Termite Protection: Building Code Provisions & Recommended Improvements

Educational Overview
Revised August 31, 2018

ABTG

Applied Building Technology Group (ABTG) is committed to using sound science and generally accepted engineering practice to develop research supporting the reliable design and installation of foam sheathing. ABTG's educational program work with respect to foam sheathing is supported by the Foam Sheathing Committee (FSC) of the American Chemistry Council.

ABTG is a professional engineering firm, an approved source as defined in Chapter 2 and independent as defined in Chapter 17 of the IBC.

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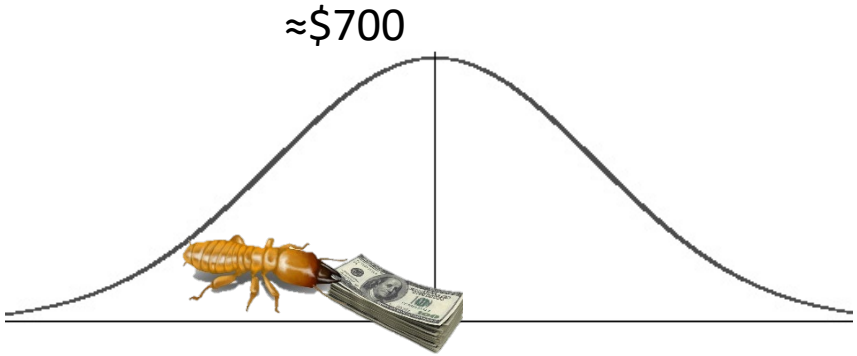
Foam sheathing research reports, code compliance documents, educational programs and best practices can be found at www.continuousinsulation.org.

Foam Plastic Applications for Better Building

Introduction

- Termites cause serious damage in the United States – around $2.5 billion yearly, or about one-third of the damage toll of wind events including hurricanes and tornadoes.
- Based on a 3% infestation rate, the repair cost of a termite infestation averages about $700 per housing unit.



Introduction

- Home insurance typically does not protect against termite damage.
- While various types of “warranties” are offered by termite treatment companies, they may vary widely in content, value, and requirements.
- Thus, especially in termite-prone regions, it is a good idea for homeowners to think about the termite resistance of their homes.

Introduction

- How does foam sheathing on home foundations or above-grade walls perform with respect to termite protection?
- So far, there has been insufficient scientific data to properly compare termite resistance in houses with foam sheathing with houses using other building materials.

Introduction

- Concerns have been brought up based on a variety of anecdotal observations:
  - Foam sheathing in foundation wall creates a “hidden pathway” (not visible to termite inspectors)
  - Foam sheathing products may somehow attract termites
- However, good science can alleviate these concerns and lead to better termite protection practices in all construction.

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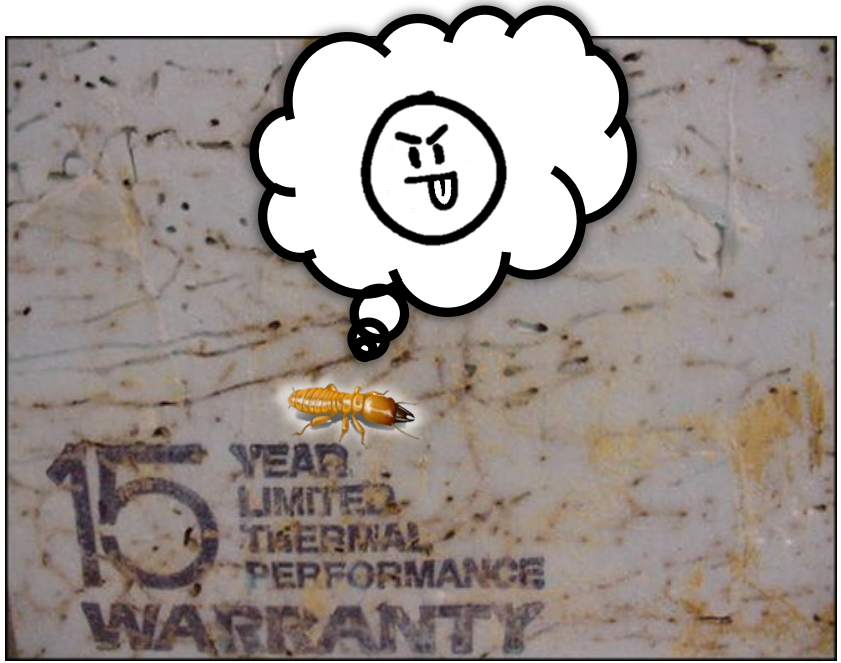
Introduction

- Fact:
  - Foam plastics are not a food source for termites.
- Therefore, foam sheathing itself does not attract termites, although they are able to burrow through it to find food sources



