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Research Report

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Protection of Wood-Frame Homes from Subterranean Termites: Evaluation of Building Code Provisions & Recommended Improvements

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Report Written by:

Applied Building Technology Group, LLC
appliedbuildingtech.com

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About this Research Report:
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 work with respect to foam sheathing is provided through a grant by the the Foam Sheathing Committee (FSC) of the American Chemistry Council. Foam sheathing research reports, code compliance documents, educational programs, and best practices can be found at www.continuousinsulation.org.

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Introduction

Annually, termite infestations occur in as much as 3% of the housing stock (4 to 5 million homes) (NPD, 2000). Consequently, these infestations result in at least $2.5 billion dollars in damage and repair costs per year as reported by the National Pest Management Association (NPMA). For perspective, this level of damage is equivalent to about one-third of the estimated average annual damage cost due to wind disasters such as hurricanes, tornadoes, and other wind events in the U.S. (HUD, 2000) Because there are about 120 million housing units in the U.S. housing stock, the average annual cost of termite damage is about $21 per housing unit. Based on the 3% infestation rate, the average cost of repair per termite infestation incident is about $700 per infested housing unit. If these figures are applicable only to the one- and two-family dwelling housing stock (e.g., homes excluding apartment units and manufactured housing), they would approximately double. If the above figures only apply to the approximately one-half of existing homes that have termite treatment contracts and warrantees, then they would double again.

The present value of the average $21 per year per housing unit risk over a 75-year life-expectancy is at least $700 (or possibly quadrupled to as much as $2,800 for reasons discussed above). Thus, an initial investment of at least $700 in termite protection features of a new home is justifiable. A greater investment in termite protective measures can be justified in areas having a greater than average termite hazard and vice-versa. Furthermore, home insurers specifically exclude and generally do not provide termite damage insurance. Instead, this market need (or opportunity) is served with various types of inspection and warranty services offered by termite treatment companies. These warranties may vary widely in content, value, and requirements (e.g., annual inspections, periodic re-treatments, spot treatment vs. full treatment, etc.). Also, the annual consumer cost of such termite warranty services can be expected to significantly exceed $21/yr to account for overhead and profit and geographic variation in termite risk, among other factors.

The statistics characterized above are relevant to the vast majority of the homes in the U.S. housing stock that are older conventional wood-frame structures. Most of these older homes and also newer homes do not have exterior continuous insulation (e.g., foam sheathing) on the foundations or above-grade walls. Yet, concerns with the use of foam sheathing causing a real or perceived increase in termite infestation risk have seen episodes of heightened interest, usually triggered by anecdotal observations of actual infestations reported in various forms of building industry media. Unfortunately, such claims have lacked substantiating scientific data to properly quantify any real impact relative to the common risk of termite infestation as described above for all homes, most of which do not have foam sheathing products applied to above-grade or below-grade walls and foundations.

One often-mentioned claim is that the application of foam sheathing products to a foundation wall creates a “hidden pathway” (not visible to termite inspectors) and, therefore, increases risk of undetected termite infestation. Another claim is that foam sheathing products may somehow attract termites based on anecdotal observations of cases where termites have burrowed into or through foam plastic materials. While such observations certainly occur, foam plastics are not a food source for termites. Furthermore, hidden pathways for termite access exist in nearly all types of construction due to lack of building code provisions requiring the use of termite shields or other means of disrupting concealed pathways for termites and their shelter tubes. Thus, the effectiveness of code-compliant termite protection often relies solely on initial chemical soil treatment and periodic elective re-treatment of soils adjacent to foundations. These re-treatments and other maintenance actions to protect homes are not regulated and may be triggered only by a termite infestation incident having already progressed to a level of significant damage or discovered during a termite inspection at the point of sale of a home. For homes that do fall under an elective termite warranty program, periodic termite inspections by a termite treatment company are intended as a means for pre-emptive detection of termite infestation. But, as shown later in this report, these inspections may at best be marginally effective for all homes, even for homes without exterior foam plastic insulation because of the ubiquity of hidden pathways in nearly all types of foundations, particularly when termite shields are not used and chemical soil treatments are not maintained.

