piece of infested wood is examined. Termites workers are physically and sexually immature males and females. These wingless, white insects are blind; they probably only perceive changes in light intensity. As workers eat wood, they cause damage to a structure. Their hardened mandibles have saw-like edges.
(Fig. 3.4) that enable them to rip and tear bits of wood.

Workers are so named because they perform most of the labor associated with colony maintenance. Worker termites are involved in a variety of tasks: They forage for food and water, and they excavate, repair, and build galleries and shelter tubes. Workers feed, groom, and care for other colony members, particularly young termites, reproductives, and soldiers. Workers also participate in colony defense.

**The Soldier Caste.** Termite soldiers are physically and sexually immature males and females whose primary function is colony defense. The soldier (Fig. 3.5) is easily recognized by its enlarged, rectangular, yellowish-brown head and long, hard black mandibles that are used to rip and tear at invading insects such as ants. Soldier termites are wingless, blind, and otherwise soft-bodied. Because soldiers cannot feed themselves, workers provide them with regurgitated food. Soldiers typically comprise 1-2% of the termites present in a *Reticulitermes* colony.
**The Reproductive Caste.** Adult winged termites have two pairs of long, narrow wings of equal size (see Figure 3.6), thus describing the name of the order of classification to which termites belong—Isoptera; *iso*, meaning equal, and *ptera*, meaning wing. The winged female and male reproductives are known as **alates or swarmers**. Alate termites have fully functional wings and eyes, and their pigmented, dark skin can better tolerate water loss than immature termites. In nature, termites start new colonies by the process of **swarming**. A "swarm" is a group of winged male and female reproductives (swarmers, alates) that leave their colony in an attempt to pair and initiate new colonies. Swarming occurs in mature colonies that typically contain at least several thousand termites.

Alate emergence is stimulated when temperature and moisture conditions are favorable, usually on warm, sunny days following rainfall. In Ohio, swarming typically occurs during daytime in the spring (March, April, and May), but swarms can occur indoors, particularly in heated structures, during the winter or other times of the year. Termite swarmers often leave the colony in large numbers (hundreds to thousands) through specially constructed mud tubes (sometimes called swarm castles). Swarming occurs during a brief period (typically less than an hour), and alates typically shed their wings soon after flight. The success rate of colony establishment via swarming is extremely low because most alates succumb to desiccation, predation, and other environmental factors. Many homeowners first become aware of a structural infestation when termites swarm indoors.

Winged termites are attracted to light, and their shed wings in cobwebs, in light fixtures, and on windowsills or other surfaces often may be the only evidence that a termite swarm occurred indoors. The discarded wings are useful for identification purposes because the wing shape and venation are unique to termites. These shed wings are an important clue for the WDI inspector.

It is very important that the WDI inspector recognize the difference between termite swarmers and ant swarmers. Winged termites are sometimes mistaken for winged (alate) ants, because they have a somewhat similar appearance. However, these insects can be readily distinguished from each other by differences in their antennae, body shape, and wings (Figure 3.7). Termites have straight antennae, whereas ants have distinctly elbowed antennae. Termites are soft bodied and the abdomen is broadly joined to the thorax, whereas ants are hard bodied and appear to have a pinched “waist” at the junction of the thorax and abdomen. Termites and ants both have two pairs of wings, but termites have wings of equal length, whereas ants have larger front wings than hind wings. Winged ants do not readily shed their wings after flight.
Figure 3.7 A termite alate (left) and an ant alate (right) have several distinguishing features. (Courtesy of The Ohio State University, Extension Entomology)

After swarming, a female and male pair that establishes a nest site are known as the primary reproductives, i.e., the queen and king (Figure 3.8) They are the colony founders, and the pair serves the reproductive role in the colony. They mate periodically, and the queen is capable of producing very large numbers of eggs.

The majority of the termite colony is comprised of immature individuals. The tiny termite that has just hatched from an egg is called a “larva”. The termite larvae are unable to feed themselves and rely on workers to regurgitate food. Workers are the most numerous individuals in the termite colony. Individuals that have wing pads are called nymphs (Figure 3.9). The nymph’s wing pads grow larger with each molt, and their compound eyes develop before the final molt into the mature alate (winged reproductive). Note that the terminology (larva, nymph) is unique to termites; such terminology is not necessarily representative of other insects that also undergo incomplete metamorphosis.

Figure 3.8 Reticulitermes flavipes queen (right) and king (left) from a young colony. (Courtesy of The Ohio State University, Extension Entomology)

Figure 3.9 Closeup view of a termite nymph that has long wing pads and compound eyes (millimeter ruler at bottom). (Courtesy of The Ohio State University, Extension Entomology)
Under certain conditions, some immature males and females (typically workers and nymphs) can mature sexually and become **neotenic reproductives** (Figure 3.10). These neotenics serve as replacement reproductives if the king or queen dies. Neotenic reproductives are generally yellowish brown or mottled black, and the female’s abdomen may be distended due to developing eggs. Numerous male and female neotenics can occur in a colony. Their contributions to egg production can greatly enhance colony growth.

**Characteristics of Wood Damaged by Subterranean Termites**

Termites excavate galleries throughout their food as they consume it. They conceal their workings and can completely honeycomb wood by feeding along the grain and following the softer springwood, leaving little more than a very thin layer of surface wood (Figure 3.11). The surface of damaged wood typically is intact, so wood must be probed to detect sub-surface excavations caused by termite feeding. A sharp pointed tool is a useful probe that can penetrate through the outer layer of wood to reveal termite damage.

Wood that has been damaged by subterranean termites has a number of distinct features. Damaged wood typically has a layered appearance because the galleries run along the grain of the wood; termites consume the softer springwood, leaving the harder summerwood. The excavations within wood typically contain soil, which has been moved by the termites. The gallery walls often are spotted with termite excrement (Fig. 3.12). Any penetrations through the wood surface are covered with carton, i.e., earthen construction material produced by the termites.

![Figure 3.10 Neotenic reproductives, with two workers between them.](Courtesy of The Ohio State University, Extension Entomology)

![Figure 3.11 Wood damaged by subterranean termites.]( Courtesy of The Ohio State University, Extension Entomology)

![Figure 3.12 Subterranean termite fecal spotting on wood.](Courtesy of The Ohio State University, Extension Entomology)
POWDERPOST BEETLES

Powderpost beetles can be found in dead as well as dried and cured lumber. Damage occurs to many wood products such as rafters, joists, flooring, molding, paneling, crating, furniture, antiques, tool handles, gun stocks, fishing poles and baskets. Sometimes homeowners hear rasping or ticking in the wood at night, notice a blistering appearance on the wood, see powdery frass piled below holes in the wood, find numerous round or oval exit holes at the wood surface, and even collect powderpost beetles around windows or lights. Mistakes are sometimes made determining if the infestation is active or non-active.

Identification

Powderpost beetle is a term used to describe several species of wood-boring insects. Adult Lyctids are flattened, slender, reddish-brown to black, varying from 1/32 to 1/8 inch long. The basal abdominal segment is long, and the antenna bears a club of only two segments. The head is visible from above. Mature larvae are C-shaped, slightly hairy with three pairs of spine-like legs, and yellowish-white with a brown head. The frass is fine flour or talc-like and loosely packed in tunnels. Large quantities often fall out at exit holes and cracks.

![Figure 3.4 Powderpost beetle damage](image)

Adult Anobiids have slender, cylindrical bodies, are reddish-brown to nearly black and range from 1/16 to 1/8 inch long. In most species, the head is bent downward. The widest point of the thorax is slightly forward of the base, tapering backward and appearing as a rough, diamond-shaped outline. Larvae are C-shaped and nearly white except for a dark head. The frass is fine to coarse, pellet-shaped, usually a gritty quality and packed loosely in tunnels. There also is a small amount of frass around the exit holes.

Adult Bostrichids, 1/32 to 3/8 inch long, are cylindrical in most species, dark brown or black, with a roughened thorax. Antennae bear a club of three distinct segments. The head is usually not visible when viewed from above. Larvae are C-shaped; the body segments immediately behind the head capsule are much wider than the body segments at the rear. The frass is fine to coarse, tightly packed and tends to stick together.

Life Cycle and Habits

Lyctids attack only large-pored hardwoods such as oak, ash, hickory and mahogany. They attack "seasoned hardwood" and sapwood timbers found in woodwork molding, window and door frames, plywood, flooring, structural wood, furniture, tool handles and firewood. Pine and soft woods are not normally attacked. Adult beetles can emerge from wood stored in the home and infest structural wood or furniture. Lyctids rarely infest wood older than five years. Infestations usually result from wood that contained eggs or larvae when placed in the home. The wood could have been improperly dried or stored. Adult exit holes are round and 1/32 to 1/16 inch in diameter. Larvae cause the damage.
Anobiids may attack both hardwoods and softwoods, which means that infestations may be found in all the same places as Lyctid beetles as well as in structural timbers (beams, sills, joists, studs, subflooring, etc.). Maple, beech, poplar and pine are especially susceptible to attack. Anobiids prefer to infest wood which is damp; therefore, infestations usually begin in moist, poorly-ventilated areas such as crawl spaces, basements, garages and utility sheds. Under favorable conditions of moisture and temperature, infestations may spread upwards into walls and upper levels of the structure, including furniture. Infestations may occur as a result of using infested lumber, or from beetles flying in from outdoors or being carried in on firewood. Infestations develop slowly, but wood can be reinfested year after year. Anobiids are called deathwatch beetles because in the past, superstitious people believed the ticking one species makes foretold impending death in the household. Adult beetles make the sound during the mating season by tapping their heads on a hard surface. They attack seasoned softwood, hardwood, sapwood and heartwood found in woodwork, flooring, structural wood, furniture, tool handles and sometimes firewood. Exit holes are round and 1/16 and 1/8 inch in diameter. Bostrichids are more abundant in the tropics. The bamboo powderpost beetle is found in baskets, picture frames, furniture and other imported bamboo material. These insects attack unseasoned and seasoned softwood, hardwood and sapwood, and are often found in dying trees or recently felled logs as well as seasoned lumber and wood products. Adults rarely reinfest wood. Adult exit holes are round and 3/32 to 9/32 inch in diameter. Both larvae and adults cause the damage. Adult females lay eggs on or in the pores of bare, unfinished wood. Eggs hatch into tiny larvae that tunnel through the wood. Adults emerge one to five years later, usually April-July through holes cut to the wood surface by the larvae. Adults are short lived, active at night and may return to the same wood or go elsewhere, lay eggs and start a new life cycle. It is the damage that homeowners are more likely to see.

The length of the life cycle for Lyctids is three months to one year, for Anobiids one to three years and for Bostrichids about one year. Some wood-boring beetles complete the life cycle in a few months, while others live in wood 30 years before emerging.

**Detecting Infestations**
The key to avoiding serious problems from powderpost beetles is early detection. Homeowners are much more likely to see damage than the beetles themselves. Since tunneling and development of the larvae takes place entirely below the wood surface, the only signs of infestation are the emergence holes made by the adults and the powder-like frass sifting from the holes.

**Lyctid or Anobiid Beetles**
Knowing how to differentiate Lyctid from Anobiid beetle damage is more than academic since Anobiids have a broader range of woods that they can potentially infest. Both Lyctid and Anobiids chew small, circular emergence holes in the surface of wood. Holes made by Lyctid beetles are about the diameter of a pinhead whereas exit holes made by Anobiids are slightly larger. One way to differentiate holes of the two species is to insert a "click-type" (refillable) ballpoint pen into the exit hole; only the tip of the ball will fit through a Lyctid beetle emergence hole. If the hole was made by an Anobiid, the tip of the pen will enter part way up the angled face of the point.

Another way to differentiate powderpost beetles is from the consistency of the powder (frass) that sifts out of the exit holes. Lyctid frass is extremely fine and feels like talc when rubbed between the fingers. Anobiid frass is also powder-like, but feels gritty.
Active or Inactive Infestations
Infestations sometimes die out on their own accord. Therefore, it is important to be able to determine whether the infestation is active or inactive. Active infestations will usually have powder the color of fresh-cut wood sifting from the exit holes. In contrast to old, abandoned holes, new holes will not have taken on the weathered appearance of the surrounding wood. Powder streaming from recently opened holes may accumulate in small piles beneath the exit holes. If these piles of powder are covered with a film of dust or debris, the damage is old. Careful observation may be required to distinguish new powder from frass that has been dislodged from old larval galleries by vibrations.

One final means of confirming that an infestation is active is to mark or seal any existing exit holes. Use crayon or tape over the holes to see if more holes appear. Sweep up all powder, and recheck the wood for new holes and powder at a later date. Since most emergence occurs from April-July, it might be worthwhile to wait until the following spring to determine if new holes and fresh powder are present. This is especially true when attempting to make a determination during the fall or winter months.

Control
Homeowners should know that there are various options for control. Selecting which is best depends on a number of factors including the severity of infestation, area being attacked, potential for reinfestation and treatment expense the customer is willing to bear. **Powderpost beetles damage wood slowly;** thus, homeowners should not feel as though they must act immediately in order to preserve the structural integrity of their home. A “wait and see” approach is often desirable, especially when there is still doubt as to whether the infestation is active.

Prevention
Most powderpost beetles are introduced into homes in lumber or finished wood products (e.g., furniture, paneling or flooring). Lumber which has been improperly stored or dried should not be used, particularly if beetle exit holes are present. Many of the most serious infestations arise from clients who used old lumber from a barn or woodpile behind their house to panel a room or build an addition.

Powderpost beetles will only lay their eggs on bare, unfinished wood. Wood which is painted, varnished, waxed or similarly sealed is generally safe from attack provided no unfinished surfaces are exposed. Bare wood can be protected from attack by painting or finishing exposed surfaces. Beetles emerging from finished articles such as furniture were usually in the wood before the finish was applied. (Note: beetles emerging from finished wood can, however, reinfest by laying eggs in their own exit holes; sealing the holes prevents this possibility.)
Moisture Control
Powderpost beetles, especially Anobiids, have specific moisture requirements for survival. Since wood moisture levels below 13 percent (during spring and summer) are generally unsuitable for anobiid development/reinfestation, it's advisable to install a moisture barrier in the crawl space of infested buildings. Covering the soil with four to six mil polyethylene reduces movement of moisture into the substructure and reduces the threat of an infestation spreading upwards into walls and upper portions of the building. Most beetles do not develop in wood with a moisture content below 10 to 15 percent.