Introduction

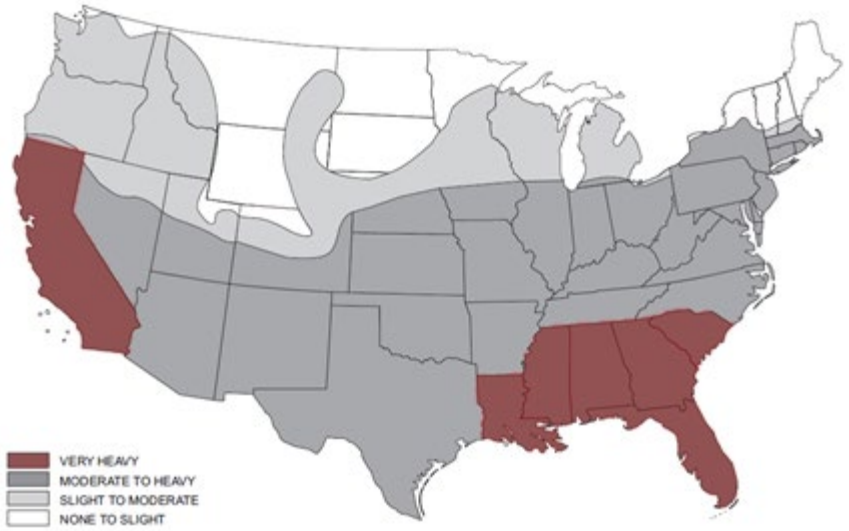
- Fact:
  - Hidden pathways for termite access exist in nearly all types of construction.
- Despite this, current building codes do not require termite shields or any other methods of disrupting hidden pathways

Introduction

- Because building codes do not require termite shields, chemical soil treatment may be the only line of defense.
- Periodic re-treatment is necessary to maintain protection, however because re-treatment is not required by code, it often only occurs after termites have caused obvious damage.

Introduction

- This Educational Program will summarize the available information on termite protection and suggest key general improvements to building code provisions, especially in the ‘very heavy’ termite risk zone



Termite Infestation Probability Map
[*IRC* Figure R301.2]
(emphasis added)

Building Code Provisions – IRC 2018

- The 2018 IRC includes provisions for termite protection, but there are some points of weakness in the code.

SECTION R318
PROTECTION AGAINST SUBTERRANEAN TERMITES

R318.1 Subterranean termite control methods. In areas subject to damage from termites as indicated by Table R301.2(1), methods of protection shall be one, or a combination, of the following methods:

1. Chemical termiticide treatment in accordance with Section R318.2.
2. Termite baiting system installed and maintained in accordance with the *label*.
3. Pressure-preservative-treated wood in accordance with the provisions of Section R317.1.
4. Naturally durable termite-resistant wood.
5. Physical barriers in accordance with Section R318.3 and used in locations as specified in Section R317.1.
6. Cold-formed steel framing in accordance with Sections R505.2.1 and R603.2.1.

R318.1.1 Quality mark. Lumber and plywood required to be pressure-preservative treated in accordance with Section R318.1 shall bear the quality *mark* of an *approved* inspection agency that maintains continuing supervision, testing and inspection over the quality of the product and that has been *approved* by an accreditation body that complies with the requirements of the American Lumber Standard Committee treated wood program.

R318.1.2 Field treatment. Field-cut ends, notches and drilled holes of pressure-preservative-treated wood shall be retreated in the field in accordance with AWPA M4.

R318.2 Chemical termiticide treatment. Chemical termiticide treatment shall include soil treatment or field-applied wood treatment. The concentration, rate of application and method of treatment of the chemical termiticide shall be in strict accordance with the termiticide *label*.

R318.3 Barriers. *Approved* physical barriers, such as metal or plastic sheeting or collars specifically designed for termite prevention, shall be installed in a manner to prevent termites from entering the structure. Shields placed on top of an exterior foundation wall are permitted to be used only if in combination with another method of protection.

R318.4 Foam plastic protection. In areas where the probability of termite infestation is "very heavy" as indicated in Figure R301.2(6), extruded and expanded polystyrene, polyisocyanurate and other foam plastics shall not be installed on the exterior face or under interior or exterior foundation walls or slab foundations located below *grade*. The clearance between foam plastics installed above *grade* and exposed earth shall be not less than 6 inches (152 mm).

Exceptions:

1. Buildings where the structural members of walls, floors, ceilings and roofs are entirely of noncombustible materials or pressure-preservative-treated wood.
2. Where in *addition* to the requirements of Section R318.1, an *approved* method of protecting the foam plastic and structure from subterranean termite damage is used.
3. On the interior side of *basement walls*.

Building Code Provisions – IRC 2018

- One area to note is that the IRC permits, but does not require, the use of multiple methods of termite protection in conjunction.
- In practice, this means that termite shields are seldom used in new home construction, because most newly constructed homes receive chemical treatment.
- However, in high termite hazard zones, using multiple methods may be appropriate as a minimum practice.

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Building Code Provisions – IRC 2018

- Another area to note is that Section R318.4 does not require protection of foam plastics, it just limits the location of their use and requires that they be located at least 6” above grade.
- The intent is to prevent the creation of a “hidden pathway” for termite infestation, but because hidden pathways exist in nearly all types of construction, these provisions do not adequately address the concern.

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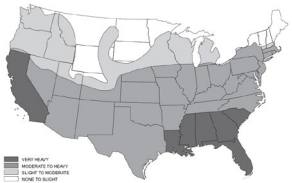
Building Code Provisions – IRC 2018

- A third point is that the code gives responsibility to the local jurisdiction to determine the need for termite protection – yet lacks definitive guidelines for assessing risk objectively.
- The IRC map may serve as a guide, however termite ecology depends on site characteristics in addition to general climate trends.