To better understand and help resolve the above concerns in an objective manner, this Research Report evaluates various sources of data on termite hazard, infestation risk, inspection effectiveness, presence of hidden pathways in various types of construction (with and without exterior insulation), and building code provisions intended to mitigate risk of termite infestation. Based on the findings, this report concludes that some key general improvements to building code provisions for protection against termite infestation risk are needed, especially in regions with very heavy termite infestation probability (see Figure 1). Recommended improvements to the termite protection requirements of the International Residential Code (IRC) (ICC, 2018) are provided in Appendix A in the form of a draft code change proposal. The recommended code-minimum practices are not new (i.e., have been known for many decades), have been included in older U.S. building codes, and are generally applicable to all types of wood-frame construction and common foundations types (not just those cases where exterior insulation is applied). The key improvement is that combinations of

measures (i.e., soil treatment plus termite shielding) are recommended in regions with the greatest termite infestation hazard to prevent infestation and promote more effective inspections by termite treatment and warranty companies.[1]

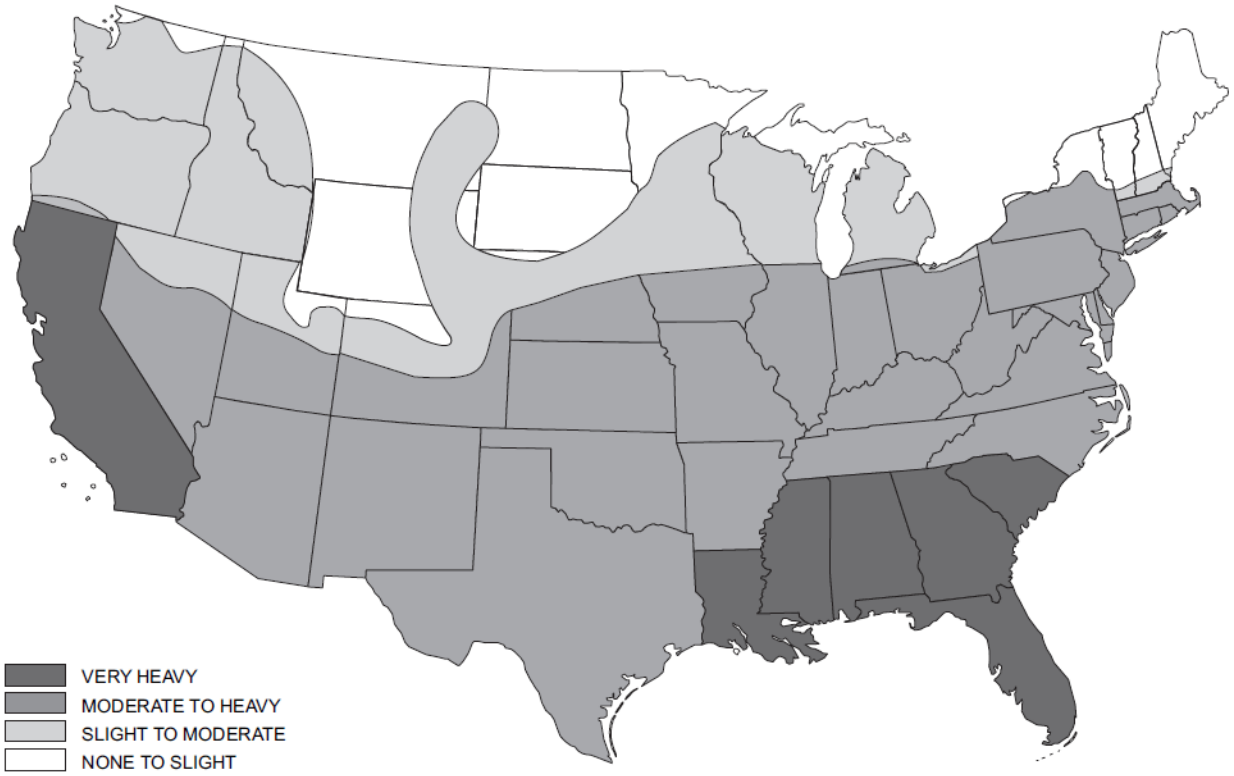

Figure 1: Termite Infestation Probability Map [*IRC* Figure R301.2]

[1] Use of termite shields or barriers in addition to chemical soil treatment is common practice in Hawaii. Refer to Lstiburek, 2017.