Another way to lower moisture content in damp crawl spaces is to increase ventilation. This can be accomplished by installing foundation vents (one square foot of vent area per 150 square feet of crawl space). Moisture meters, used by some pest control operators, are useful tools for predicting the potential reinfestation in wood.

Wood Replacement
If the infestation appears to be localized (e.g., only a few holes in a board or sheet of paneling), simply replacing the board or sheet of paneling may solve the problem. If additional holes begin to appear in adjacent areas, additional action can then be taken.

Kiln Dried Lumber
For new construction, use kiln-dried lumber (dried a minimum of eight hours at 130 to 140 degrees F and 80 percent relative humidity). Also, chromated copper arsenate (CCA) salts with trade names such as Wolmanized is an excellent wood preservative for wood in soil contact. The life of CCA treated wood is 40 years or more. This product is not available for homeowner application to wood since pressure application is essential. Treated wood has a slightly green cast and is often sold for use as landscape timbers and for fencing and deck construction. Compounds available under trade names of Cuprinol are sold for homeowner application to wood. Penetration on wood surfaces is only about 1/8 inch and protection is much shorter than CCA treated wood.
Table 3.1 Characteristics of damage by wood-boring beetles that reinfest wood in use (modified from Williams 2000).

<table>
<thead>
<tr>
<th>Beetle common names (family)</th>
<th>Shapea &amp; size (inches) of exit holes</th>
<th>Ageb &amp; typec of wood attacked</th>
<th>Frass texture and packing</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lyctid beetles, true powderpost beetles (Lyctidae)</td>
<td>Round 1/32–1/8 • • • •</td>
<td>New hardwoods with &gt;3% starch (only sapwood portion of U.S. tree species; sapwood and heartwood of tropical hardwoods). Bamboo.</td>
<td>Very fine powder (consistency of talcum powder); loosely packed in tunnels</td>
</tr>
</tbody>
</table>
| Anobiid beetles (Anobiidae) | Round 1/16–1/8 • • • • | New and old hardwoods and softwoods with >12% moisture content. Prefer sapwood; rarely occur in heartwood. | In softwoods, fine powder with elongate lemon-shaped pellets; loosely packed in tunnels
In hardwoods, fine powder without pellets; usually tightly packed in tunnels |
| Bostrichid beetles, false powderpost beetles (Bostrichidae) | Round 3/32–9/32 • • • • | Raw and new hardwoods (only the sapwood portion of U.S. tree species; sapwood and heartwood of tropical hardwoods). Bamboo. Grapevine. | Fine to coarse powder tending to stick together; tightly packed in tunnels |

aShape of hole may vary when damaged wood has been machined.
bRaw (unseasoned wood with bark and >30% moisture content [i.e., trees, stored logs, firewood, lumber]); New (wood with <30% moisture content, stored or in use for ≤10 years [i.e., seasoning lumber or recently processed seasoned products]); Old (processed wood with <20% moisture content, stored or in use for >10 years).
cSoftwood (wood from coniferous [needle-bearing] trees) or hardwood (wood from deciduous [broad-leaved] trees). Sapwood is lighter-colored wood closest to the bark; heartwood is the darker-colored, central portion of the tree.

Carpenter Ants

Carpenter ants belong to the genus *Camponotus*. They are social insects that live in colonies. Carpenter ants are so-named because they excavate galleries in wood to create nest sites. They use their strong
jaws (mandibles) to remove quantities of wood as they expand the size of their nests. Unlike termites, carpenter ants do not consume wood.

Carpenter ants may be black, red, brown, tan, yellow, or some combination thereof, depending on the species. Carpenter ants are among the largest ants occurring in the United States, with some species ~1/2 inch long. However, size alone is not a good diagnostic tool, because carpenter ants from a single colony are polymorphic (different sizes). These polymorphic workers are sometimes called minor, intermediate, and major workers (from smallest to largest, respectively). A major worker is shown in Figure 3.18.

Workers have strong jaws and bite readily if they are handled. In addition to delivering a painful bite, they also can inject formic acid into the wound. They do not have a stinger.

**Identification**

Like other ants, carpenter ants have a constricted waist and elbowed antennae. The alates (winged reproductives) have transparent wings that are not easily removed; the paired forewings are much larger than the hind wings. Winged males are much smaller than winged females (Figure 3.19).

Carpenter ants may be identified based on several characteristics, including an evenly rounded, arched thorax, when viewed from the side; one node between the thorax and abdomen (gaster); and a fringe of hairs around the anal opening at the tip of the abdomen (Figure 3.20). The combination of the first two characteristics is useful to distinguish carpenter ants from other ant species commonly found in Ohio.
In Ohio, the black carpenter ant, *Camponotus pennsylvanicus*, is the most common species (Figure 3.21). This ant is black, with very fine whitish or yellowish hairs on the abdomen. Minor workers of the black carpenter ant generally are about 1/4 inch long and major workers are approximately 1/2 inch.

Carpenter ants DO NOT create mounds in the soil; such behavior is characteristic of *Formica*, a genus that also contains species of large black ants. *Formica* species (field ants) are common in Ohio. These ants have a single node, but the thorax has a distinct indentation (Figure 3.22). Be sure that you do not mistake *Formica* foragers (not reportable) (Figure 3.22) for *Camponotus* foragers (a reportable WDI) (Figure 3.21). Management strategies for these types of ants are entirely different.

The following sections on life cycle, habits, etc. pertain to the black carpenter ant. They do not necessarily pertain to other species of carpenter ants.

**Life Cycle**

Winged male and female carpenter ants (swarmers) emerge from mature colonies usually from March to July. After mating, the males die and each newly fertilized female (sperm is stored in the spermatheca) establishes a new colony in a small cavity in wood, under bark, etc. The first brood of larvae is fed entirely by the queen. She does not take food, but metabolizes stored fat reserves and wing muscles for nourishment. The few workers emerging from the first brood assume duties of the colony, such as collecting food (the carpenter ant diet consists of a wide range of plant and animal materials), excavating galleries to enlarge the nest, and tending the eggs, larvae, and pupae of the second generation. The workers regurgitate food to nourish the developing larvae and the queen. The queen has few duties except to lay eggs. All of the workers in the colony are sterile females.
In later generations, workers of various sizes are produced. Larger major workers typically guard the nest, battle intruders, and forage for food; generally, smaller minor workers expand the nest and care for the young. The larvae and pupae must be fed and tended or they die. Larvae are legless and grub-like, later pupating in tough silken, tan-colored cocoons, which sometimes are erroneously referred to as “ant eggs”.

For the black carpenter ant, oviposition frequency is bimodal, and the queen lays eggs in early spring and again in late summer. Bimodal egg production generates two adult cohorts. Eggs that are laid in spring generate workers and sexual forms in August and September, whereas eggs laid in late summer produce workers only the following year in June and July. A mature colony typically contains ~2,000 to 4,000 individuals and produces winged males and females annually.

Habits

Carpenter ants often establish a number of interconnected nests; the parent nest houses the queen and small larvae, and the satellite nests contain larger larvae and pupae. The parent nest of the black carpenter ant typically is established in a cavity of hardwoods, sometimes in softwoods. The nest is associated with wood that has a moisture content >15%, a situation often caused by rain, leaks, condensation, etc., in structures. The satellite nests usually are positioned in drier areas with higher temperatures that enhance larval and pupal development. The workers can move the brood among the satellite nests. There often may be several satellite nests in different locations in or around a structure.

Carpenter ant nests can be found outside or inside the house. Carpenter ant nests have been found in water-damaged wood near skylights, chimneys, drain gutters, window and door frames, wooden shingles, etc., as well as inside hollow porch posts and columns, window boxes, crawl spaces, dishwashers, etc. Sometimes, nests are found in dry areas, such as hollow veneer doors, curtain rods, small voids between the door casing and ceiling, false beams, or under insulation in attics or crawl spaces.

An active colony may produce a distinct, dry rustling sound (sometimes loud), similar to the crinkling of cellophane. Sounds of their chewing activity in wood often are audible. The workers may respond to a disturbance by striking their mandibles and abdomen against the gallery walls so as to warn other colony members; these alarm signals can be quite loud.

Carpenter ants are most active at night. Large numbers of foragers emerge very soon after sunset to search for food. Foraging ants bring food back to the nest to feed the larave; they may carry food items in their mandibles or they may consume the food and store it in their crop.

Carpenter ants are omnivorous, and they feed upon a great variety of both plant and animal materials, including insects (living or dead), plant juices, fresh fruits, honey, jelly, sugar, syrup, meats, grease, fat, etc. Carbohydrates are the primary energy source for adults, i.e., workers. One of their most common, readily available foods is honeydew, which is a sugary substance excreted by aphids and scale insects feeding on the plants. (Landscape plants infested with these plant-sucking insects are a good place to inspect for carpenter ants.) Honeydew is a preferentially collected food item.

The carpenter ants’ food preferences appear to change on a seasonal basis, which is related to the typical brood production cycle. The larvae require protein-based foods (the quantity and quality of nitrogen in the protein are key factors that affect growth and development). A field study in Virginia showed that C. pennsylvanicus protein collection peaked in June and again in September.
older larvae were present in the nest.

Workers may forage for food as far as 100 feet from their nest. Outdoors, look for ants traveling from a tree cavity or stump to the structure. They may travel over tree branches or vines touching the roof, electrical and telephone wires, fences next to the house, piles of firewood, logs, railroad ties, etc. They may be seen walking on plants, tree trunks, and rotten wood stumps. They frequently travel along well-established trails between nest sites and feeding sites.

**Characteristics of Damaged Wood**

Carpenter ants chew wood with and across the grain, creating irregular, clean galleries (Figure 3.23). The gallery walls are very smooth and sculpted, with a sandpapered appearance. There is no soil as is found in subterranean termite workings.

Carpenter ant borings consist of wood shavings that resemble pencil sharpener shavings (Figure 3.24). The ants carry the wood shavings from the nest and deposit them outside; piles of shavings may be found beneath special openings (windows) or nest openings. The wood shavings often contain portions of insects, empty seed husks, and remnants of other food items.

**Carpenter Bees**

Carpenter bees do not consume wood, but they excavate galleries in wood to create nest sites. Homeowners often complain about the round holes in wood. Carpenter bees are primarily a nuisance
pest, but sometimes they cause damage to wood over time.

Carpenter bees sometimes become a nuisance outdoors when they hover or fly erratically around people. In actuality, these are male bees, which are territorial but harmless because they lack a stinger. Only females have a stinger. However, females are docile and rarely sting, except if handled. Carpenter bees sometime are bothersome because they are noisy. Nonetheless, carpenter bees are beneficial insects because they are important pollinators of flowers and trees.

**Identification**

Carpenter bees (Figure 3.25) are large, 3/4 to 1 inch long, heavy-bodied, black with a metallic sheen. The thorax is covered with bright yellow, orange or white hairs and the upper side of the abdomen is black, shiny, and bare. The female has a black head, and the male has white markings on the head. Carpenter bees have a dense brush of hairs on the hind legs. Carpenter bees somewhat resemble bumble bees, except bumble bees have dense yellow hairs on the abdomen and large pollen baskets on the hind legs.

![Figure 3.25 Carpenter bee (Courtesy of Kansas State University)](image)

**Life Cycle**

Unlike carpenter ants, which are social insects, carpenter bees are solitary insects that do not form colonies. The males are not long lived, and the female carpenter bee prepares the nest during springtime. The female uses her strong jaws (mandibles) to excavate a clean-cut, round nest entrance hole that is ~1/2 inch wide, approximately the diameter of her body. She then excavates a gallery (tunnel) that continues inward from the entrance hole for one to two inches then turns sharply at a 90° angle and runs in the same direction as the wood grain for four to six inches. She excavates the gallery at the rate of about one inch in six days.

The female then places a mixture of pollen and regurgitated nectar at the far end of an excavated gallery, forms this larval food into a ball and lays an egg on top of the mass, then walls off the cell with a plug of chewed wood pulp. Each female may have six to ten partitioned brood cells in a linear row in one gallery. Larvae feed on the pollen/nectar food mass, which is sufficient food for them to develop to the adult stage. The life cycle (egg, larva, pupa, to adult) is completed in approximately 7 weeks. The new adults chew through the cell partitions and emerge in late August. They collect and store pollen in the existing galleries, return to the tunnels to hibernate, then emerge and mate the following spring (April and early May). The previous year's adults die. There is one generation per year.
Habits

Typical indicators of carpenter bee activity in wood include the round entrance hole in wood (Figure 3.26) and the coarse sawdust from their borings. Carpenter bees deposit excrement and pollen on surfaces below their entrance holes, leaving unsightly stains (Figure 3.27). Note that the entrance hole may not necessarily be in an exposed area. The gallery where the larvae develop typically is concealed within the wood (Figure 3.28).

Carpenter bees can nest in all species of dried, seasoned wood, but they prefer softwoods such as cedar, redwood, cypress, pine, and fir. Woods that are soft and that have a straight grain are easy for the bees to tunnel through. Nail holes, exposed saw cuts, and unpainted wood are attractive sites for the bees to start their excavations. These bees may nest in wood trim near roof eaves and gables, fascia boards, porch ceilings, outdoor wooden furniture, decks, railings, arbors, fence posts, telephone poles, siding, shingles, dead tree limbs, and other weathered wood.

Carpenter bee damage to wood initially is minor. However, old galleries may be enlarged by the bees, eventually resulting in considerable wood damage. A gallery can extend for 10 feet if used by many carpenter bees over the years. Carpenter bees may refurbish an existing tunnel instead of boring a new one or they may construct new tunnels near old ones, with infestations persisting for several years.

Sometimes several carpenter bees use the same piece of wood. If more than one bee uses the same entrance hole, their tunnels extend in opposite directions or run parallel to each other.
Drywood termites are very common in some southern and western states. They are easily transported to other locations in infested wood, such as furniture, decorative items, etc.

Even though drywood termites are quite rare in Ohio, there have been isolated cases where drywood termites have infested structures and even swarmed year after year. Drywood termite swarmers generally are larger than subterranean termite swarmers.

Drywood termites nest in sound, dry wood, which also is their food source. They do not require contact with the soil and therefore they do not construct mud tubes. They consume wood with and across the grain, creating irregular, clean galleries.