TABLE R301.2(1)
CLIMATIC AND GEOGRAPHIC DESIGN CRITERIA

GROUND SNOW LOAD	WIND DESIGN				SEISMIC DESIGN CATEGORY[f]	SUBJECT TO DAMAGE FROM			WINTER DESIGN TEMP[e]	ICE BARRIER UNDERLAYMENT REQUIRED[h]
	Speed[d] (mph)	Topographic effects[k]	Special wind region[l]	Wind-borne debris zone[m]		Weathering[a]	Frost line depth[b]	Termite[c]		



For SI: 1 pound per square foot = 0.0479 kPa, 1 mile per hour = 0.447 m/s.

a. Weathering may require a higher strength concrete or *grade* of masonry than necessary to satisfy the structural requirements of this code. The weathering column "negligible," "moderate" or "severe" for concrete as determined from Figure R301.2(3). The *grade* of masonry units shall be determined from ASTM C 34, C 5 C 652.

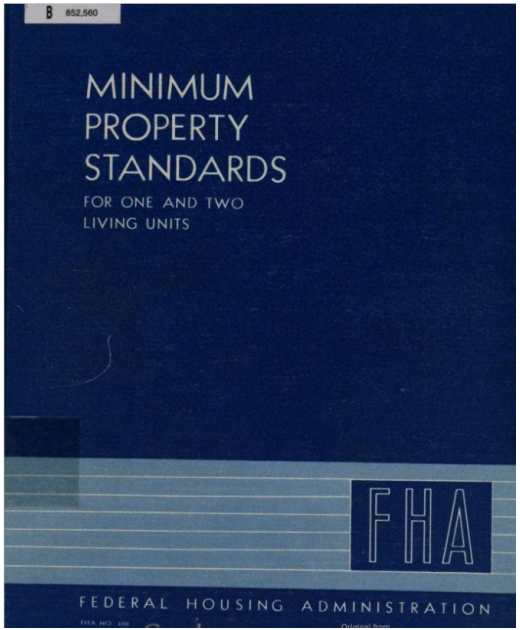
b. The frost line depth may require deeper footings than indicated in Figure R403.1(1). The *jurisdiction* shall fill in the frost line depth column with the minimum depth of footing below finish *grade*.

c. The *jurisdiction* shall fill in this part of the table to indicate the need for protection depending on whether there has been a history of local subterranean termite damage.

d. The *jurisdiction* shall fill in this part of the table with the wind speed from the basic wind speed map [Figure R301.2(4)A]. Wind exposure category shall be determined on a site-specific basis in accordance with Section R301.2.1.4.

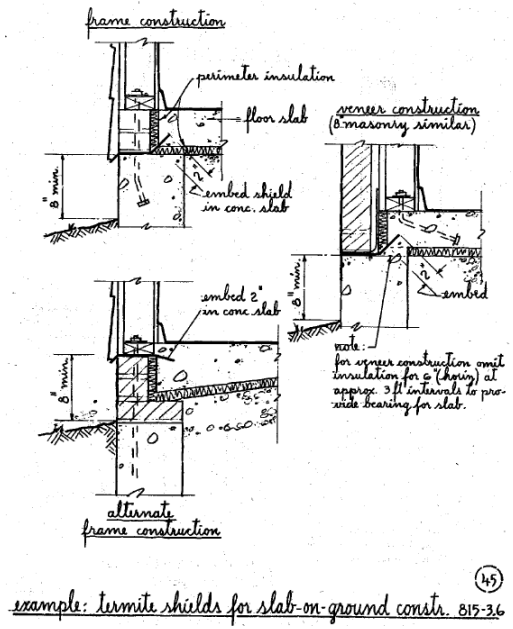
Building Code Provisions – 1958 FHA

- Despite being decades old, the 1958 FHA Minimum Property Standard (MPS) was actually much more systematic and thorough in addressing the issue of termites.
- The MPS covers:
  - The use of termiticides and termite shields
  - Moisture protection of wood structural materials
  - Semi-annual termite inspection requirements
  - Specific instructions for determining the need for termite protection



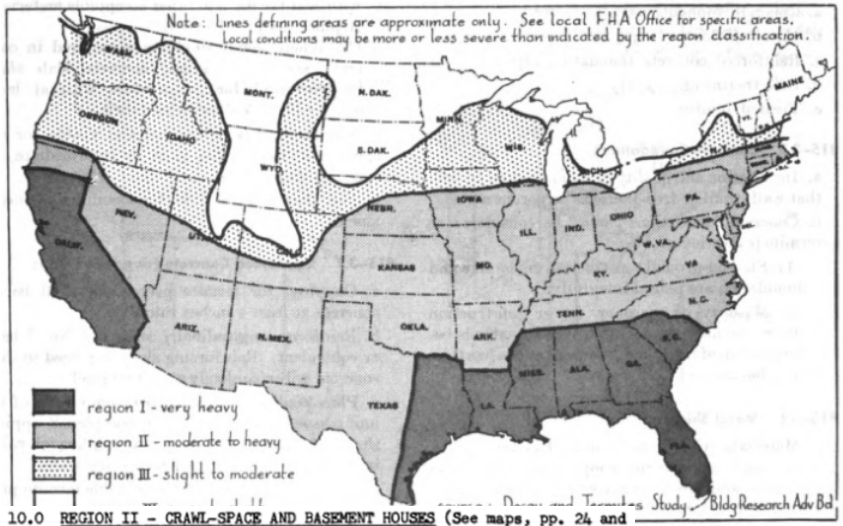
Building Code Provisions – 1958 FHA

- Unlike the IRC, the MPS:
  - Included detailed illustrations for application of termite shields and integration with use of foundation insulation
  - Was based on sound science, namely a 1950's National Academy of Sciences (NAS) study which included the expertise of a broad variety of experts, the results of which remain relevant today
- Although the NAS study did not recommend combinations of measures in even the most severe termite hazard regions, there was some apparent dissention on this matter among the NAS study participants.