Current Building Code Provisions (2018 IRC)

The 2018 IRC includes the following provisions for protection buildings against termite infestation:

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*.

Figure 2: 2018 IRC provisions for protection against subterranean termites (ICC, 2018).

The most important aspect of the above code requirements is that only one of the listed methods of protection is required by Section R318.4 in locations with any level of termite hazard. Combinations of methods are only permitted, not required. For example, physical barriers (i.e., termite shields which facilitate termite inspection) are not required if soils are chemically treated with termiticide (without specifying the minimum durability of treatment or frequency of re-treatment) and vice versa. Because most homes are simply treated at the time of construction, termite shields are seldom used in new home construction. If there is a real concern with hidden pathways, proper specification and installation of termite shields is one way to better insure the effectiveness of termite inspections. However, reliance on shielding alone (without chemical soil treatment) may be less reliable than relying solely on chemical treatment as recognized in Section R318.3 of the IRC. But, contrary to Section R318.1 of the IRC, a combination of these measures may be appropriate as a minimum practice for areas with high termite hazard. Supporting evidence is provided later.

The second matter of interest focuses on requirements regarding foam plastic protection in Section R318.4 which apply in areas of "very heavy" probability of termite infestation (see Fig. 1). However, these requirements do not actually require protection of the foam plastic material. Instead, the provision initially prohibits its use in ground contact on foundations and requires that it be located at least 6 inches above grade. In particular, it is prohibited from use below slabs on grade (a location where a hidden pathway already clearly exists and is not changed by the presence of foam plastic insulation below the slab). Exceptions are provided for homes constructed of termite resistant materials or cases where the foam plastic material is protected by an "approved" method (which may include foam plastic materials with a termiticide incorporated into the product formulation) in addition to using one of the methods specified in Section R318.1 to protect the building. The primary concern behind Section R318.4 relates to the creation of a "hidden pathway" for termite infestation, but hidden pathways exist in nearly all types of construction, with or without foam sheathing products present as will be evaluated later in this Research Report. Thus, these provisions offer no real or comprehensive resolution of the

"hidden pathway" problem that exists in many applications with or without the presence of foam plastic insulation on a building foundation.

Finally, it must be recognized that the code places responsibility on the local building code authority to determine the need for any termite protection (see Figure 3) based on "history of local subterranean termite damage." The map of Figure 1 (identical to Figure R301.2(6) in the IRC) may guide this local decision. However, termite infestation probability or hazard does not necessarily vary so simply as indicated in Figure 1. As discussed later in this report, termite ecology is far more complex and may vary due to local ecological conditions including wetness of a site, southerly exposure, etc. Thus, Figure 1 is at best a very general guide. Consequently, there is an apparent lack of definitive guidelines for local jurisdictions making a termite risk assessment in an objective (risk-consistent) manner.

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]	FLOOD HAZARDS[g]	AIR FREEZING INDEX[i]	MEAN ANNUAL TEMP[j]
	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 shall be filled in with the weathering index, "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 55, C 62, C 73, C 90, C 129, C 145, C 216 or 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.

e. The outdoor design dry-bulb temperature shall be selected from the columns of $97^1/_2$-percent values for winter from Appendix D of the *International Plumbing Code*. Deviations from the Appendix D temperatures shall be permitted to reflect local climates or local weather experience as determined by the *building official*.

f. The *jurisdiction* shall fill in this part of the table with the seismic design category determined from Section R301.2.2.1.

g. The *jurisdiction* shall fill in this part of the table with (a) the date of the *jurisdiction's* entry into the National Flood Insurance Program (date of adoption of the first code or ordinance for management of flood hazard areas), (b) the date(s) of the Flood Insurance Study and (c) the panel numbers and dates of the currently effective FIRMs and FBFMs or other flood hazard map adopted by the authority having *jurisdiction*, as amended.

h. In accordance with Sections R905.1.2, R905.4.3.1, R905.5.3.1, R905.6.3.1, R905.7.3.1 and R905.8.3.1, where there has been a history of local damage from the effects of ice damming, the *jurisdiction* shall fill in this part of the table with "YES." Otherwise, the *jurisdiction* shall fill in this part of the table with "NO."