Often, the only evidence of an infestation is the presence of fecal pellets. These hard, dry, six-sided pellets are unique to drywood termites (Figure 3.30). Fecal pellets are ejected from the colony and can often be found in piles near infested wood. The termites seal the kick holes with carton after ejecting the pellets.

**Figure 3.29 An alate of the western drywood termite.**

**Figure 3.30 Drywood termite fecal pellets.**
CHAPTER FOUR

MISCELLANEOUS INSECTS AND FUNGI THAT MAY BE FOUND ASSOCIATED WITH WOOD IN STRUCTURES

Although the insects listed in Chapter 3 must be reported on the NPMA-33 form, a variety of other insects, particularly beetles, may be found in wood during the course of a WDI inspection. According to the guidelines from the National Pest Management Association for completing the NPMA-33 form, you are not required to report these insects since they are considered to be non-reinfesting insects. However, at the discretion of the inspector, these findings may be reported in the comments section of the NPMA-33 form or in an attachment for disclosure purposes.

Beetles

In addition to the beetles discussed in Chapter 3, a few other beetle species in the U.S. can infest seasoned wood—the old house borer (*Hylotrupes bajulus*), the flat oak borer (*Smodicum cucujiforme*), and the wharf borer (*Nacerdes melanura*). The first two species are in the family Cerambycidae, commonly referred to as longhorned beetles because of their extremely long antennae; the wharf borer is in the family Oedemeridae (false blister beetles). All three species make oval exit holes in wood. These beetles are relatively uncommon in Ohio, and they are categorized as non-reinfesting insects in Ohio.

The old house borer (Figure 4.1) is a slightly flattened, black to brownish black beetle, approximately 5/8 to 1 inches long. The prothorax is rounded, with two shiny “bumps” on each side. The wing covers may be completely black or they may have distinct gray bands.

Cerambycid larvae have a plump, rounded head and hence are commonly called “roundheaded borers”. Old house borer larvae (Figure 4.1) have three dark eye spots (ocelli) on each side of the head. Full-grown larvae may be 1.2 inches long. The older, larger larvae often can be heard chewing in wood.

The frass produced by the larvae is slightly granular and composed of small, barrel-shaped pellets of digested wood and uneaten irregular-shaped wood fragments. Larvae usually feed parallel to the wood grain, but they can excavate large chambers in wood.

![Figure 4.1 Old house borer adult (left) and larva (right).](Illustration courtesy of The Ohio State University, Extension Entomology)
The old house borer is an introduced species. It is most common in states along the eastern seaboard, but it is occasionally found in structures in Ohio. Contrary to its common name, the old house borer primarily occurs in structures that are less than 10 years old.

The larvae feed on the sapwood of softwood timber, including pine, fir, and spruce. Larval development occurs most rapidly in wood with >10% moisture content and high nutrient levels, and when the temperature is 68–88°F and the relative humidity is 80–90%. Depending on these environmental conditions, the old house borer spends from 2 to 10 years in the larval stage. Although the old house borer can re-infest a structure, centrally heated and well-ventilated structures are unlikely to harbor an ongoing infestation.

The wharf borer (Figure 4.2) is a soft-bodied, yellowish tan beetle with black tips on the wing covers; it is approximately 0.5 inch long. The antennae are less than half the length of the body.

The wharf borer is an introduced species. The larvae live in rotted wood that is nearly saturated with water. They are of particular concern in wharves, pilings, and waterfront properties. This beetle is not commonly encountered in Ohio. When large numbers of adults occasionally emerge within a structure, the source of these beetles typically is rotted wood buried below the structure. (Illustration courtesy of The Ohio State University, Extension Entomology)

Many beetles in the families Buprestidae, Cerambycidae, Platypodidae, and Scolytidae do not reinfest dry, seasoned wood, but their previous feeding damage may be evident. It is important to distinguish their damage from that caused by beetles that can reinfest seasoned wood. For non-reinfesting beetles, the adults initiate their attack in the moist wood of recently dead or dying trees or in drying logs and lumber, where larvae begin their development. Note that the larvae may complete their development in wood after it is dry. These beetle infestations are usually removed by kiln-drying and wood-processing operations. However, adults occasionally emerge from air-dried wood. No control measures are needed because these beetles cannot infest the bark-free, dry wood in the structure.
Bark beetles are sometimes called engraver beetles because they carve elaborate galleries in wood (Figure 4.3). Bark beetles attack raw hardwoods and softwoods, but they feed only on the inner bark and the sapwood surface. The larvae feed while the bark is in place. Their tunnels are round, and some contain tightly packed fine to coarse powder. Sometimes wood that has been etched by bark beetles is incorporated into a structure.

Ambrosia beetles tunnel through wood, but they do not consume it. The adults and larvae feed on fungus, called ambrosia, that grows in the excavated galleries. The fungus leaves a distinctive dark blue to black stain on tunnel walls and around the beetle emergence holes. This can often be seen in lumber where the milling process cuts through galleries (Figure 4.4). Ambrosia beetles excavate round tunnels, and their frass typically is compacted into wicks on the wood surface. Ambrosia beetles most frequently occur in log homes built with freshly cut logs.

Table 4.1 Characteristics of damage by wood-boring beetles that may be associated with wood in use, but that are NOT reportable wood-destroying insects in Ohio (modified from Williams 2000).

<table>
<thead>
<tr>
<th>Beetle common names (family)</th>
<th>Shape &amp; size of exit holes</th>
<th>Age &amp; type of wood attacked</th>
<th>Characteristics of tunnels &amp; frass</th>
</tr>
</thead>
<tbody>
<tr>
<td>Old house borer, roundheaded borer (Cerambycidae)</td>
<td>Oval 1/4–3/8</td>
<td>New softwoods; only sapwood. Old softwood if &gt;10% moisture content.</td>
<td>Oval tunnels tightly packed with slightly granular frass composed</td>
</tr>
<tr>
<td>Wood-boring weevils (Curculionidae: Cossoninae)</td>
<td>Round</td>
<td>Ragged edges 1/16 – 1/12</td>
<td>New and old hardwoods and softwoods; only very damp sapwood and heartwood.</td>
</tr>
<tr>
<td>Flat oak borer, roundheaded borer (Cerambycidae)</td>
<td>Round to oval</td>
<td>1/8 – 1/4</td>
<td>Raw and new hardwoods, primarily oak; sapwood and heartwood. Adults may emerge from old wood in damp sites.</td>
</tr>
<tr>
<td>Ambrosia beetles (Scolytidae) &amp; pinhole borer (Platypodidae)</td>
<td>Round</td>
<td>1/50 – 1/8</td>
<td>New hardwoods and softwoods; sapwood and heartwood. Rare in raw wood. Adults attack new or old wood that is rewetted or covered with certain paints or solvents.</td>
</tr>
<tr>
<td>Bark beetles, Ips beetles, scolytid beetles (Scolytidae)</td>
<td>Round</td>
<td>1/16 – 3/32</td>
<td>Raw hardwoods and softwoods; only inner bark and surface of sapwood.</td>
</tr>
<tr>
<td>Metallic wood borers, flateheaded borers, buprestisds (Buprestidae)</td>
<td>Oval</td>
<td>1/8 – 1/4</td>
<td>Raw hardwoods and softwoods. Adults may emerge after &gt;2 to 10 yrs.</td>
</tr>
<tr>
<td>Longhorned beetles, roundheaded borers, cerambicids (Cerambycidae)</td>
<td>Round to oval</td>
<td>1/8 – 3/8</td>
<td>Raw hardwoods and softwoods. Common in firewood and log homes. <em>Eburia</em> spp. may emerge from old wood.</td>
</tr>
</tbody>
</table>

*Shape of hole may vary when damaged wood has been machined.

* Raw (unseasoned wood with bark and >30% moisture content [i.e., trees, stored logs, firewood, lumber]); New (wood with <30% moisture content, stored or in use for ≤10 years [i.e., seasoning lumber or recently processed seasoned products]); Old (processed wood with <20% moisture content, stored or in use for >10 years).

* Softwood (wood from coniferous [needle-bearing] trees) or hardwood (wood from deciduous [broad-leaved] trees). Sapwood is lighter-colored wood closest to the bark; heartwood is the darker-colored, central portion of the tree.

* Primarily with the wood grain, except for ambrosia beetles and the pinhole borer (most tunnels across the grain).

* Subfamily.
Horntail Wasps

Horntail wasps are large insects, often more than 1.25 inches long (Figure 4.5). If these large wasps emerge from finished walls in a structure, then the larval or pupal stage actually was present in the wood when the structure was built. Horntail wasps may cause cosmetic damage, but they do not pose a risk to the structure. They will not reinfest wood in a structure. The female horntail wasp may sting if handled.

Wood-Destroying Fungi

Although it is not a requirement in Ohio to report the presence of wood-destroying fungi, it is important to recognize wood that has been damaged by fungi. It is possible to have both fungal damage and insect evidence in the same piece of wood.

Wood that has been damaged by fungi typically appears solid, but it weighs much less than normal. Discolored wood also is a sign of fungal damage. Fruiting bodies (i.e. mushrooms and brackens) are evidence of fungi. In contrast, WDI activity actually results in the removal of wood, galleries in the wood are present, and insect frass is evident.

Brown rot is a common wood decay fungus. Brown rot fungi reduce the strength of wood and are often referred to as "dry rot" fungi. Brown rot fungi are most common in softwoods. Wood that is attacked by this fungus has a "cubed" appearance with checks going across the wood grain. The wood typically becomes brown and crumbly.

Figure 4.5 Horntail wasp. 
Photograph courtesy of IPM of AK)
CHAPTER FIVE

UNDERSTANDING BASIC CONSTRUCTION TERMINOLOGY

The WDI inspector needs to be familiar with the elements that make up a structure. When reporting the results of an inspection, the WDI inspector must communicate findings using standard terminology that describes common aspects of the structure. Although the WDI inspector is not required to report conditions that may be conducive to pests, the inspector must be able to recognize those areas of a structure that are most likely to harbor an insect infestation.

The WDI inspector should be knowledgeable of current building methods, technologies, and materials, as any of these factors may affect the inspection process. As construction practices change, so should the approach of the inspector. It is a good idea to periodically stop by construction sites to see what a structure looks like during various stages of construction. Some construction types and construction practices are problematic because they lend themselves to termite infestation; they provide ready or undetectable access for termites to enter a structure.

This chapter provides definitions of common construction terminology and it also provides a basic overview of the foundation types and elements that make up a structure. This chapter also discusses typical termite entry points in various types of construction.

The WDI inspector should be familiar with the following terms:

attic - The space above the ceiling floor and below the roofing material. This area may contain insulation, mechanical equipment, or stored items. Access to roof rafters and roof sheathing is gained in the attic area. The attic may or may not be accessible to the inspector.

backfill – The gravel or excavated earth replaced into the trench around and against a basement foundation.

band board - Another name for header joist when fastened to the end of floor joists.

basement – A habitable area either completely or partially below grade and beneath the main story of the home or structure.

bearing wall – A wall that supports any vertical load in addition to its own weight.

block wall caps - Solid masonry blocks that sit on top of hollow block walls of a foundation.

box sill - Area where the sill plate, floor joist, and header joist meet.

brick foundation - Building foundation formed of bricks that are stacked in a staggered arrangement and held together with mortar. Brick foundations can be 2, 3, 4, 5 or more layers wide; the spaces/joints between these layers and the mortar can allow access for termites to get into a structure.

brick veneer – A facing of brick laid against and fastened to sheathing of a frame wall or tile wall construction.
ceiling joists - One of a series of parallel framing members (usually wood) used to support ceiling loads; ceiling joists are supported in turn by larger beams, girders, or bearing walls. Also sometimes called roof joists. Insulation often is present between ceiling joists, especially in attics or other unheated areas.

concrete block foundation - Building foundation formed of concrete blocks (usually 8”x8”x16”) that are stacked in a staggered arrangement and held together with mortar. Termites may construct shelter tubes inside the hollow blocks and gain hidden access to the structure.

crawl space – A shallow, unfinished space beneath the living quarters of a structure. The floor of the crawl space typically is soil or gravel but occasionally is concrete. The crawl space is not livable or habitable. The crawl space often is enclosed by the foundation walls and may or may not be accessible to the inspector.

cripple stud – Short vertical structural member (usually wood or metal) used above and/or below windows and doorways. Cripple studs connect the sole plate to the bottom of the window sill.

decay – Disintegration of wood or other substance through the action of fungi.

deck – A floor-like platform, often made of wood, that is attached to a structure and typically used as an outdoor entertainment/living space.

downspout – A pipe, usually of metal, for carrying rainwater from roof gutters.

drywall – Interior wall covering material, such as plywood or gypsum board, that is applied in panels or large sheets.

eaves – The lower part of the roof projecting beyond the wall.

EIFS (Exterior Insulation and Finish System) – EIFS consists of a Styrofoam® base that is applied to the exterior walls of a structure and then is covered with a synthetic stucco material. EIFS is commonly referred to as synthetic stucco, and it is sometimes used in modern construction. Moisture problems often are associated with this type of construction material, which can provide conditions conducive for termite and carpenter ant infestations. EIFS is a particularly susceptible to termites when it extends into the soil; termites readily tunnel through the insulation itself.

expansion joint - A space between concrete components that allows for expansion and contraction. This space is commonly filled with a pliable material. Termites may find their way into a structure through these gaps in the concrete.

fascia – Horizontal boards attached to rafter/truss ends at the roof eaves and along gables. Roof drain gutters are attached to the fascia. Fascia boards are commonly attacked by carpenter bees.

flashing - Noncorrosive sheet metal or other material used around protrusions, angles or junctions in roofs and exterior walls to protect against water seepage.

floor joist - One of a series of parallel members (usually wood) used to support floor loads. The floor
joists sit on edge, on top of the sill plate, and are covered by the sub-floor.

**footing or footer** - A masonry section, usually concrete, in a rectangular form wider than the bottom of the foundation wall or pier that it supports. The concrete footer sits or bears weight upon compacted soil and/or gravel. Footings must be placed below the frost line to prevent movement and protect their integrity.

**form** - Temporary structure erected to contain concrete during placement and initial hardening. Wooden **form boards** should be removed after concrete has set up; form boards that are left in place can be readily infested by termites.

**foundation** – Lower parts of walls on which the structure is built. Masonry **foundation walls** are mainly below ground level.