Termite Hazard and Protective Measures

- The MPS provisions required termite protections as follows:
  - Region 1 (“very heavy”) – in all types of foundation construction.
  - Region 2 (“moderate-heavy”) – same as Region 1 “except in local areas of this region (i.e., the arid Southwest) where termites are known not to be a problem…”
- In other words, Region 2 was considered hazardous like Region 1 unless local data suggested otherwise.
- This concept has reversed in many recent model codes – where termite protection is unnecessary, unless deemed necessary by local jurisdiction.



Termite Hazard and Protective Measures

- Modern building codes also appear to have relaxed requirements
- For example, the MPS required the lower story of the building or through the first floor framing to use treated lumber.
- The 2018 IRC doesn't specify to what extent treated wood must be used in the structure for termite protection purposes.
- Thus, one could simply use a treated sill plate as required by decay resistance provisions

b. Members to be treated:

(1) Frame construction—basement or crawl space. Treat all wood up to and including sill plate, joists, header joists, girders, columns, sole plate, subfloor and wood or cellulose type sheathing below first floor line.

(2) Frame construction—slab-on-ground. Treat all wood, including partitions, up to and including sole plate, studs, top plate, blocking and wood or cellulose type sheathing, but not including siding. In two-story structures, treat as above up to bottom of second floor joists.

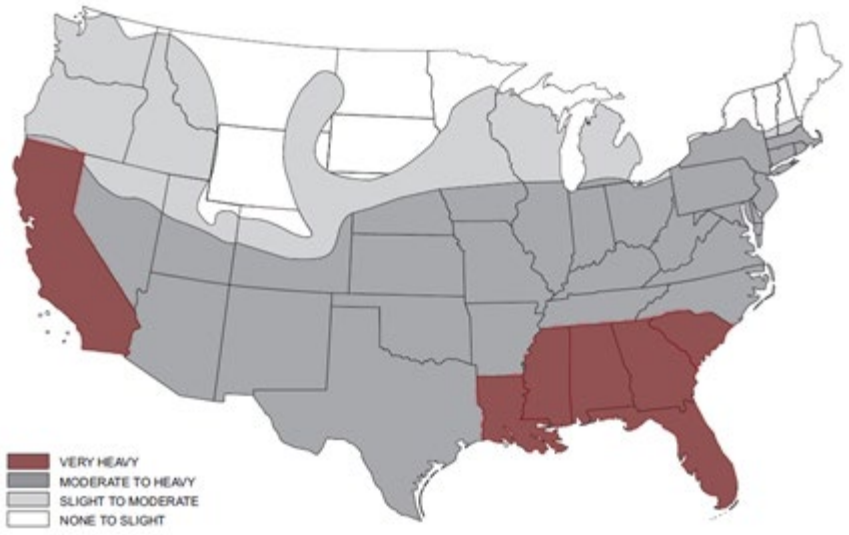
(3) Masonry veneer construction. Treat as (1) and (2) as applicable.

(4) Masonry or cavity wall construction—basement or crawl space. Treat all wood up to and including joists, girders, columns, and subfloor below first floor line. Above first floor, treat all wood, except millwork, in contact with or framing into exterior wall, but not including ceiling and roof construction.

(5) Masonry or cavity wall construction—slab-on-ground. Treat all wood, except millwork in contact with or framing into exterior wall but not including ceiling and roof construction. Treat all wood partitions including studs, plates and blocking, up to ceiling construction in one-story structures and to second floor construction in two-story structures.

Termite Hazard and Protective Measures

- The map follows broad ecological trends, showing lower termite hazard as climates become cooler and dryer.
- However, local variation is significant.



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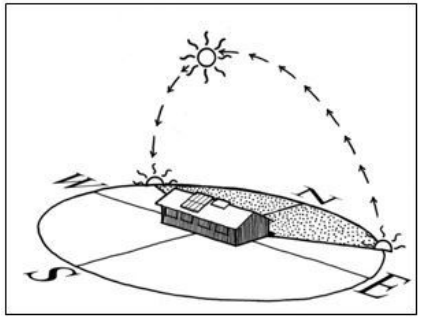
Termite Hazard and Protective Measures

- Research done in Colorado, a state spanning three termite hazard zones, has shown that termite hazard is dependent on local or site microclimatic conditions, including:
  - Availability of food sources
  - Soil moisture conditions (e.g., low lying verses higher well-drained soil)
  - Solar exposure (e.g., north vs. south facing slope).