i. The *jurisdiction* shall fill in this part of the table with the 100-year return period air freezing index (BF-days) from Figure R403.3(2) or from the 100-year (99 percent) value on the National Climatic Data Center data table "Air Freezing Index-USA Method (Base 32°F)."

j. The *jurisdiction* shall fill in this part of the table with the mean annual temperature from the National Climatic Data Center data table "Air Freezing Index-USA Method (Base 32°F)."

k. In accordance with Section R301.2.1.5, where there is local historical data documenting structural damage to buildings due to topographic wind speed-up effects, the *jurisdiction* shall fill in this part of the table with "YES." Otherwise, the *jurisdiction* shall indicate "NO" in this part of the table.

l. In accordance with Figure R301.2(4)A, where there is local historical data documenting unusual wind conditions, the *jurisdiction* shall fill in this part of the table with "YES" and identify any specific requirements. Otherwise, the *jurisdiction* shall indicate "NO" in this part of the table.

m. In accordance with Section R301.2.1.2.1, the *jurisdiction* shall indicate the wind-borne debris wind zone(s). Otherwise, the *jurisdiction* shall indicate "NO" in this part of the table.

Figure 3: *2018 IRC* Language Empowering Local Jurisdiction to Determine if Termite Protection is Needed

Past Building Code Provisions (1958 FHA MPS)

Unlike the 2018 IRC, nearly six full pages of the 1958 FHA Minimum Property Standard (MPS) are devoted to termite protection requirements and details including the use of termiticides and termite shields, moisture protection of wood structural materials (i.e., ground clearances, flashing, and use of vapor retarders and water-resistive barriers then known only as sheathing papers), requirement for semi-annual termite inspection, and specific instructions for determining the need for termite protection. For reference, the 1958 MPS provisions are included in **Appendix B**. These provisions also include detailed illustrations for application of termite shields and integration with use of foundation insulation (see Fig. 4 below). Thus, the 1958 MPS was much more systematic and thorough in addressing the issue of termites than current building codes in the U.S. Furthermore, the 1958 MPS provisions were based on findings and practice recommendations from a National Academy of Sciences (NAS) study (NAS, 1956) addressed in the review of literature in the next section. Much of this information still exists in the code today, but with lacking specificity and guidance. Also, the NAS study did not recommend combinations of measures in even the most severe termite hazard regions, although there was some apparent dissention on this matter among the NAS study participants (see **Appendix C**).