**foundation/sill plate insulation** - Commonly “tar board”, as used in sidewalk expansion joints, is installed as an insulation layer between the concrete foundation wall and wood sill plate. Termites will not eat or damage this “tar board,” but they may tube over it or around it. Occasionally, “celotex” (a cellulose material) is used and can be eaten and damaged by termites and damaged by carpenter ants. Most recently, the material being used for foundation/sill plate insulation is a thinner, lighter plastic foam material. Termites do not feed on it, but they can penetrate through it.

**frost line** – The depth of frost penetration in soil. This depth varies in different parts of the country.

**furring strips** - Small strips of wood or metal attached to masonry walls that allow for a wall covering to be attached.

**grade** - The inclination or slope of the ground on the outside of a structure.

**gradient** - The degree of the angle of the grade. A negative gradient moving away from the structure is needed to be sure that water drains away from the foundation.

**grain** – The direction, size, arrangement, appearance, or quality of the fibers in wood.

**grout** – Mortar of a consistency that it flows into the joints and cavities of masonry work and fills them solid.

**header** – [a] A beam placed perpendicular to joists and to which joists are nailed in framing for a chimney, stairway, or other opening. [b] A wood lintel. [c] The horizontal structural member over a door or window opening.

**header joists** - Horizontal boards that are fastened to the end of the floor joists to provide stability and “close” off the voids between the floor joists to the outdoors.

**joist** - One of a series of parallel members (usually wood) used to support floor and ceiling loads.

**lintel** – The top piece over a door or window that supports walls above the opening.

**masonry** – Stone, brick, concrete, hollow tile, concrete block, gypsum block, or other similar building
units or materials, or a combination thereof, bonded together with mortar to form a wall, pier, buttress, or similar mass.

**mortar** - A mixture of cement (or lime) with sand and water used in masonry work.

**pier foundation** - A type of foundation in which masonry or wood columns are used to support floor joists or floor girders of a structure. This type of construction generally allows more access for termites to the structure.

**plenum** – A condition in which the pressure of the air in an enclosed space is greater than that of the outside atmosphere.

**plywood** - A panel of wood made of three or more layers of veneer that are compressed and joined with glue.

**porch** – An open or enclosed gallery or room attached to the outside of a building at an entrance. Sometimes called a veranda or portico. Porches often harbor termites because they allow for moisture due to leaks or condensation.

- **pier supported porch** – A porch that is constructed of concrete or wood and supported by a frame on top of “piers” usually at two corners of the porch and then attached to the structure, or on all four corners of the porch. The area under this type of porch may be a crawl space.

- **slab-on-grade porch** - A concrete slab poured directly on the soil (or gravel) without a foundation. The area under this porch is inaccessible.

- **supported slab porch** - A porch with a foundation, usually brick, concrete block, or poured concrete that “supports” a concrete slab. The area under this type of porch may be a hollow crawl space, either accessible or inaccessible. If the area is filled with soil and/or gravel, it is considered inaccessible.

**poured foundation** - A concrete foundation constructed in place with the use of forms to mold poured concrete into solid walls.

**rafter** – One of a series of structural members (usually wood 2 X 10’s or 2 X 12’s) installed on edge and at a pronounced slope to form and support the roof. The rafters of a flat roof are sometimes called roof joists.

**rubble foundation** - A foundation constructed from field stones. This type of construction is usually only found in older homes. Many irregular voids are created and these can provide multiple pathways for termites and/or moisture to enter the structure.

**sheathing** - The structural covering, usually plywood, wafer board, or particle board, used over studs, floor joists, or rafters/trusses of a structure.

**sill** – [a] The bottom framing member (usually a 2 X 4 or 2 X 6) resting on the foundation wall and supporting the floor joists. The sill usually is bolted (with anchor bolts) to the foundation wall. [b] The member forming the lower side of an opening, such as a doorsill or window sill.
sill plate – The bottom horizontal member of an exterior wall frame resting on top of the foundation wall and usually anchored to it. The sill plate usually is treated lumber.

sole plate - The bottom horizontal member (usually a 2X4) of an interior wall frame (either a load bearing or non-load bearing wall). Wall and partition studs rest on and are supported by the sole plate.

splash block – A small masonry block laid on the ground to receive roof drainage from downspouts and to carry it away from the structure.

stair stringers - Angled structural elements that support the stair treads (steps) and the risers (backs of steps). The base of stringers is sometimes embedded in the concrete slab in basement construction.

stoop - One or two steps of wood or concrete, leading into a structure (house or porch) and positioned directly against the structure.

stucco - A plaster material, usually made with Portland cement or synthetic compound as its base, that provides a decorative and functional exterior wall covering.

stud – One of a series of vertical structural members (usually wood or metal) placed as supporting elements in walls and partitions. Studs are commonly covered by drywall or other finished material on the interior and sheeting or other weather resistant material on the exterior.

sub-floor – Boards or plywood installed directly on the floor joists, over which a finish floor is laid.

support posts - Metal or wood posts or columns that support floor joists from the crawl space, basement, or porch overhangs.

terrazzo – High-quality flooring consisting of white or colored grout with ornamental stones divided into sections with brass strips and ground to a smooth finish.

threshold – A strip of wood or metal with beveled edges used over the sill of a doorway or entryway.

tile block foundation – A building foundation formed from hollow ceramic tiles that are stacked in a staggered arrangement and held together with mortar. These hollow blocks can allow access to the structure by termites.

trimmer stud - The vertical structural member (usually wood or metal) that supports a header at a door, window, or other opening.

vapor barrier – A material, commonly polyethylene sheeting, used to retard the movement of water vapor into walls, floors, or slabs and to prevent condensation in them. (A vapor barrier may be incorporated into the insulation, or it may be attached to studs or the foundation walls, or it may be positioned under the concrete slab or on top of the crawl space floor.) Also, a covering used over the soil/gravel floor of a crawl space.

wood foundation - A type of foundation in which footings, studs, and all other components of the foundation are composed of wood (preservative-treated lumber and/or plywood). Wood foundations
present a variety of concerns and problems related to inspecting and treating for wood-destroying insects.
Understanding Foundation Types

The three basic foundation types are: **slab-on-ground**, **crawl space**, and **basement**. There are several types of slab-on-ground foundations, including **monolithic slab**, **supported slab**, and **floating slab**. **Plenum** is a type of closed crawl space construction. These foundation types are shown in Figure 5.1. Each foundation type is discussed in further detail in this chapter.

A structure’s susceptibility to termite attack is greatly influenced by the construction type(s) as well as by construction practices. Some types of construction are more prone to hidden termite infestations than others. As discussed in chapter 8, treatment procedures differ somewhat depending on the foundation type.

![Figure 5.1 Foundation types. (Handbook of Pest Control, 7th Edition, [original figure slightly modified])](image)

**Slab-on-ground foundation**

Slab-on-ground construction is used extensively throughout the U.S. The three basic types of slab-on-ground foundations, **monolithic slab**, **supported slab**, and **floating slab**, vary in their susceptibility to termite attack.

In **monolithic slab** construction, the concrete foundation footing and slab floor are formed as one continuous unit (Figure 5.2). A solid concrete foundation eliminates joints and other structural features that permit hidden termite entry. A monolithic slab typically provides the best protection against termites. However, the homeowner also may have a false sense of security, because many termite entry points are not readily visible.

Figure 5.3 shows possible termite entry points for a monolithic slab foundation. Because termites have to come up over the solid concrete foundation and into the exterior block masonry to gain access to the structure, these sites are not the main source of termite problems in monolithic slabs. Problem areas generally are limited to the

![Figure 5.2 Monolithic slab foundation. (Illustration courtesy of MSUE)](image)
openings for pipes and plumbing, any faults or cracks in the slab, and grading stakes or other articles embedded in the slab that termites might use to gain access to the structure. Furthermore, termites can travel up the outside wall and behind an exterior veneer of brick, stone, or stucco, particularly if the veneer extends below grade.

In **supported slab** construction, the slab floor and the foundation wall are separate units, with the slab floor extending over the top of the foundation wall, which supports it (Figure 5.4). The slab floor is concrete; the foundation wall may be constructed from a variety of materials, such as solid block, hollow block, or concrete.

When the slab extends completely across the top of the foundation (Figure 5.4A), the joint between the foundation wall and the slab is visible on the outside of the structure. It is important that the lower edge of the slab is not below grade, but rather kept open to view. Then, if a vertical crack develops in the masonry foundation wall, termites will have to tunnel over an exposed part of the concrete slab (Figure 5.5). Nonetheless, termites may enter a structure via any cracks that develop in the concrete slab, and their entry points may not be readily visible (Figure 5.5).

When the edge of the slab rests on the foundation wall (Figure 5.4B), a hidden joint is created around the entire inner perimeter of the structure. Termites can gain hidden
access through the expansion joint. This type of construction is very susceptible to termites, similar to that observed for floating slab construction (discussed in next section).

In floating slab construction (sometimes called suspended slab construction), the concrete slab floor and the foundation wall are separate units, with an expansion joint between them (Figure 5.6). The expansion joint is hidden by the interior floor covering. The slab floor does not extend over the top of the foundation wall, but instead rests on the fill material. The foundation wall can be composed of a variety of materials, such as hollow concrete block, solid block, or concrete.

Floating slab construction is very susceptible to termites, which may enter via several hidden routes. Termites can move from the sub-slab area, up through the expansion joint between the concrete slab and the foundation wall, then into the interior furred wall as shown in Figure 5.7. They may proceed upward to feed on wood floors, doorjambs, window frames, and even roof timbers. Termites also can gain access into the concrete block where it meets the footer then travel upwards inside the block voids. This allows them access to nearly all of the wooden structural members in the house, as well as to any framing and wooden trim. When the foundation is made of hollow concrete blocks, preventing termite entry through the center voids is a primary concern.

Another less common method of termite entry into floating slab construction is from the outside soil, up over the surface of the concrete block (via shelter tubes), into a crack or void in the masonry (Figure 5.7). The termites then can move upwards through the concrete block voids or into the furred wall. This is more common when there is an attached outside slab such as a sidewalk or carport that abuts the exterior structure, leaving an expansion joint as well as an unexposed, protected site for termite activity.
Crawl space foundation

Crawl space construction is common in many parts of the country. A **crawl space** is an unfinished shallow space, usually less than 3 feet high, below the living quarters of a structure (see Figure 5.8). This space is not livable or habitable. The floor of the crawl space often is exposed soil or gravel, although it occasionally is concrete. Masonry piers may be present inside the crawl space. The crawl space often is enclosed by the foundation walls and may or may not be accessible to the inspector.

Termite entry points into crawl space construction are shown in Figure 5.9. The exposed soil, the short distance to wooden floor joists and sills, the relative dampness, and the sheltered conditions are factors that make crawl spaces an ideal place for termites to find and infest wood. Crawl spaces also often contain cellulose-based trash and debris that termites can feed upon.

Some buildings are constructed so that the crawl space under the home is used as a **plenum** for air distribution (see Figure 5.1). A plenum crawl space requires specific insulation and air sealing so that it can be used for air distribution. The air from a central furnace is blown into the closed crawl space and allowed to enter the living space via air registers cut into the floor. A potential drawback is that delivery of cool air to the crawl space can lead to condensation of moisture from hot, humid outdoor air if it comes into contact with poorly insulated/sealed portions of the crawl space. Inspection of a plenum crawl space may be difficult or impossible due to accessibility issues.
**Basement foundation**

A basement (Figure 5.10) is a habitable area either completely or partially below grade and beneath the main story of the home or structure. It may be either finished or unfinished—with or without wall and ceiling coverings, respectively. Finished basements have many inaccessible areas.

Basement construction is vulnerable to termites. Typical termite entry points into basements are shown in Figure 5.11. Termites can enter a basement at the slab expansion joint where the floor and wall meet. Termites also can travel behind the brick veneer of a foundation wall. They may gain entry via cracks or holes in the concrete slab floor of the basement or via wooden support members that extend into the soil. It is important to remember that termites can enter through any crack or crevice as small as 1/32 of an inch.

![Figure 5.10 Basement construction.](Illustration courtesy of MSUE)

![Figure 5.11 Arrows indicate possible termite entry points into basement construction.](Illustration courtesy of MSUE)
CHAPTER 6

INSPECTING STRUCTURES

- Inspecting the exterior of the structure
- Inspecting the interior substructure
- Crawl spaces
- Unfinished basements
- Finished basements
- Slabs (the area under the slab is understood to be inaccessible)
- Inspecting the living areas of the structure
- Inspecting attics

This chapter is intended to give the inspector the basic principles for conducting a visual wood-destroying insect (WDI) diagnostic inspection. Although the inspector IS NOT REQUIRED to report any conditions that are conducive to an insect infestation, this knowledge is invaluable in the decision-making process of where to inspect.

The WDI inspection is intended to report any visible evidence of reportable insect infestations in or on the structures to be inspected. **Live insects do not need to be present on or in the structure to report the structure as infested.** Evidence of termite activity may be mud shelter tubes, shed swarmer wings, or excavated wood. Carpenter ant activity may be determined from frass or excavated wood. Frassed exit holes in wood and loose frass may be evidence of powderpost beetles. Carpenter bee activity may be evident from round holes in fascia boards or deck rails and fecal material and dislodged pollen on uppermost siding.

In addition to inspecting for wood-destroying insects, the inspector must look for signs of previous treatments or inspections. Inspection companies and pest management companies often place their printed stickers in areas that should be conspicuous to another inspector. Look for these stickers on electrical panels, furnaces, water heaters, stairway stringers, etc. Evidence of previous treatment for wood-destroying insects, may include drill holes in the foundation walls and slabs (sidewalks, porches, driveways, house and garage slabs) or termite bait stations. If the seller or agent is available, ask them if they know of any previous WDI treatments.

**Scope of the Inspection**

The inspection process begins with ordering of the inspection by a real estate agent, title company, mortgage company, buyer, or seller. At the time of taking the order, the inspection company should:

1. Ask what structures on the property are included in the purchase contract and therefore need to be inspected.
2. Ask for pertinent information about closing to allow for sufficient preparation time and delivery of the report.

The WDI inspection should only include the main structures, usually a house and any attachments to it such as additions, attached porches/decks and attached garages, and any detached or "out buildings" as requested by the person ordering the inspection and report.
Fence posts, mulch, stumps, and wood piles are not considered part of the structure according to the state-mandated form NPMA-33 guidelines. However, an inspection of these items will help the WDI inspector to determine if wood-destroying insects are present nearby. Wood-destroying insects found in locations other than the actual structure may be reported in the comments section of the NPMA-33 form, but the inclusion of such comments is at the discretion of the inspector.