Termite Hazard and Protective Measures

- Recent research conducted by Cookson and Trajstman shows:
  - Relying on visual inspection (with or without foam sheathing) was only 33% effective
  - Chemical treatment was 96% effective
- **These findings suggest that foam sheathing has little impact on the ability of termites to escape visual detection, and that both protective chemical soil treatment and protective physical barriers such as termite shields are called for.**
- Current codes in the U.S. require, at most, only one protection measure in any region, or none at all if determined by the local jurisdiction, which appears inconsistent with the research.

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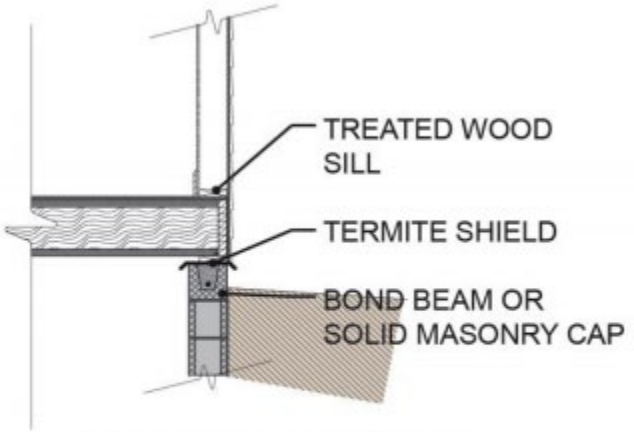
Ubiquity of Hidden Pathways for Termite Access

- The following slides describe several types of assemblies with hidden pathways that are currently allowed by the model codes.
- Conventional block foundations
  - Termites gain access to food sources (wood) via cracks in mortar joints and voids in block interiors or cores.
  - This foundation type demonstrates that hidden pathways exist with block foundations.

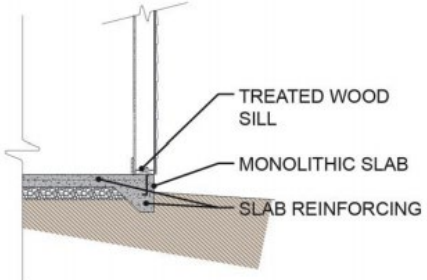


MASONRY FOUNDATION CONSTRUCTION

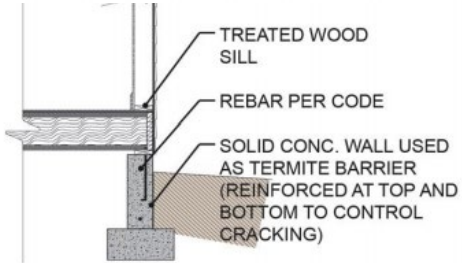
Durability by Design

Ubiquity of Hidden Pathways for Termite Access

- Conventional monolithic concrete slab on grade and independent stem wall with a slab on grade foundation
  - When concrete develops cracks, termites enter to seek food sources within the building.
  - Independent stem wall and slab foundation have an intentional “crack” or construction joint between the slab and stem wall that is frequently concealed under finishes, providing a hidden pathway for termite access.



CONCRETE MONOLITHIC SLAB CONSTRUCTION

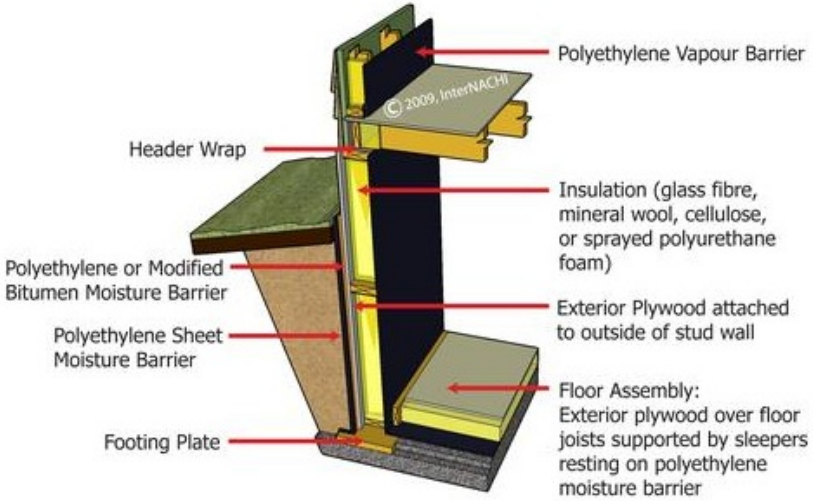


CONCRETE STEM WALL CONSTRUCTION

Durability by Design

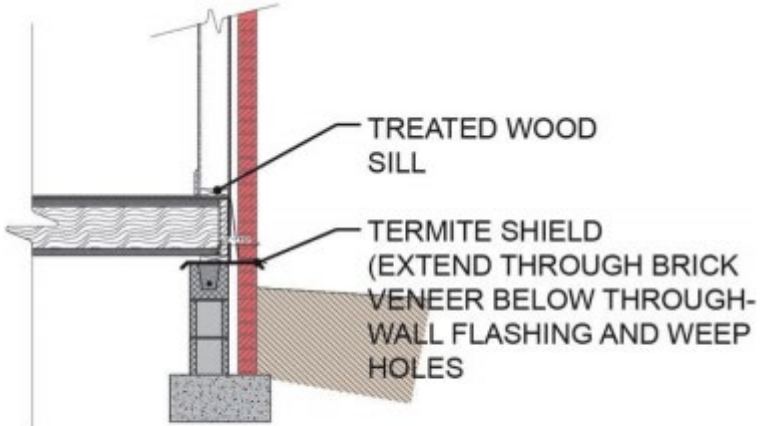
Ubiquity of Hidden Pathways for Termite Access

- Permanent wood foundations
  - Hidden pathways are created by plastic water-proofing films required in these foundations.
  - Additionally, these foundations often include exterior “skirt boards” (usually treated plywood) extending from just below grade to the bottom of above grade walls to protect the plastic film.