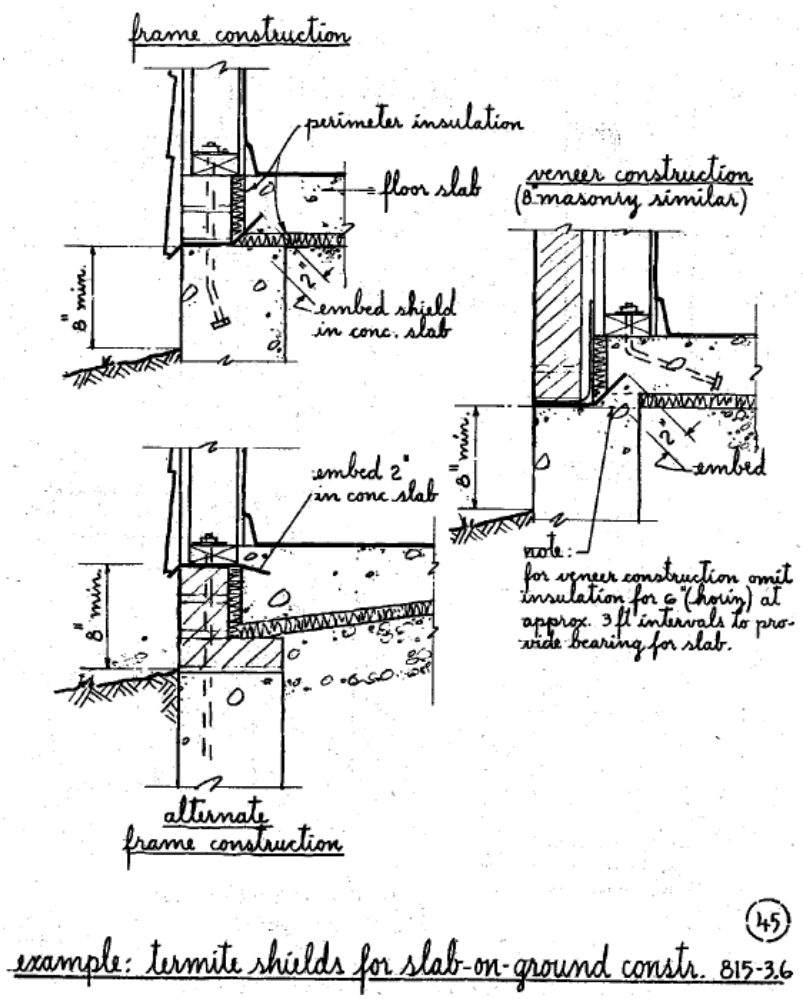

Figure 4: Example termite shield and slab on grade foundation insulation detail from 1958 FHA MPS

Termite Hazard and Protective Measures

A thorough assessment of termite infestation problems was first conducted in the U.S. by way of a National Academy of Sciences (NAS) technical study commissioned by the Federal Housing Administration (FHA) in 1956 (NAS, 1956). It is still very relevant today. Excerpts from this study are included in **Appendix C**.

The NAS special advisory committee responsible for the study included experts from the USDA Forest Products Laboratory, university professors, entomologists, building contractors, architects and engineers, homebuilders, treatment and product manufacturers, termite pest control contractors, the National Pest Control Association, the National Association of Home Builders, and others. Furthermore, the conclusions and recommendations were reviewed by the full Building Research Advisory Board representing even broader interests and expertise.

The NAS study produced an extensive set of recommendations for treatment and detailing (i.e., shielding) of various foundation types. Certain aspects of the study recommendations were incorporated into the 1958 FHA MPS provisions (see **Appendix B**). Termite protective measures in the 1958 MPS were required in Region 1 ("very heavy") for all types of foundation construction. In Region 2 ("moderate-heavy"), the same requirements as in Region 1 applied "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 to be considered hazardous just like Region 1 unless local data suggested otherwise. This prudent "mandatory" protection approach has been lost in more recent model building codes and even reversed such that termite protection is considered unnecessary unless deemed necessary by local experience in all regions (e.g., refer to *2018 IRC* Section R318.1 and Table R301.2(1) footnote c shown in Figure 3). Modern building codes also appear to have relaxed protective detailing requirements and added new protection methods that may be less effective (e.g., use of treated wood sills or

ground clearances originally meant only to prevent decay, not necessarily shield against termite access to other parts of a building). As a specific example, the NAS study and the 1958 MPS required the lower story of a building or the first floor framing to use treated lumber when this method of termite protection was selected. The 2018 IRC, however, doesn't specify to what extent treated wood must be used in the structure to protect against termite infestation of untreated wood. Thus, one could simply use a treated sill plate as only required by decay resistance provisions in the code.

Based on the extensive experience of the NAS committee and available data, the current termite infestation probability map (then called the "Geographic Distribution of Termites" map) was developed with three termite hazard zones (including an additional zone with negligible hazard). This map is still used in building codes today as shown in **Figure 1** (see also **Appendix C**). The map is correct at least in its trend that follows ecological expectations of decreasing termite populations or pressure with increasingly cooler and/or dryer climates. But, the NAS committee also recognized that local conditions may be more or less severe than indicated for reasons of highly localized environmental factors. In confirmation, recent research in the northern Colorado area has shown that termites, like wind and earthquake hazards, have local or site conditions that affect the degree of hazard at specific sites (Crist, 1998). For example, the following observation is made: *"Termites were most frequently found on a south-facing slope and in a lowland swale."* Such local site effects are related to micro-environmental factors such as availability of food sources, soil moisture conditions (e.g., low lying verses higher well-drained soil), and solar exposure (e.g., north vs. south facing slope). According to **Figure 1**, Colorado is also located in a region with highly variable regional-scale termite risk ranging from moderate-to-heavy to none-to-slight termite infestation probability (spanning three hazard zones). Thus, a proper consideration of variation in termite hazard or infestation risk is important to establishing risk-consistent (and economically justified) practices as was intended by the NAS study.