**Inspection Equipment**

Upon arriving at the structure to be inspected, the inspector should have as a minimum a powerful flashlight (extra batteries and bulbs or an extra flashlight often prove necessary) and a probe (flat-headed screwdriver, awl, ice pick, or similar tool) for testing the integrity of wood in the structure. It is imperative to bring the report form (NPMA-33 form) and a pen; a clipboard is useful for holding these materials.

Other tools and equipment that frequently are needed during a WDI inspection include:

- Measuring tape
- Ladder
- Tool kit with screwdrivers, pliers, hammer, etc.
- Inspection mirror
- Thin saw blade
- Moisture meter
- Camera (still, video, digital)

It is a good idea to bring items for personal protection such as:

- Gloves
- Coveralls
- Bump hat
- Knee pads
- Dust mask

Other items that may be helpful in certain circumstances, but typically are not part of an inspection, include:

- Fiber optic device (Boroscope®)
- Termite detection dog
- Methane detector
- Stethoscope

**Inspecting the Exterior of the Structure**

On the exterior of the structure, the inspector should look for any wood-to-ground contact. In locations where the grade level or abutting slab is above the sill plate, termites do not even need to build mud tubes to get to the structure, and thus they may be hidden and difficult to detect. The inspector should look closely if this situation exists. The inspector should look for termite shelter tubes on the slab. The inspector should look for any rigid foam insulation, particularly if it contacts the soil, as this can provide access and shelter for termites and it is a favorable nesting site for carpenter ants. Next to or along the foundation, be sure to inspect for old form boards, wooden stakes, and any cellulose-based materials that can provide a potential food source for termites. When inspecting the exterior of the structure, some other areas that should be examined include:

1. Siding below grade or near grade
2. Planter boxes
3. Firewood piled against the structure
4. Garage doorframes and other exterior doorframes
5. Carports
6. Enclosed porches
7. Siding behind porch slabs

Subterranean termites need moisture to survive. The inspector should pay attention to the soil grade to determine if it properly slopes away from the structure as this affects moisture accumulation near the foundation. The inspector should carefully inspect areas that are damp or wet. Some typical areas to inspect include:

1. Air conditioners
2. Leaky spigots
3. Sprinkler systems
4. Downspouts, gutters, and/or sump pumps, particularly if improper drainage is evident
5. Flat roofs
6. Chimneys
7. Dense vegetation against foundation walls
8. Thick mulch against foundation walls

The inspector should check other potential areas for wood-destroying insect activity such as:

1. Deteriorating or rotted window and door frames and siding
2. Pipes and conduits that penetrate through the foundation walls
3. Cracks in the foundation walls or slab
4. Foundation abutting earth-filled porches
5. Fascia boards and nearby siding (look for carpenter bee holes and fecal material/dislodged pollen)

The exterior of the structure must be inspected for indications of carpenter ant activity. Some of the areas to examine for carpenter ants entering the structure include:

1. Utility wires connected to the structure
2. Trees touching the structure
3. Attached fences
4. Porches
5. Roof overhangs
6. Loose siding
7. Any areas of the structure with evidence of moisture problems
8. Wood piled against the structure
9. Hollow columns

Decks and porches are considered part of the structure if they are attached to the structure. Carefully inspect and probe any areas that have wood-to-soil contact and look for evidence of termite activity. If the bottom of the floor joists is less than 18 inches from the ground, inspect as best as possible without entry under the deck and report this area as inaccessible on the NPMA-33 form. Although decks are usually constructed of treated lumber, experience has shown that attack by wood-destroying insects can still occur especially on weathered wood. Carpenter ants commonly infest void areas created between decks and the original structure as well as void areas of decks and hollow support columns.

The inspector also should pay attention to the shape or footprint of the foundation. It may be that some
of the areas beneath the structure should be inspected (if accessible), but they may not be
distinguishable and/or accessible from inside the structure. These may include additions to the structure
that may be of crawl space or slab construction. A tape measure is useful to compare interior and
exterior linear dimensions of the structure, which can reveal hidden or inaccessible areas.

Since snow, ice, and heavy rain are a possibility in Ohio, there may be times when the inspector is unable to
thoroughly inspect the exterior of a structure. If snow, ice, or standing water prevents access to areas normally
inspected, this should be reported in detail on the inspection form (NPMA-33). It may be recommended that
these areas be inspected at a later time when the weather conditions are favorable.

Inspecting the Interior Substructure
An area underneath a structure is one of four main types:

1. Crawl space
2. Unfinished basement
3. Finished basement
4. Slab (the area under the slab is understood to be inaccessible)

Inspecting a crawl space
Crawl spaces may be accessible from either outside or inside the structure. Diligence sometimes is
needed to locate the access to a crawl space. Utility rooms and closet floors are common areas to look
for an access door. Crawl spaces are sometimes only accessible from the exterior of the structure.

A crawl space opening that meets the dimensional requirements (at least 18 inches wide and 18
inches high) and can be reached using an eight-foot ladder is considered to be accessible. If the
entrance to the crawl space is less than 18 inches wide and less than 18 inches high, the crawl space is
considered inaccessible.

Any areas determined to be inaccessible in a crawl space must be reported as such on the NPMA-33
form. Any areas of the crawl space that are less than 18 inches from the floor of the crawl space to
the bottom of the floor joists are considered inaccessible. Any areas that are covered with
insulation and thus inaccessible for visual inspection must be reported as such on the inspection
report NPMA-33 and/or on attachments to it. The presence of some inaccessible areas does not
negate the inspector’s responsibility to visually inspect the remainder of the crawl space that is
accessible.

There may be occasions when the crawl space is obstructed or contains standing water so as to render
the crawl space inaccessible. Unsafe conditions such as broken glass, animals, faulty electric wiring,
etc. also may limit access to a crawl space. It may be recommended that the crawl space should be
inspected at a later time when the obstructions, water, or unsafe items have been removed. Once again,
it is critical to provide proper, thorough, and detailed documentation of these situations using the
NPMA-33 form.

When inspecting a crawl space, effort must be made to "crawl" to all accessible areas to visually
inspect them. Personal protection items such as gloves, coveralls, a bump hat, knee pads, and a dust mask
are particularly important in crawl spaces. An inspection should include the visually accessible sub-floor
under kitchens and bathrooms where potential moisture problems may exist. In crawl spaces, always
inspect for direct evidence of WDI activity such as:
1. Termite shelter tubes on foundation walls, piers, and wood members
2. Free-standing termite shelter tubes (hanging down or coming up from soil)
3. Damaged wood
4. Carpenter ant frass
5. Live or dead insects or insect parts (such as termite wings) (note that insects often are caught in spider webs)
6. Powderpost beetle exit holes and/or frass

Conditions in crawl spaces that contribute directly to termite activity are:
1. Cellulose debris
2. Wooden form boards and stakes
3. Foundation cracks
4. Tree roots or stumps
5. Foam insulation along footers and foundation walls

Moisture problems in crawl spaces are common. The inspector should recognize moisture conditions that could lead to an insect infestation, such as:
1. Poor ventilation
2. Standing water
3. Plumbing leaks
4. Faulty grade levels
5. Faulty or cracked foundation walls
6. Lack of a moisture barrier on the crawl space floor
7. Faulty downspouts and drains
8. Insulation between floor joists and in the box sill

**Inspecting an unfinished basement**

Unfinished basements have no wall coverings and no ceiling covering. Unfinished basements allow for a visual inspection of critical areas such as the sill plate, box sill, and floor joists. In some situations, insulation may prevent a thorough examination of these areas. **Any areas which are covered with insulation and thus inaccessible for visual inspection must be reported as such on the inspection report NPMA-33 and/or on attachments to it.** The inspector also should check the basement window frames for insect activity, particularly if the window sills are below grade. Spider webs, particularly those near windows, should be examined for evidence of wood-destroying insects. Inspect any utility lines coming through the foundation walls or basement floor. Check the furnace area for signs of termite shelter tubes and termite swarvers.

**Inspecting a finished basement**

Finished basements pose a challenge for the WDI inspector. Many of the areas that are critical to inspect are covered with various materials that can hide evidence of insect activity. Even the bottom of the stair stringers may be hidden or inaccessible for visual inspection.

If the ceiling covering is drywall or permanently attached acoustical tile, the area above or behind the ceiling is considered to be inaccessible to inspection and should be reported as such. Drop ceilings with tiles suspended in a support grid may be removable around the perimeter of the room to permit limited access to critical areas. **Although some suspended tiles may be removed at the inspector's discretion, this is still considered to be a very limited visual inspection, and any area with a drop ceiling should be reported as inaccessible (in accordance with NPMA directive based on HUD specifications).**
It is common to encounter insulation in areas above dropped ceilings, which further makes the area less accessible for inspection or totally inaccessible. **Actual conditions of accessibility or inaccessibility, whether by the ceiling materials and/or insulation, must be reported on the NPMA-33 form and attachments to it.**

**Inspecting a slab foundation**
Note that the area under the slab is understood to be inaccessible. Termites can gain access to the structure through expansion joints, cracks in the slab, and openings around plumbing, so all of these sites require inspection. The accessible baseboards and doorframes on slab construction should be tapped and inspected for insect activity or damage. Pay particular attention to bathrooms and kitchens. Inspect inside bath traps that are accessible. Inspect around any pipes that come through the slab floor and along seams in the floor for signs of termite shelter tubes and evidence of swarming. As previously noted, when conducting the exterior inspection, look for evidence of shelter tubes on the outer edge of the slab.

**Inspecting Living Areas of the Structure**
Pay particular attention to bathrooms and kitchens. Inspect inside bath traps if accessible. Inspect around any pipes that come through the walls or floor and along seams in the floor for signs of termite shelter tubes and evidence of termite swarmers. Accessible baseboards and door frames should be tapped and inspected for insect activity or damage. Inspect all windowsills for evidence of deterioration from insect activity or dead insects that were attracted to the outside light.

The inspector should realize that occasionally, cosmetic materials and/or stored items are used to cover evidence of insect activity or evidence of damage. Inspect carefully in any areas with new wallpaper, trim, or paint.

**Inspecting Attics**
Care and judgment must be used by the inspector when entering an attic. **Attics without floors should be reported as inaccessible. Attics with no stairway or pull-down stairs should also be reported as inaccessible.**

If the attic has a floor suitable for walking or crawling and has pull-down stairs or a stairway, that attic should be inspected. Inspect the sheeting, rafters, and eaves if possible. Inspect areas around pipes and chimneys where roof leaks might lead to an insect infestation. If the attic is accessible, the inspector should look for:

1. Termite shelter tubes
2. Shed termite swarmer wings
3. Carpenter ants

The attic typically contains insulation that limits or prevents the inspector from making a visual inspection of critical areas within the attic. If this is the case, this must be reported on the NPMA-33 form and its attachments.
CHAPTER SEVEN

MANAGEMENT OPTIONS FOR WOOD-DESTROYING INSECTS

This training manual is designed to advise on the proper procedures for inspecting and reporting of wood-destroying insects. If evidence of wood-destroying insects is found during an inspection, the inspector needs to determine if treatment is necessary and to recommend treatment. On the NPMA-33 form, the box to be checked reads, "ACTIVE; treatment recommended at this time." See Chapter 7 for instructions on reporting the results of an inspection using the NPMA-33 form.

In Ohio, any company that treats an insect infestation for hire must have the proper license from the Ohio Department of Agriculture. Treating for termites, carpenter ants, powderpost beetles, and carpenter bees requires licensing in the "Termite Control" category.

An integrated pest management (IPM) approach involves multiple tactics, such as preventive measures, exclusion, sanitation, and chemicals applied to targeted sites. Homeowners should know that there are various options for insect management. The best treatment option varies depending on a number of factors, such as type of insect, the severity of infestation, the area being attacked, the potential for re-infestation, and expense the customer is willing to bear.

Subterranean Termite Control
Many methods are available for accomplishing termite control and thereby protecting structures from the damage that these insects can cause. The numerous options provide additional flexibility for the termite control specialist, who is knowledgeable of the various methods, technological advances, equipment and tools available, and how to integrate and coordinate the use of these methods to enhance treatment results. The pest management professional (PMP) is able to obtain up-to-date information on termite control by attending training sessions and conferences, reading and reviewing product labels and other literature, and discussing the products with researchers, manufacturers, distributors, and other qualified individuals.

The homeowner can be confused by the many marketed termite control options. Termites feed slowly so there is no need to panic, and a few weeks or months may be needed to decide on a course of treatment, which typically requires employing a professional pest management firm. Homeowners are unlikely to have the experience, availability of pesticides, and equipment needed to perform the job effectively. The homeowner should consider getting at least three estimates before signing a contract for control measures and should be cautious of price quotes that are substantially lower or higher than the others. Prices for termite treatment and conditions of warranties often vary considerably. A guarantee is no better than the firm who presents it, so selecting a reputable pest management firm is of utmost importance.

The homeowner should deal only with licensed, certified pest management firms having an established place of business and a good professional reputation. Ideally the firm will belong to a city, state or national pest management association. It is a very good idea to consult the state’s licensing agency to determine a firm’s complaint history. In Ohio, licenses are issued through the Pesticide Regulation Section of the Ohio Department of Agriculture (614-728-6987 or 800-282-1955). Information on selecting a reliable pest management firm is presented in OSU Extension Fact Sheet HYG-2091-03.
Overall, as part of a termite control program, consideration should be given to removing or changing any condition that exists in or around a structure that aids the termites ability to gain access to the structure. Mechanical alterations are services or functions that can be performed in conjunction with a termite control treatment. Mechanical alterations may include, but are not limited to, removal of wood and cellulose materials from contact with soil in the crawl space and around the exterior perimeter of the structure; correcting water problems due to faulty grade levels, non-functioning or improperly functioning sump pumps, or faulty gutters and downspouts; removing or eliminating soil-to-wood contact of siding, porches, sill plates, steps, etc.; and repairing the plumbing, siding, or roof in order to eliminate leaks or excess moisture conditions.