Ubiquity of Hidden Pathways for Termite Access

- Brick veneer extending below grade
  - Creates a hidden pathway behind the brick veneer for termite access.
  - Adhered veneers backed by a drainage mat material can also create a hidden pathway.
  - Flashing materials at weeps could serve as a termite shield if properly specified and installed.



Durability by Design

Ubiquity of Hidden Pathways for Termite Access

- The FHA's required "Subterranean Termite Soil Treatment Builder's Guarantee" (Form NPCA-99a) includes the statement at right.
- This statement misrepresents termite infestation risk factors in two ways:
  - First, one might believe that foam sheathing has a greater effect on infestation risk simply by being mentioned first.
  - Second, the list fails to recognize the ubiquity of hidden pathways in all foundations.

"Factors which may lead to infestation from wood destroying insects include: (bullets and emphasis added)

- **Foam insulation at the foundation**
- Earth-wood contact
- Faulty grade
- Firewood against structure
- Insufficient ventilation
- Moisture
- Wood debris in crawlspace
- Wood mulch
- Tree branches touching structures
- Landscape timbers
- Wood rot

Should these or other such conditions exist, corrective measures should be taken by the owner in order to reduce the chances of infestations by wood destroying insects, and the need for treatment."

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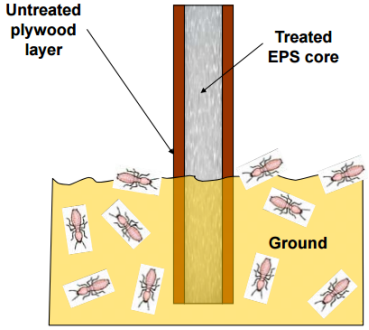
Ubiquity of Hidden Pathways for Termite Access

- In some cases, concern over foam has led to refusals to warrant homes with foam insulation on the exterior of foundations as though hidden pathways don't exist otherwise
- This can be particularly troubling at the point of sale of a home for which the NPCA-99a form is intended to apply for VA or FHA financed home construction.

In Situ Architecture

Termites, Carpenter Ants and Foam Plastic Materials

- Field test data shows only minor damage in both treated foam vs. untreated foam in field studies done in a “very heavy” termite probability condition.
- Conversely, untreated wood becomes severely damaged and consumed in a short time period.



Matrix	Treatment	Concentration	Termite damage rating EPS core*	Termite damage rating Wood*
EPS	PREVENTOL® TM Preservative Insecticide	500 ppm	9.4	6.8
EPS	None	0 ppm	9.0	5.5
Wood	None	0 ppm	---	4.7
Wood	ACQ	6.4 kg/m^3	---	10

*Average of 15 replicates

AWPA Termite Rating System
10 = sound
9 = Slight attack, up to 3% of cross sectional area affected
7 = Moderate to severe attack, penetration, 10 – 30% of cross sectional area affected
4 = Very severe attack, 50 – 75% of cross sectional area affected
0 = Failure

LANXESS

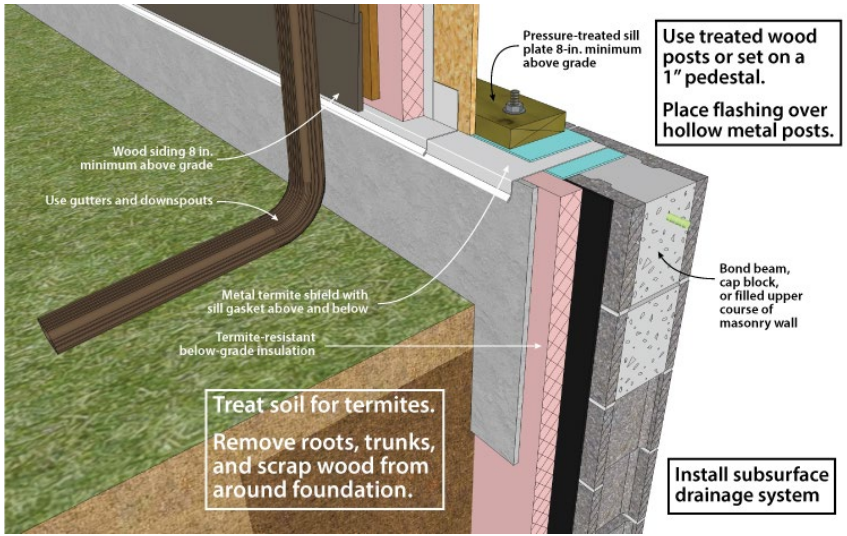
Termites, Carpenter Ants and Foam Plastic Materials