More recent research conducted by Cookson and Trajstman (2002) seems to echo and reinforce the recommendations of the much earlier NAS study, while also supporting the need for combinations of measures. The key relevant implications of the Cookson and Trajstman (2002) research show:

- Visual inspection is only 33% effective in preventing termite damage. Relying on visual inspection, even without the presence of foam sheathing, was found to be largely an ineffective means (67% of the time) of addressing termite infestation and damage issues.

- Chemical treatment is 96% effective in preventing termite infestation and damage.

- There should be an emphasis on treatment and protective practices, such as termite shields, for improving inspection success while also mitigating vulnerability to termite infestation.

The above findings tend to confirm that termites can readily find hidden access (i.e., escape visual detection) to wood building materials with or without the presence of foam sheathing on foundations. From this data, there is no indication that foam sheathing has any greater impact on the level of risk of termite infestation probability relative to homes without such materials on walls or foundations. Instead, the findings suggest strongly a need for both chemical soil treatment (as a primary protective measure) and protective practices, such a termite shields (as a secondary protective measure that would also improve ability to inspect for termites). Current codes in the U.S. require use of only one such measure (or other less effective measures such as treated sill plates) in any termite infestation probability region per Figure 1 and, theoretically, require no termite protection if the local jurisdiction so decides in any region. These provisions appear inconsistent with the data, findings, and recommendations presented in the reviewed research.

Ubiquity of Hidden Pathways for Termite Access

Hidden termite pathways exist in nearly all types of foundations, even without the presence of foam sheathing on foundation walls or below slabs on grade. Some examples of hidden pathways that are not addressed in the current U.S. building codes for common foundation types or conditions include (Ohio 2007):

a) *Conventional block foundations* are very common and are susceptible to hidden pathways for termite infestation even without the presence of foam sheathing. Termites gain access to food sources (i.e., wood-based building components) via cracks in mortar joints and voids in block interiors or cores. Thus, hidden pathways exist with block foundations. Yet, these foundations are not prohibited or subject to special restrictions or detailing requirements (e.g., termite shields) in any termite infestation hazard condition in current U.S. codes.

b) *Conventional monolithic concrete slab on grade* and *independent stem wall with a slab on grade* foundations are very common foundation construction methods in the south that are susceptible to hidden pathways for termite infestation, even without the presence of foam sheathing. Concrete invariably cracks and termites can use these as hidden pathways to food sources within the building. Independent stem wall and slab foundations 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. Yet, these foundation types are not prohibited or subject to special restrictions or detailing requirements (e.g., termite shields) in any termite infestation hazard condition in current U.S. codes.

c) *Permanent wood foundations* also are susceptible to termite infestation via hidden pathways created by plastic water-proofing films required by the standard for construction of these foundations. Additionally, these foundations often include exterior "skirt boards" (usually of treated plywood) extending from just below grade to the bottom of above grade walls to protect the plastic film. These practices create hidden pathways, even without foam sheathing present. Yet, this type of foundation is not prohibited or subject to special restrictions or detailing requirements (e.g., termite shields) in any termite hazard region in current U.S. codes.

d) *Brick veneer* extending below grade creates a hidden pathway behind the brick veneer for termite access. Also adhered veneers backed by a drainage matt material can create a hidden pathway. Yet, these products are not prohibited or subject to special restrictions or detailing requirements, although flashing materials at weeps could serve as a termite shield if properly specified and installed.

If there is real concern with the hidden pathways and the ability to effectively inspect for termite infestation, it appears that the best solution for areas with a high termite hazard is the proper and consistent use of termite shielding (in addition to soil treatment) regardless of foundation type or materials used. Such a practice is consistent with the findings and recommendations in the reviewed literature. This practice would also address a major concern of the pest control industry regarding the hidden pathways for termite access in a comprehensive and consistent manner.