**Soil Termitecide Treatments**
Specialized tools and equipment are needed to apply a soil termiticide. Effective termite control often requires several hundred gallons of prepared termiticide solution per house, depending on size, foundation type, etc. As noted in Chapter 5, an individual must have knowledge of construction elements and construction types in order to effectively perform termite soil treatments. Termite entry points vary in each foundation type, thus different soil treatment procedures are required. For example, with slab construction, it may be advisable to treat from the outside by drilling through the foundation wall because of the hazard of potentially drilling through heat pipes or ducts, electric conduits, and plumbing imbedded in a slab floor. Mechanical alteration may be necessary depending on the type of construction.

There are many important factors that the pest management professional (PMP) should consider when determining what soil termiticide to use and where. Experience actually using a product and knowledge of termite biology and control will undoubtedly help in selecting a termiticide. Some factors to consider are: how long the termiticide is expected to be effective?; What are the label instructions for application?; Are there issues regarding safety, mixing, concentration, ventilation, etc.?; What are the odor characteristics of the termiticide?; Does the chemical have insect repellent properties?; How does the product perform under environmental conditions such as damp soil, hard pack soil, under slabs, in crawl spaces, etc.? Disruptive noise and disturbance factors should also be considered. Certain structural elements or conditions such as wells within or near the foundation of the structure, cisterns, a high water table, foundation drainage problems, sump pump discharge, nearby lakes or streams, and a variety of other conditions require care and strict adherence to the label directions.

When performed properly according to label directions, soil termiticide treatments provide an effective method to protect structures from infestation and damage by subterranean termites. Pre-treating to prevent termites is a practice that often is employed in regions of the country that have high termite pressure.

**Barrier-Type Soil Termiticides.**
Conventional soil treatments rely on creating a chemical barrier in the soil that is toxic to termites contacting it. Many also have repellent characteristics and termites avoid the treated soil. To achieve termite control for long periods of time, such termiticides must be applied as a continuous barrier in the soil next to and under the foundation. If there are untreated gaps in the soil, termites may bypass the chemical treatment, thus allowing continued infestation or reinfestation of a structure. Soil termiticide treatments during pre-construction can provide for more uniform coverage.
Once a home is constructed, the chemical has to be injected through drill holes and trenching around the foundation, which can result in less accurate coverage. Termiticides may need to be applied to numerous sites, including masonry and other structural components; under slabs, sidewalks, driveways, and porches abutting the foundation; and inside hollow foundation walls.

Most pest management firms will refuse to do "spot treatments only" using barrier termiticides or they will not guarantee such treatments, because termites have a very high probability of finding other untreated points of entry into the structure. Localized spot treatments are considered risky except in re-treatment situations.

Termiticides that act by creating a chemical barrier in the soil include bifenthrin (Talstar®), cypermethrin (Demon®, Prevail®), and permethrin (Dragnet®, Prelude®).

**Treated-Zone Soil Termiticides**
The most recently marketed termiticides are non-repellent to termites, but they show delayed toxicity as termites forage through treated soil. Termites apparently do not avoid the "treated zone" so they contact the active ingredient, which causes delayed mortality and also possibly allows the termites to be overcome by lethal microbes. Furthermore, the toxicant is thought to be passed to nestmates through grooming activities and social food exchange (trophallaxis). Control usually is achieved within 3 months. As with soil barrier termiticides, specialized application equipment and large volumes of chemical solution are needed.

Non-repellent termiticides include fipronil (Termidor®), imidacloprid (Premise®), and chlorfenapyr (Phantom®).

**Termite Baits**
Baits rely on the biological fact that termites are social insects that feed and groom each other, hence providing a mechanism for transfer of chemical throughout their colonies. Because of social exchange of food (trophallaxis), termites can be affected by a slow-acting toxicant without directly contacting or feeding upon it. Furthermore, baits can have colony-wide effects because individual termites are not site-specific, but instead move freely between numerous interconnected sites during relatively short periods of time. They also intermix with other colony members so that the same group of termites does not simultaneously visit a bait site.

Wood or some other type of cellulose is used in termite baits, because cellulose (wood) is the food of subterranean termites. The cellulose is impregnated with a slow-acting toxicant that cannot be detected by the termites. The toxicant necessarily is slow acting because termites tend to avoid sites where sick and dead termites accumulate. Termite workers feed on the treated material and carry it back to other colony members, where it slowly poisons the termites and eventually reduces or eliminates the entire colony.

The toxicant in a number of bait systems is classified as a chitin synthesis inhibitor (CSI). CSIs disrupt the termites' normal molting process, causing them to die in the process of shedding their skin (molting). CSIs can achieve their effects because worker termites continue to molt periodically throughout their life and they comprise the majority of the colony. Furthermore, workers feed other colony members, which starve as the worker population is depleted.
Typically, in-ground stations are inserted in the soil next to the structure and in the vicinity of known or suspected sites of termite activity. In-ground stations often initially contain untreated wood that serves as a monitoring device. The monitoring wood is replaced with the toxicant once termites have been detected feeding on it. In addition, aboveground stations may be installed inside or on the structure in the vicinity of damaged wood and shelter tubes. Aboveground stations initially contain bait. The use of aboveground stations in combination with in-ground stations can enhance delivery of the bait toxicant to the colony.

**Successful termite baiting necessitates proper installation, monitoring, and maintenance of the stations.** It is very important that bait systems are diligently serviced. Some bait systems are labeled for monthly inspections, and others are designed for quarterly inspections.

Baits work much more slowly than soil termiticides, and the homeowner should be aware of the possibility of a lengthy baiting process. Several months or more may elapse before the termites locate stations, then termites must feed on sufficient amounts of the toxicant. An often-cited advantage of termite baits is that they are "environmentally-friendly" because they use very small quantities of chemical and decrease the potential for environmental contamination. In addition, bait application causes little disruptive noise and disturbance compared to soil treatments. Furthermore, baits can be used in structures with wells or cisterns, sub-slab heating ducts, and other features that may preclude a soil treatment. Baits are often used in sensitive environments.

Bait systems are frequently offered as an ongoing service due to the fact that a chemical barrier is not established and when baiting is discontinued, no residual chemical remains. Termite baiting is a complex subject that is discussed in greater detail in the [OSU Extension Fact Sheet HYG-2092A-03](#). A number of baits have been marketed to control termites. Most are only available to licensed pest management professionals (PMPs), and these include: Sentricon® Termite Colony Elimination System (noviflumuron [Recruit® IV bait]), Hex-Pro® (hexaflumuron), FirstLine® Termite Defense System (sulfluramid), Exterra® Termite Interception and Baiting System (diflubenzuron [Labyrinth® bait]), Subterfuge® Termite Bait (hydramethylnon), and Advance® Termite Bait System (diflubenzuron). Not all of these bait systems are equally effective. It is advisable to review the independent research that has been conducted on a particular bait, as some products have been evaluated much more rigorously than others.

Little or no research has been conducted to verify the effectiveness of over-the-counter termite bait products, particularly when used by homeowners. Spectracide Terminate® (sulfluramid) and Termirid® 613 (borate) can be purchased by homeowners. According to the label, Terminate® is not recommended as sole protection against termites, and an active infestation should be treated by a professional. **The label indicates that the product is intended to be used before termites find the home.** Terminate® stakes do not replace mechanical alteration and soil treatments. Termirid® can be used to reduce subterranean termite populations.

**Treated Wood**
Wood treatments are primarily used to supplement other termite control measures, because termites are able to attack untreated wood in other areas of the structure. Wood treatments typically are applied to localized areas, and they generally are used in conjunction with a soil treatment or baiting system.

Certain products are used to treat wood to control active termites in the wood and also to protect it against
termites. Borates (disodium octaborate tetrahydrate [Tim-bor®, Bora-Care®, Jecta®, Impel®]) protect wood against termites and wood-decay fungi. The borates are popular products because of their very low odor and long lasting properties. However, borates are fairly soluble in water, so borate-treated wood should be protected from constant rewetting. They are not suitable for situations where wood is in direct contact with soil or exposed to rainfall.

The use of CCA (creosote, chromated copper, arsenate) pressure-treated wood in residential settings is no longer approved by the EPA (as of 1 January 2004) because of concerns regarding its arsenic content. However, even creosote-treated railroad ties and telephone poles, and CCA-treated wood, over time, can be subject to termite attack. Termites can build mud tubes over treated surfaces. Furthermore, termites can gain entry through cut and cracked ends or areas where the chemical has not sufficiently penetrated.

**Physical Barriers**
Physical barriers are particularly appropriate during the pre-construction phase to provide protection of the structure from subterranean termites. One such physical barrier is stainless-steel wire mesh (TermiMesh®) that is fitted around pipes, posts, or foundations. The newest physical barrier, Impasse® Termite System, contains a liquid termiticide (lambda-cyhalothrin) locked in between two layers of heavy plastic that is installed before the concrete slab is poured. It is supplemented with Impasse® Termite Blocker, which uses special fittings around plumbing and electrical pipes and conduits.

**Biological Control Agents**
Certain species of parasitic roundworms (nematodes) will infest and kill termites and other soil insects. They have been promoted and marketed by a few companies. Although effective in the laboratory, control is often quite variable under field conditions. Limited success with nematode treatments may be attributed to the ability of termites to recognize and wall-off infected individuals, hence limiting the spread of nematodes throughout the colony. Furthermore, soil moisture and soil type appear to limit the nematode’s ability to move in the soil and locate termites.

A fungus *Metarhizium anisopliae* (Bio-Blast®) is a biological termiticide that requires special application and handling techniques. It is labeled for aboveground application to termite infestations in structures, but it is not labeled for application to the soil. Spray effectiveness is enhanced when applied to many foraging termites because infected termites can pass the fungus to nestmates. However, it is difficult to infect a large enough number of termites for the infection to spread throughout the colony. Furthermore, it provides no long-lasting residual activity, and the fungal spores die along with the dead termites. Insufficient research has been conducted to indicate whether this is an effective method for controlling termites.

**Powderpost Beetle Control**
Powderpost beetles damage wood slowly. Thus, a homeowner should not think that immediate chemical treatment is needed to preserve the structural integrity of their home. A "wait and see" approach often is desirable, especially when there is doubt as to whether the infestation is still active.

**Prevention and Exclusion**
Infestations often result from improperly dried or stored wood that contained eggs or larvae when placed in the home. Most powderpost beetles are introduced into homes in lumber or finished wood products (e.g., furniture, paneling, flooring, etc.). Lumber which has been improperly stored or dried should not
be used, particularly if beetle exit holes are present. Many of the most serious infestations arise when old lumber from a barn or outdoor wood pile is used for home remodeling, such as paneling a room or building an addition.

Powderpost beetles only lay their eggs on bare, unfinished wood. Bare wood can be protected from powderpost beetle attack by painting, varnishing, waxing, or otherwise finishing exposed surfaces. Infestations by some bostrichid species can be avoided by removing all bark edges from wood. Beetles that emerge from finished articles such as furniture typically were in the wood before the finish was applied. Because many species of powderpost beetles emerging from finished wood can reinfest it by laying eggs in their own exit holes, it is important to seal the holes to prevent this possibility.

Anobiid infestations sometimes occur as a result of beetles flying in from outdoors or being carried in on firewood. Use tight-fitting screens on windows and doors to prevent entry of flying beetles.

**Moisture Control**
Powderpost beetles, especially anobiids, have specific moisture requirements for survival and development. Most beetles do not develop in wood with a moisture content below 15%. Wood moisture content of 13% to 30% are preferable for anobiid development/reinfestation. A moisture meter is useful for predicting potential beetle re-infestation of wood.

Wood moisture content varies seasonally, typically reaching its peak during mid- to late summer and its lowest levels during winter. Use of a central heating or air-conditioning system to reduce moisture levels to <12% can create unfavorable conditions for anobiids.

It is advisable to install a moisture or vapor barrier in the crawl space of buildings. Covering the soil with four to six mil polyethylene sheeting reduces wood moisture content. For existing anobiid beetle infestations, installing a moisture barrier greatly reduces the threat of the infestation spreading upwards into walls and upper portions of the building. A moisture barrier may slowly eliminate anobiid beetle infestations by preventing reinfestation.

Increased ventilation also can lower moisture in damp crawl spaces. This can be accomplished by installing foundation vents (one square foot of vent opening per 150 square feet of crawl space area if a vapor barrier is not present; one square foot of vent opening per 300 to 500 square feet of crawl space area if a vapor barrier is present). Make sure that vents are kept open. Remove any vegetation covering vents.

**Kiln-dried lumber**
Powderpost beetle infestations in lumber usually are removed by kiln-drying and wood-processing operations. For new construction, use kiln-dried lumber (dried a minimum of eight hours at 130 to 140 degrees F and 80% relative humidity).

**Wood replacement**
If the infestation appears to be localized (e.g., a few pieces of flooring, molding, or paneling), simply removing and replacing infested pieces may solve the problem. If additional holes begin to appear in adjacent areas, additional action can then be taken.

**Subzero Temperatures**
Powderpost beetle infestations in small, movable items can be eliminated by storage at
subzero temperatures for approximately 48 hours.

**Insecticide Treatment**

Control of powderpost beetle infestations in structural wood can be achieved by applying a liquid insecticide to the wood’s surface or its injection into the wood. Boron-based insecticides are effective in controlling powderpost beetles. These products tend to penetrate deeply into the wood to kill some of the larvae, and they are highly effective in preventing reinfestations. Effective control can be obtained by thoroughly spraying all exposed wood surfaces in crawl spaces or outbuildings with a boron-based insecticide. Liquid also can be pressure injected into the larval galleries through small holes drilled in the damaged wood. When wood is protected from the weather, such as in crawl spaces, boron-based products have a long residual lifetime.

A pyrethroid can be pressure injected into wood to provide quick contact-kill. Copper compounds are available for application to wood. Penetration on wood surfaces is only about 1/8 inch and protection is much shorter than CCA-treated wood.

Fumigation with an insecticide usually provides immediate control of all beetle life stages within the wood. However, this method is expensive and it provides no residual protection against beetle reinfestation. Infestations in small, movable items can be eliminated by fumigation. Tent fumigation of a structure generally is not warranted, although it may be the best choice for infestations of tropical species of bostrichids.