- To keep buildings safe, regardless of the construction materials used, it is important to make conditions unfavorable to termites and carpenter ants.
- First, the following protective measures are useful:
  - Termite shields
  - Chemical soil treatment around and underneath foundations, along with periodic inspection and retreatment
  - Treated wood and foam plastic (in severe conditions)

Heron Cay Executive Home

Termites, Carpenter Ants and Foam Plastic Materials

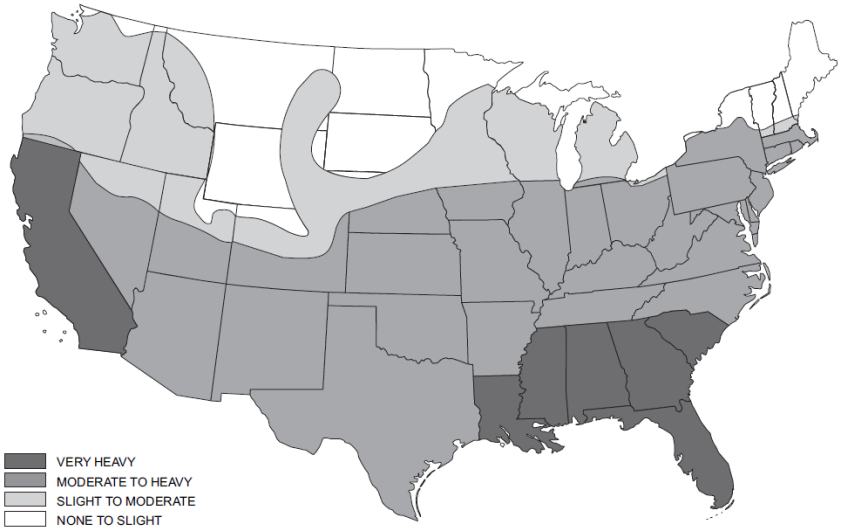
- Second, keeping assemblies dry not only prevents decay, but also repels termites and ants.
- Weatherproofing measures are important, including:
  - Flashing
  - Water-resistive barrier,
  - Siding installation,
  - Roof overhangs, Grading and surface drainage,
  - Guttering and downspout discharge away from the foundation
- Water vapor diffusion control measures, such as proper use of vapor retarders and/or exterior insulation, are also important.



ORNL

Conclusions & Recommendations

- Keep the current termite infestation probability map
  - The map is still relevant and need not be updated
- Because termite hazard can vary significantly at specific sites within a region, providing default regional guidance is important
  - Local jurisdictions can still relax requirements given substantiating data and experience



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Conclusions & Recommendations

- In ‘very heavy’ or ‘moderate-to-heavy’ regions, use multiple methods of termite protection
  - For example, initial chemical soil treatment plus use of termite shields.
    - Even if chemical soil treatment is not maintained, termite shields will deter access and assist in early detection.
    - Universal use of termite shields in high risk regions would also help resolve concerns with hidden pathways in a manner that is product-neutral and consistent

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Conclusions & Recommendations

- Maintain existing requirements in U.S. model codes regarding an approved method of protecting foam plastics in ‘very heavy’ termite regions on foundation walls and below slabs on grade.
  - It is recommended that the method in Section R318.4 of the 2018 IRC become the primary method, not an exception, and that it continue to be used in combination with one or more of methods in Section R318.1.

R318.4 Foam plastic protection.

In areas where the probability of termite infestation is “very heavy” as indicated in Figure R301.2(6), extruded and expanded polystyrene, polyisocyanurate and other foam plastics shall not be installed on the exterior face or under interior or exterior foundation walls or slab foundations located below *grade*. The clearance between foam plastics installed above *grade* and exposed earth shall be not less than 6 inches (152 mm).

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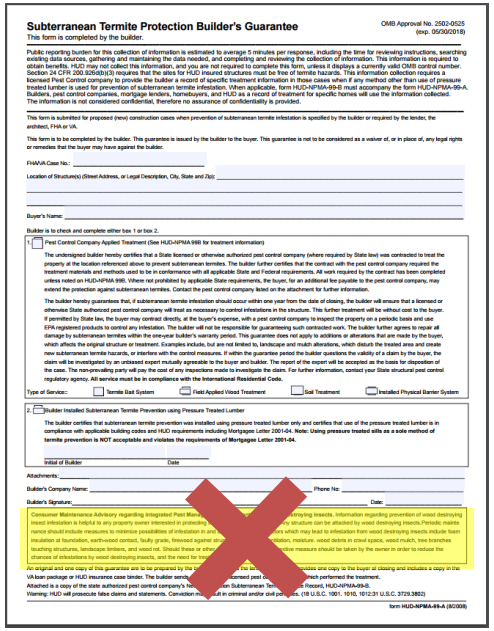
Conclusions & Recommendations

- It is strongly recommended that the reference to foam plastic insulation as an implied risk for termite infestation be removed from FHA Form No. NPCA-99a
  - Instead, the form should indicate various types of hidden pathways that can increase the potential for undetected termite infestation and provide guidance on how to protect against termite infestation



Subterranean Termite Protection Builder's Guarantee

OMB Approval No. 2502-0525
(exp. 05/30/2018)

This form is completed by the builder.