Currently, pest control professionals' inability to easily see these pathways results in their inability to offer termite warranties or effectively conduct termite inspections required for home sales. Unfortunately, this concern is often narrowly focused on only cases where foam plastic insulation is present when the real concern and the need for an appropriate solution is much broader. In some cases, the concern has involved refusals to warrant homes with foam insulation on the exterior of foundations as though hidden pathways don't exist otherwise. This concern is exemplified and perhaps exacerbated by the FHA's required "Subterranean Termite Soil Treatment Builder's Guarantee" (Form NPCA-99a) which states:

> *"Factors which may lead to infestation from wood destroying insects include 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, and 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."*

At face value, the above statement could lead one to believe that the presence of foam sheathing on a foundation will have a greater effect on risk of infestation than the other potential and more commonly-known causal factors listed, simply based on it being mentioned first in the list. Second, the list fails to recognize the ubiquity of hidden pathways in foundations without foam sheathing which are known to be problematic and common. Thus, rather than solve a real or perceived problem by providing proper guidance (e.g., use termite shields and soil treatment on all types of construction in high termite risk regions, with or without foam sheathing present), Form NPCA-99a appears to make foam sheathing into a "scape-goat" for avoiding warranties or pushing responsibility to generally uniformed consumers regarding appropriate actions. 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 homes. It places the builders and pest control operators in an avoidable conundrum at a critical point in the sale of a home, particularly as energy codes are increasingly requiring insulated foundations. This Research Report and the proposed code change proposal in **Appendix A** should serve as a basis for revising the language quoted above in Form NPCA-99a.

Termites, Carpenter Ants and Foam Plastic Materials

Foam plastic materials are not a food source for termites and do not appear to be an "attractant" for termites any more (and generally much less than) than many other materials commonly used in construction. This is confirmed in the literature. For example, field test data (Fink, 2009) shows only a minor difference in damage to one type of treated foam vs. untreated foam in field studies where exposed foam sheathing on wood materials was monitored in a "very heavy" termite probability condition. More importantly, in both the treated and untreated cases, the damage to foam was minor. Conversely, untreated wood left exposed in "very heavy" termite probability conditions is generally observed to become severely damaged and consumed in a short time period. Again, foam plastics are not a food source for termites and carpenter ants, even though they are known to burrow through or into such materials and other materials if measures to prevent infestation are not properly taken and maintained.

Regardless of the construction materials used, it is important to minimize conditions favorable to termites and carpenter ants by making conditions unfavorable to them taking interest in and gaining hidden access to a building and its many component parts. For example, use of termite shields and chemical soil treatment around and underneath foundations are appropriate minimum actions in areas prone to infestation. Unfortunately, current U.S. model building codes require only one or the other and, in some cases, neither (refer to the earlier review of "current building codes"). In addition, persistent and periodic inspection and retreatment are necessary to prevent infestations as also recommended and specified by the NAS study. Finally, in severe conditions of termite exposure, treated wood and treated foam plastic materials are available as additional deterrents and is a code-recognized solution in areas subject to "very heavy" termite infestation probability (see Figure 2 and IRC Section R318.4, exception #2).

Second, the same agent that promotes wood decay – water or moisture -- also creates a favorable environment for ants and termites and is nearly always associated with their presence. Thus, taking action to ensure a dry environment within and surrounding buildings is appropriate in all cases. This involves appropriate weather-proofing (flashing, water-resistive barrier, siding installation, roof overhangs, grading and surface drainage, guttering and downspout discharge away from the foundation, etc.). It also involves careful execution of water vapor diffusion control measures for building assemblies (e.g., proper use of vapor retarders and/or exterior insulation to protect assemblies). Refer to "Durability by Design -2nd Edition" and also ABTG Research Report No. 1410-03 for excellent guidance on these matters that supplement and improve upon existing minimum provisions (or lack of completeness thereof) in current U.S. model building codes.

Conclusions & Recommendations

The findings reported in this Research Report support the following conclusions and recommendations:

1. The current termite infestation probability map used in U.S. model codes (see Fig. 1) is based on the map originally developed as part of the 1956 NAS study and used in the 1958 MPS. It appears relevant today and there appears to be no obvious reason or need for updating the map.

2. Termite hazard can vary significantly at specific sites within a given termite hazard region (see Fig. 1) based on various ecological factors such as moistness of the site, food sources, and micro-climate (e.g., south facing slope). Thus, it is important to provide effective solutions on a regional scale (see Fig. 1) that recognize this uncertainty. Such solutions should, by default, be applied by local jurisdictions unless data and experience indicate otherwise. This approach relieves local jurisdictions from making uncertain determinations with regard to the need to address termite hazard (see Fig. 3), yet gives them the opportunity to relax requirements with substantiating data and experience. Refer to Appendix A for a draft code change proposal to implement this recommendation.