**Carpenter Ant Control**

**Prevention**

Homeowners should trim all trees and bushes so branches do not touch or come in contact with the house. High moisture conditions must be eliminated to help control carpenter ants. Correct moisture problems such as leaking roofs, chimney flashing, or plumbing; poorly ventilated attics or crawl spaces; and blocked gutters. Replace rotted or water-damaged wood and eliminate wood-to-soil contact. Remove dead stumps within 50 feet of the house, if practical, and repair trees with damage at broken limbs and seal holes in the trunk. Seal cracks and crevices in the foundation, especially where utility pipes and wiring occur from outside. Be sure to store firewood off the ground away from the house. Consider using non-organic mulches near the house in heavily infested ant areas.

**Insecticide Treatment**

The most important and often most difficult part of carpenter ant control is locating the nests. Furthermore, more than one colony may be present in the structure or on the property. Once the nest locations are found, control measures can be implemented. The nests can be removed physically (for example, by using a vacuum) or by a insecticide treatment.

Sometimes, chemical flushing agents are used to locate the nests. A household aerosol spray containing pyrethrins and piperonyl butoxide, applied directly into cracks, crevices or holes, will excite the ants by its repellent action, causing them to come running out, thereby revealing the presence of their nest in some instances.

Spraying or dusting the baseboards or cracks and crevices around the infested area with residual insecticides, without locating and treating the nest, usually does not give complete control. Foraging workers will contact the insecticide and die, but ants staying inside the galleries of the nest, along
with the queen and developing larvae, may not be affected to any great extent.

If the nest is located in a wall void, it is best to apply a dust via drill holes to help the insecticide penetrate. Treat three to six feet on either side of where ants are entering to hopefully contact the nest. Sometimes, a series of holes are drilled at 12-inch intervals in infested timbers to intercept cavities and galleries of the nest. Holes can later be sealed by putting in dowels, small corks, or an appropriate sealant and then touched up with paint, leaving no visible damage from the repairs.

Aerosol spray treatments to the nest can be effective, particularly if much insulation is present. Insecticidal vapors can spread within the wood to penetrate inaccessible areas of the nest, aiding in colony eradication. Approaches and areas adjacent to the nest must be thoroughly treated with residual insecticides.

Perimeter treatments are used outside the structure to prevent ant entry. All breaks where ants can enter the home need to be treated, and a perimeter spray applied against the foundation wall at least two feet up and three feet out. The treatment should be applied under the lower edge of sidings, around window and door frames, and around the chimney flashing. During the summer, a perimeter treatment should be re-applied every 4 to 6 weeks or within a week after a heavy rain.

Baits sometimes can provide control. Baits need to be a readily accepted food source that is carried back to nesting sites to eliminate the queen, brood, and workers. Baits need to be contained in childproof bait stations indoors. Liquid and granular formulations often are used outdoors.

**Carpenter Bee Control**

**Prevention**
Keep all exposed wood surfaces well painted with an oil base or polyurethane paint to reduce attack by carpenter bees. Wood stains will not prevent damage. If practical, remove and replace damaged wood with chemical pressure-treated wood to discourage nest construction. Or using aluminum, asbestos, asphalt, vinyl siding, and similar non-wood materials that are not damaged by carpenter bees.

**Insecticides**
Dust applications are usually more residual and effective than sprays due to the nature of the gallery construction. Even newly emerged bees will contact the dust when leaving the opening. Locate tunnel entrances during the daytime, but treat after dark, on a cool evening when carpenter bees are less active. Be sure to wear protective clothing to avoid any stings during treatment. Treat directly into the nest entrance and on a wide area of adjacent wood surface. Do not plug the entrance since bees should be allowed to pass freely to distribute the insecticide within the galleries. If tunnels are plugged before bees are killed, they may chew new openings elsewhere. After treatment, it may be a good idea to wait until adult activity ceases or until autumn before sealing the hole with caulking compound or wood putty, which reduces wood deterioration and possible future infestation.
CHAPTER EIGHT

OHIO GUIDELINES FOR COMPLETING THE NPMA-33 FORM
REPORTING THE RESULTS OF AN INSPECTION

901:5-11-13 Recordkeeping for wood-destroying insect diagnostic inspections.

Commercial applicators conducting wood-destroying insect diagnostic inspections:

A) Shall conduct all inspections in accordance with the practices set forth in the Ohio wood-destroying insect diagnostic inspection training program.

(B) Shall make a complete record of the findings of each inspection on form NPMA-33 which is attached to this rule as an appendix. For the purposes of this chapter, a “complete record” means that the information recorded in NPMA-33 [the form] shall be recorded pursuant to this rule. In the event of conflicting instructions for completing the form, the provisions of this rule shall apply for all inspections made within this state.

(C) Shall completely and accurately record the following information in section one of the form:

(1) The name, address and telephone number of the pesticide business conducting the inspection; and

(2) The license number of the pesticide business or registered location conducting the inspection; and

(3) The date of the inspection; and

(4) The physical address of the property inspected; and

(5) The name, license number and original signature of the commercial applicator conducting the inspection; and

(6) The specific structures inspected.

(D) Shall record the following in section two of the form for inspection findings on or within the specific structures inspected by:

(1) Checking box A if there is no visible evidence of wood-destroying insect [insect] activity;

(2) Checking box B if there is visible evidence of insects observed; and

(a) Shall, if live insects are observed:

(i) Check box B(1); and

(ii) List the types of insects observed; and
(iii) State the specific location (including by way of example but not limited to sill plates, foundation, etc.) where the insects are observed;

(b) Shall, if dead insects, insect parts, frass, shelter tubes, exit holes, staining or other physical evidence are observed:

(i) Check box B(2); and

(ii) Describe the type of insects and insect parts observed, and describe all other physical indicators observed, including but not limited to frass, shelter tubes, exit holes and staining; and

(iii) State the specific location (including by way of example but not limited to sill plates, foundations, etc.) where the dead insects, insect parts, frass, shelter tubes, exit holes, staining or other physical indicators are observed.

(c) Shall if visible insect damage to the structure was observed:

(i) Check box 3; and

(ii) Describe the type of damage observed; and

(iii) State the specific location (including by way of example but not limited to sill plates, foundations, etc.) where the dead insects, insect parts, frass, shelter tubes, exit holes, staining or other physical indicators are observed.

(3) Checking “yes” or “no” in response to the question of whether evidence of previous treatment was observed. If evidence of previous treatment, including but not limited to drill marks, bait stations, dyed wood from borate treatments, and dusted carpenter bee holes is observed, or documentation was supplied to the inspector prior to the inspection, the commercial applicator conducting the inspection shall check yes and:

(a) Describe the evidence of previous treatment; and

(b) State the specific location (including by way of example but not limited to sill plates, foundation, etc.) where the evidence of previous treatment is observed or documented; and

(c) Attached to the form copies of documentation supplied.

This box shall be checked regardless of whether box A or box B in section two of the form is checked. If the comments to be noted in this section of the form exceed the space provided, the commercial applicator conducting the inspection shall attach supplemental pages to the form, and state in section five of the form that additional pages are attached to the form.

(E) In section three of the form, shall check one box in accordance with the following:
(1) Shall check the box indicating “no treatment recommended” if box A in section two of the form is checked; or

(2) May check the box indicating that treatment is recommended if box B in section two of the form is checked; and

(a) There is evidence of active insect infestation; or

(b) There is:

(i) No evidence of previous treatment; or

(ii) Evidence of insect activity that appears to have occurred after the most recent treatment; or

(iii) Evidence of subterranean termites; and

(a) The structure is not currently under a termite treatment service contract or warranty; and

(b) The structure has not been treated with a liquid soil termite treatment within the previous five years; and

(c) The commercial applicator conducting the inspection describes the evidence relied upon in making the determination that treatment is recommended.

(3) May check the box indicating that no treatment is recommended if;

(a) Box B in section two of the form is checked; and

(b) The commercial applicator conducting the inspection:

(i) Believes, based on the evidence observed, that there is not an active insect infestation; and

(ii) Describes the evidence relied upon in making the determination that treatment is not recommended.

(F) Shall designate by checkmark in section four of the form any obstructed or inaccessible area of the specific structure inspected. Access coverings which are readily removed using commonly available tools such as screwdrivers, pliers and wrenches do not render an area obstructed or inaccessible.

(G) Shall include in section five of the form:

(1) Any comments which are not provided for in the other sections of the form, including but not limited to infestation or damage observed in areas other than the specific structure inspected; and
(2) Any comments amplifying information provided in other sections of the form; and

(3) If attachments were used to detail inspection findings described in other sections of the form, a list and description of these attachments.

(H) Shall complete and sign the form within five business days following completion of the inspection. The commercial applicator’s signature on the form is the commercial applicator’s certification that the inspection was conducted and reported in accordance with the requirements of Chapter 901:5-11 of the Administrative Code.

(I) Shall submit, within ten days following completion of the inspection, a copy of the completed and signed form to the pesticide business or registered location from which the inspection was conducted.
Wood Destroying Insect Inspection Report

Section I. General Information

Inspector Company, Address & Phone

Company's Business Lic. No.

Date of Inspection

Address of Property Inspected

Inspector's Name, Signature & Certification, Registration, or Lic. #

Structure(s) Inspected

Section II. Inspection Findings

This report is indicative of the condition of the above identified structure(s) on the date of inspection and is not to be construed as a guarantee or warranty against latent, concealed, or future infestations or defects. Based on a careful visual inspection of the readily accessible areas of the structure(s) inspected:

☐ A. No visible evidence of wood destroying insects was observed.

☐ B. Visible evidence of wood destroying insects was observed as follows:

1. Live insects: (description and location):

2. Dead insects, insect parts, frass, shelter tubes, exit holes, or staining: (description and location):

3. Visible damage from wood destroying insects was noted as follows: (description and location):

NOTE: This is not a structural damage report. If box B above is checked, it should be understood that some degree of damage, including hidden damage, may be present. If any questions arise regarding damage indicated by this report, it is recommended that the buyer or any interested parties contact a qualified structural professional to determine the extent of damage and the need for repairs.

Yes ☐ No ☐ It appears that the structure(s) or a portion thereof may have been previously treated. Visible evidence of possible previous treatment:

The inspecting company can give no assurances with regard to work done by other companies. The company that performed the treatment should be contacted for information on treatment and any warranty or service agreement which may be in place.

Section III. Recommendations

☐ No treatment recommended. (Explain if Box B in Section II is checked)

☐ Recommend treatment for the control of:

Section IV. Obstructions and Inaccessible Areas

The following areas of the structure(s) inspected were obstructed or inaccessible:

☐ Basement
☐ Crawlspace
☐ Main Level
☐ Attic
☐ Garage
☐ Exterior
☐ Porch
☐ Addition
☐ Other

Section V. Additional Comments and Attachments (these are an integral part of the report)

Attachments

Signature of Seller(s) or Owner(s) if refinancing. Seller acknowledges that all information regarding WDI infestation, damage, repair, and treatment history has been disclosed to the buyer.

Signature of Buyer. The undersigned hereby acknowledges receipt of a copy of both page 1 and page 2 of this report and understands the information reported.

X

Form NPMA-33 (801004) © 2004 National Pest Management Association. All Rights Reserved. No reproduction of this form is permitted without the express permission of NPMA.

Page 1 of 2
Appendix

General Guidelines For Soil Termiticide Treatment

The following general treatment specifications apply to all slab types, and they often apply to crawl space and basement construction.

**Exterior Soil Treatment**

Soil may be treated by rodding or trenching. **Rudding** is the injection of termiticide into the soil through a long pipe inserted at appropriate intervals (4 to 12 inches apart, depending on the soil type and other factors). In this way, termiticide can be distributed to the level of the footing. **Trenching** involves removing the soil within about 1 foot above the footing. As the soil is replaced, it is treated with termiticide at the rate of 4 gallons per 10 linear feet for each foot of depth from grade level to footing. Many pest management professionals use a combination of trenching and rodding, especially if the footing is very far below grade level. Whenever possible and practical, the soil to the footing should be saturated with termiticide.

**Treatment of an Exterior Concrete Slab**

An exterior concrete slab that abuts the structure complicates outside treatment. Poured slabs such as sidewalks, patios, and carports should be vertically drilled no more than 12 inches apart, then rodded to inject the termiticide into the soil. It may be necessary to vary the termiticide concentration and volume, as allowed by the label, to treat thoroughly under slabs.
Treatment of Foundation Voids in Slab Construction
Drill and treat concrete block foundation voids. It is very important that the holes be drilled at a height that is as close to the outside grade level as possible but not above the top of the slab inside. Every void should be treated in the block. Clean up any leakage around drill holes. Fill all drill holes.

Caution: Special care must be taken to ensure that the chemical does not puddle and flow out over the inside slab floor. If the soil line is above the slab, it may be necessary to trench below the slab line before treating the block voids.

Figure 8.x Foundation void treatment (dark shading shows treated area). (Illustration courtesy of MSUE)

Treatment of Brick or Stone Veneer
Drill and treat brick veneer voids only where the brick ledge is below grade level. Holes measuring approximately 1/4 or 3/8 inch in diameter must be drilled from the outside into the masonry between the bricks in order to treat the void. Generally, these holes should be drilled in every other brick. The holes should not be drilled above the top of the foundation for basements or above the level of the interior slab in slab construction unless the slab is at or below exterior grade level.

Introduce enough termiticide to completely flood the void to the footing or base. Use enough pressure to spread the chemical and completely cover the voids. Holes drilled in outside brick walls should be sealed after treatment.

Where it is not possible to drill and treat below the top of the foundation or interior slab level, it may be necessary to trench and treat the soil to below the brick ledge. This method will eliminate the need to drill and treat the void and also reduce the risk of accidental spillage into the interior of the structure.

Figure 8.x Treatment of brick or stone veneer (arrow points to treatment of void). (Illustration courtesy of MSUE)

Interior Treatment of Slab Construction
Soil treatment of the inside perimeter of a slab adjacent to the foundation can be accomplished by any
of three methods: **vertical drilling**, **short rodding**, or **long rodding**.

### Vertical drilling
Vertical drilling is the most common method of interior slab treatment. Vertically drill through the slab floor adjacent to the perimeter foundation with holes no more than 12 inches apart. Inject the termiticide under low pressure so that the chemical overlaps in the soil between the holes.

In addition, treat along each support wall and wood partition within the structure. In the case of a masonry support foundation that extends through the floor and rests on a footing, it is necessary to drill and treat soil adjacent to both sides of the wall. Clean up the drill dust. After treatment, plug the holes and finish the surface in a manner that the customer has previously agreed upon.