Public reporting burden for this collection of information is estimated to average 5 minutes per response, including the time for reviewing instructions, searching existing data sources, gathering and maintaining the data needed, and completing and reviewing the collection of information. This information is required to obtain benefits. HUD may not collect this information, and you are not required to complete this form, unless it displays a currently valid OMB control number. Section 24 CFR 200.925(b)(3) requires that the sites for HUD insured structures must be free of termite hazards. This information collection requires a licensed Pest Control company to provide the builder a record of specific treatment information in those cases when if any method other than use of pressure treated lumber is used for prevention of subterranean termite infestation. When applicable, form HUD-NPMA-99-B must accompany the form HUD-NPMA-99-A. Builders, pest control companies, mortgage lenders, homebuyers, and HUD as a record of treatment for specific homes will use the information collected. The information is not considered confidential, therefore no assurance of confidentiality is provided.

This form is submitted for proposed (new) construction cases when prevention of subterranean termite infestation is specified by the builder or required by the lender, the architect, FHA or VA.

This form is to be completed by the builder. This guarantee is issued by the builder to the buyer. This guarantee is not to be considered as a waiver of, or in place of, any legal rights or remedies that the buyer may have against the builder.

FHA/VA Case No.: _____

Location of Structure(s) (Street Address, or Legal Description, City, State and Zip): _____

Buyer's Name: _____

Builder is to check and complete either box 1 or box 2.

1. ☐ Pest Control Company Applied Treatment (See HUD-NPMA-99B for treatment information)

The undersigned builder hereby certifies that a State licensed or otherwise authorized pest control company (where required by State law) was contracted to treat the property at the location referenced above to prevent subterranean termites. The builder further certifies that the contract with the pest control company required the treatment materials and methods used to be in conformance with all applicable State and Federal requirements. All work required by the contract has been completed unless noted on HUD-NPMA-99B. Where not prohibited by applicable State requirements, the buyer, for an additional fee payable to the pest control company, may extend the protection against subterranean termites. Contact the pest control company listed on the attachment for further information.

The builder hereby guarantees that, if subterranean termite infestation should occur within one year from the date of closing, the builder will ensure that a licensed or otherwise State authorized pest control company will treat as necessary to control infestations in the structure. This further treatment will be without cost to the buyer. If permitted by State law, the buyer may contract directly, at the buyer's expense, with a pest control company to inspect the property on a periodic basis and use EPA registered products to control any infestation. The builder will not be responsible for guaranteeing such contracted work. The builder further agrees to repair all damage by subterranean termites within the one-year builder's warranty period. This guarantee does not apply to additions or alterations that are made by the buyer, which affects the original structure or treatment. Examples include, but are not limited to, landscape and mulch alterations, which disturb the treated area and create new subterranean termite hazards, or interfere with the control measures. If within the guarantee period the builder questions the validity of a claim by the buyer, the claim will be investigated by an unbiased expert mutually agreeable to the buyer and builder. The report of the expert will be accepted as the basis for disposition of the case. The non-prevailing party will pay the cost of any inspections made to investigate the claim. For further information, contact your State structural pest control regulatory agency. **All service must be in compliance with the International Residential Code.**

Type of Service:: ☐ Termite Bait System ☐ Field Applied Wood Treatment ☐ Soil Treatment ☐ Installed Physical Barrier System

2. ☐ Builder Installed Subterranean Termite Prevention using Pressure Treated Lumber

The builder certifies that subterranean termite prevention was installed using pressure treated lumber only and certifies that use of the pressure treated lumber is in compliance with applicable building codes and HUD requirements including Mortgagee Letter 2001-04. **Note: Using pressure treated sills as a sole method of termite prevention is NOT acceptable and violates the requirements of Mortgagee Letter 2001-04.**

Initial of Builder _____ Date _____

Attachments: _____

Builder's Company Name: _____ Phone No: _____

Builder's Signature: _____ Date: _____

Consumer Maintenance Advisory regarding Integrated Pest Mana... ...rrying Insects. Information regarding prevention of wood destroying insect infestation is helpful to any property owner interested in protecting... ...or structure can be attached by wood destroying insects.Periodic mainte nance should include measures to minimize possibilities of infestation in and... ...ors which may lead to infestation from wood destroying insects include foam insulation at foundation, earth-wood contact, faulty grade, firewood against sto... ...ilation, moisture. wood debris in crawl space, wood mulch, tree branches touching structures, landscape timbers, and wood rot. Should these or othe... ...ctive measure should be taken by the owner in order to reduce the chances of infestations by wood destroying insects, and the need for tre...

An original and one copy of this guarantee are to be prepared by the bu... ...the lender shall receive one copy to the buyer at closing and includes a copy in the VA loan package or HUD insurance case binder. The builder sends... ...licensed pest ... which performed the treatment.

Attached is a copy of the state authorized pest control company's ho... ...on Subterranean Termite Record, HUD-NPMA-99-S.

Warning: HUD will prosecute false claims and statements. Conviction ma... ...nt in criminal and/or civil penalties. (18 U.S.C. 1001, 1010, 1012;31 U.S.C. 3729,3802)

form HUD-NPMA-99-A (8/2008)

Suggested Resources

- Residential Foundations - ContinuousInsulation.org