**Caution:** Take special care to identify the location of any heating ducts, water lines, or electrical conduits embedded in the slab before beginning treatment to prevent damage, injury, or contamination.

### Short rodding
Short rodding refers to a procedure conducted from outside a structure to treat the subslab soil area. Short rodding may be preferable when no access is available inside the structure. For example, floor coverings, plumbing (bathtubs, sinks, or showers), cabinets, or other furnishings may obstruct drilling from the inside. Short rodding can prevent damage to interior finished flooring, which would be caused by drilling through the slab.

To access the subslab soil area, drill a series of holes through the foundation about 12 inches apart or less. Drill through both sides of the concrete into the area precisely below the expansion joint at the edge of the slab. Then, insert the rod into
the area to receive treatment. Apply the chemical under low pressure. Saturate all of the soil around the expansion joint area to the extent possible. This will cause treatment to overlap in the spaces between the holes and produce a continuous barrier.

**Long Rodding**
Long rodding is a procedure conducted from outside a structure to treat the the bottom of the interior slab. As in short rodding, it is necessary to determine the precise location of the bottom of the slab to ensure that no untreated soil layer remains above the treatment zone and to allow for easier insertion of the rod. This method has similar benefits to the short rod method, with the added advantage of possible access behind concrete porches. However, long rodding for any significant distance may leave untreated areas if the rod veers away from the foundation and toward the soil.

**SLAB CONSTRUCTION, SPECIAL CASES**
Termite treatment guidelines will vary, depending on factors such as the type of slab construction, the foundation type, the materials used for the frame walls or flooring, and the termite entry points under certain elements of construction. Described below are treatment guidelines for some situations.

**Floating Slab Construction with Concrete Block Foundation and Concrete Block Walls**
When the walls and foundation are made of concrete blocks, preventing termite entry through block voids is a primary concern. The block voids need to be treated with termiticide below the soil line.

**Treatment procedures**
- Trench and/or rod exterior soil.
- Drill and treat beneath exterior slabs adjacent to the foundation.
- Treat interior foundation walls by vertical drilling, short rodding, and/or long rodding.
- Vertically drill and treat adjacent to interior walls and partitions, where necessary.
- Drill and treat foundation voids.
- Treat wood that has accessible termite galleries.
- Repair and plug all drill holes.

**Floating Slab Construction with Concrete Foundation and Brick Veneer on Wood Frame**

In this type of construction, treating brick veneer voids to prevent infestation of the wood frame is a primary concern. It is necessary to thoroughly treat the voids in the brick veneer, the subslab soil area along the expansion joint, and the soil around the outside perimeter of the building to a point lower than the bottom of the veneer.

**Treatment procedures**

- Trench and/or rod exterior soil.
- Drill and treat beneath exterior slabs adjacent to foundation.
- Treat interior foundation walls by vertical drilling and/or long rodding.
- Vertically drill and treat adjacent to interior walls and partitions.
- Drill and treat brick veneer voids.
- Treat wood that has accessible termite galleries.
- Repair and plug all drill holes.

**Monolithic Slab with Terrazzo Floor**

Terrazzo is high-quality flooring consisting of white or colored grout with ornamental stones divided into sections with brass strips and ground to a smooth finish. This type of floor is common in commercial and institutional buildings.

The property owner must thoroughly understand the necessity of drilling the terrazzo and the various methods of repairing the drill holes. Before any drilling is started, be sure to establish how the patching will be done. Terrazzo may be patched by saving the drilling dust so that a portion of the dust can be mixed with quality cement. With experience, the mixture can be made to closely match the original floor. If this method of repair is not acceptable to the property owner, then a professional terrazzo floor company can be contacted to patch the drill holes.
When drilling terrazzo, a sharp bit and steady pressure are required to prevent chipping around the edge of the drill hole. One method is to apply light pressure on the drill while quickly hitting and releasing the trigger. This prevents the bit from jumping about and damaging the surface of the terrazzo floor.

**Treatment procedures**

- Trench and treat exterior soil.
- Drill and treat beneath exterior slabs adjacent to foundation.
- Vertically drill and treat adjacent to interior partition walls where necessary.
- Drill and treat brick veneer or foundation voids where they extend below outside soil.
- Treat wood that has accessible termite galleries.
- Repair and plug all drilling holes.

![Figure 4.19 Completed treatment of a monolithic slab with atile floor (dark shading shows areas treated). (Illustration courtesy of MSUE)](image)

**Completion**

This composite diagram shows the total protection afforded the structure by thoroughly treating the soil around the exterior perimeter of the building to a point lower than the bottom of the veneer and the soil beneath interior wood partition walls. Foundation voids should be treated if they extend below exterior grade level.

**Special considerations – monolithic slabs**

Treating soil next to the interior perimeter of the foundation, which is required in almost all other types of construction, may not be necessary in this case. However, soil treatment around the exterior is very important, particularly if there are veneers (such as brick) near the soil line. Trenching and treating is the most practical method. Remember to treat any backfill.

Rodding does not need to be done because there is no advantage here in deep soil chemical treatment. Wood treatment also is not required unless there is a reason for doing so. No routine treatment of wood is done in monolithic slab construction.

When drilling and rodding, use caution around sewer pipes, heating ducts, plumbing, plenums, electrical wiring, etc.

On monolithic slabs, a very careful inspection needs to be made to determine exactly how termites have gained access and to find those areas where they might gain access. The constructions of access plates, doors and panels to permit inspection of the entry points of plumbing, bath traps, conduits, etc., constitutes the major part of treatment to this type of structure, together with soil treatment around the outside perimeter.
Wood Over Slab
To treat the soil under a slab covered by a wood floor, both the wood and the slab should be drilled and treated in a checkerboard pattern to ensure adequate coverage. It may also be advisable to treat the wood with borates. The wooden floor may also need to be removed to facilitate treatment. After treatment, all holes in both the slab and wood floor must be plugged and filled.

CRAWL SPACE CONSTRUCTION

![Crawl Space Diagram](image)

Figure 8.xx Application of chemical to crawl space construction. Soil treatment (1) along outside and (2) inside foundation wall; (3) around pier and (4) plumbing. (Illustration adapted from USDA, courtesy MSUE)

All cellulose-containing trash and debris must be removed from the crawl space to aid in proper treatment, reduce changes of future attack, and aid in future inspections. Treat the soil adjacent to both sides of foundation and support walls and around piers, plumbing lines, or other points of access by trenching and/or rodding. If the foundations or piers have hollow voids, these areas also must be treated to prevent termite access through a crack in the footing. The soil beneath exterior porches next to the foundation should be treated by vertical drilling, horizontal rodding, or excavation to gain access for treatment.

To control infestations occurring along interior walls or around supporting piers of houses with crawl spaces, dig a trench 6 to 8 inches wide and a few inches deep next to the walls or piers, taking care not to go below the top of the footing. When the top of the footing is exposed, the commercial pesticide applicator must treat the soil adjacent to the footing to a depth not to exceed the bottom of the footing. If the land slopes or if the footing is more than 12 inches deep, make crowbar, pipe, or rod holes about 1 inch in diameter and a foot apart in the bottom of the trench. The holes should go to the footing (this will help distribute the chemical evenly along the wall).

The trench along the exterior foundation wall is also made 6 to 8 inches wide, and up to a foot deep. If needed, holes are also made in the trench bottom, as described for the trench along the interior wall.

BASEMENT CONSTRUCTION
Where termites are coming from beneath the concrete floor in the basement, remove any wood that
may extend into the ground, treat the soil, and then seal cracks or holes with a dense cement mortar. When the infestation is located between the floor and wall (expansion joint) or around a furnace, make a series of holes, spaced about 1 foot apart, through which a chemical can be poured or injected. Holes along a wall should be made about 6 to 8 inches from it, so as to clear the footing and reach the soil beneath.

When the infestation occurs along the exterior foundation wall in houses having full basements, it is necessary to treat the soil to a greater depth than is required for other types of houses. The trench is prepared in the same way, but the pipe or rod holes should extend down to the top of the footing to aid in proper distribution of the chemical to all parts of the wall. This is especially important in masonry foundations with numerous mortar joints below grade that may be susceptible to termite attack.

![Figure 4.22 Completed treatment of basement construction (dark shading indicates areas treated). (Illustration courtesy of MSUE)](image)

**Figure 4.22 Completed treatment of basement construction (dark shading indicates areas treated).** (Illustration courtesy of MSUE)

**Treatment Procedures**
- Trench and/or rod exterior soil.
- Drill and treat beneath exterior slabs adjacent to the foundation.
- Treat adjacent to interior foundation walls by vertical drilling.
- Vertically drill and treat adjacent to interior partition walls where necessary.
- Drill and treat any brick veneer voids.
- Drill and treat any foundation voids.
- Treat wood that has accessible termite galleries.
- Repair and plug all drill holes.

**Special Considerations – Basements**
The soil treatment techniques for basements are the same as described for floating slab construction on the exterior and interior of the structure. If treatment of the exterior soil to the top of the footing is not possible or practical, it will be necessary to indicate clearly to the customer that your treatment is considered either a “spot treatment” or “limited treatment.” Brick and stone veneer should be drilled and treated only if it extends below grade level, and then treatment should be made only below the top of the foundation wall to prevent accidental contamination of the interior. Treat hollow foundations from the interior in the case of unfinished walls, and then only at the bottom course of block just above basement floor level. In the case of a block, rubble, or other masonry foundation wall construction with interior finished walls, use extreme caution in treating exterior soil and voids in the foundation – the termiticide may seep into and contaminate the structure.
GLOSSARY OF TERMS

Abdomen - hindmost region of the insect’s body

Adult - fully grown, sexually mature insect

Alate - winged form or with wings; also known as swarmers
Antennae - pair of feeler-like sensory organs located on head of insect
Antennal Club - enlarged segments at terminal end of antennae
Cellulose - a component of plant cell walls; what termites extract from wood for energy
Exoskeleton - a skeleton or supporting structure on the outside of the insect’s body
Frass - solid excrement of insect larvae when feeding in wood
Galleries - voids in wood hollowed out by insects feeding on wood or excavating for nest expansion
Larvae - the immature stage between egg and pupae in insects with complete metamorphosis
Mandibles - jaws/ mouthparts
Metamorphosis - the process of molting from one stage to another when passing from an egg to an adult
Molt - to shed the old exoskeleton and form a new one
Oviposit - to deposit eggs
Pronotum - the dorsal or top surface plate of the prothorax
Prothorax - the first or front segment of the thorax
Pupae - the stage of complete metamorphosis where transformation takes place; the step in between larva and adult
Queen - the primary female reproductive individual in social insect colony.
Serrate - saw-like in appearance (usually describes antennae type)
Social - a group of insects that cooperate in taking care of their young with sterile individuals working on behalf of the reproductives
Soldiers - individuals in a termite colony responsible for defending against attacking insects
Swarming - the process by which a large number of winged, reproductive adults leave the nest for the purpose of mating and starting new colonies
Thorax - the “middle” part of an insects body where the legs and/or wings are attached
**Workers** - the individuals in a termite colony responsible for rearing young, foraging for food, and attending to the reproducives
Chapter 921 of the Ohio Revised Code (ORC) contains several particular sections that pertain to wood-destroying insect diagnostic inspections:

§ 921.01 Definitions

(F) “Authorized diagnostic inspection” means a diagnostic inspection conducted by a commercial applicator in the pesticide-use category in which the commercial application is licensed under this chapter.

(K) “Commercial applicator” means an individual who is licensed under section 921.06 of the Revised Code to apply pesticides or to conduct authorized diagnostic inspections.”

§ 921.06 Commercial applicator license; fees.

(A)(1) No individual shall do any of the following without having a commercial applicator license issued by the department of agriculture:

(e) conduct authorized diagnostic inspections.

§ 921.16 Rules for enforcement and administration; civil penalties.

(C) The director shall adopt rules that set forth the conditions under which the director:

(7) Determines the pesticide-use categories of diagnostic inspections conducted by each commercial applicator and by any trained service person.

§ 921.14 Records.

(A) Each commercial applicator shall keep a record of . . . the following:

(1) all diagnostic inspections conducted to determine infestations of pests as required by rules adopted under division (C) of section 921.16 of the Revised Code.

Each commercial applicator shall submit copies of the records required under division (A) of this section to the pesticide business, other business, state agency, or political subdivision that employs the commercial applicator.§ 921.24 Prohibitions.

No person shall do any of the following:

(D) Refuse or fail to keep or maintain records required by the director in rules adopted under this chapter, or to make reports when and as required by the director in rules adopted under this chapter;
(I) Make false or fraudulent records, invoices, or reports;

(P) Make a false or misleading statement in an inspection concerning any infestation of pests or the use of pesticides;

(Q) Refuse or fail to comply with this chapter, the rules adopted thereunder, or any lawful order of the director.

The following are the particular sections of the Ohio Administrative Code rules that pertain to wood-destroying insect diagnostic inspections:

**901:5-11-01 Definitions**

(N)(12) “‘Wood–Destroying Insect Diagnostic Inspection’ means the examination of a structure at the request of any party involved in a contemplated real estate transaction to determine if wood-destroying insects are present in the structure, if there is evidence they either are or have been present in the structure, or the presence of any visible damage to the structure caused by wood-destroying insects and the generation of a written report of the findings of the examination”.

(P) “‘Wood-destroying Insects’ include termites, carpenter ants, carpenter bees and re-infesting wood boring beetles.”

**901:5-11-04 Commercial applicator license**

(C) An applicant shall be issued a commercial applicator license if the applicant has satisfied the licensing requirements set out in chapter 921. of the Revised Code and the rules adopted thereunder and the following have been received by the director:

(2) Demonstration that the applicant possesses the adequate knowledge and competence to apply pesticides and conduct diagnostic inspections within the pesticide-use category for which the applicant seeks licensure as set forth in rule 901:5-11-08 of the Administrative Code.

**901:5-11-08 Demonstration of competence**

(A) Each applicant for a [commercial] applicator license shall show, by passing a general examination and an examination for each applicable pesticide-use category, that the applicant possesses adequate knowledge and competence to conduct diagnostic inspections within the pesticide-use categories for which the applicant seeks licensure.

(4) Each applicant for licensure as a commercial applicator in the category of wood-destroying insect diagnostic inspections shall submit a valid certificate verifying that they have completed the Ohio wood-destroying insect inspection program.