3. In regions with 'very heavy' or 'moderate-to-heavy' termite infestation probability in accordance with Fig. 1, reliance on only one protective measure as currently required by code (see Fig. 2) appears risky or inadequate based on available data. For example, effective protection over the life of a structure may require initial chemical soil treatment (and periodic retreatments which is beyond the scope of a building code only addressing new construction) plus use of termite shields to promote more effective periodic inspections for termite activity (even though inspections also are a matter that extends beyond of the scope of a building code only for new construction). Even if chemical soil treatment is not maintained, use of termite shields will deter access and provide a greater likelihood for early detection of a termite infestation. The use of termite shields more universally in regions of higher termite infestation would also help resolve concerns with hidden pathways in a manner that is not arbitrary or directed only to selective conditions (e.g., presence of foam sheathing materials on a foundation or

below a slab) while ignoring many others of equal or more common significance. The data reported by Cookson and Trajstman (2002) provides strong justification to require a combination of termite shields and chemical soil treatment in regions or sites prone to 'very heavy' termite infestation probability. Refer to Appendix A for a draft code change proposal implementing this recommendation.

4. Given that available data does indicate that termites can burrow into or through foam plastic insulation materials (even though they may not be particularly attracted to it), it appears important to maintain existing requirements in U.S. model codes regarding an approved method of protecting the foam plastic material where used in 'very heavy' termite regions on foundation walls and below slabs on grade (see Fig. 2, IRC Section R318.4, Exception #2). In fact, it is recommended that this means of protecting foam plastics become the primary method in Section R318.4 of the 2018 IRC, not an exception, and that it continue to be used in combination with one or more of methods in Section R318.1 (see Appendix A). This means of protecting foam plastics from termite damage is similar to the requirement to use treated wood in ground contact applications and available data indicates this is a viable approach. Several foam plastic products with approved termiticide treatments or repellants are already available on the market.

5. 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 for reasons discussed in this report. Instead, the form should indicate various types of hidden pathways that can increase the potential for undetected termite infestation and encourage consumer's and builders to (1) maintain chemical soil treatments and (2) use termite shields as a means to improve protection and mitigate hidden pathways to promote successful detection of termite infestations by way of routine visual inspections by trained pest-control professionals. This recommendation is intended to apply in tandem with improved building code provisions as proposed in Appendix A.

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Appendix A:
Recommended Code Change Proposal for the 2018 International Residential Code

Revise footnote 'c' of Table R301.2(1) as follows:

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

…

c. The *jurisdiction* shall fill in this part of the table by entering the termite infestation probability as determined from Figure R301.2(6) or as determined by data representing ~~to indicate the need for protection depending on whether there has been~~ a history and frequency of local subterranean termite damage.
(all other footnotes unchanged)

Revise Section R318 as follows:

SECTION R318
PROTECTION AGAINST SUBTERRANEAN TERMITES

R318.1 Subterranean termite control methods. In areas subject to damage from subterranean termites as indicated by Table R301.2(1) and Figure R301.2(6), ~~methods of~~ protection against termites shall be provided in accordance with Table R318.1(1) using methods complying with Table R318.1(2), or an alternative approved method~~. include one of the following:~~

Exceptions:
1. Any building entirely of pressure-preservative-treated wood, cold-formed steel framing, masonry, or concrete structural materials (excluding interior finish materials and fenestration frames) shall not require termite protection in accordance with Section 318.
2. Any building located in a region with 'none to slight' termite infestation probability per Figure R301.2(6) shall not require termite protection in accordance with Section 318.

~~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 Section R505.2.1 and R603.2.1.~~

TABLE R318.1(1)
REQUIREMENTS FOR TERMITE PROTECTION

Termite Infestation Probability (Figure R301.2(6))	**Minimum Protection Requirement (See Table R318.1(2) for Methods)**
'Very Heavy'	Method 4 plus one of Methods 1, 2, 3, 5, or 6
'Moderate to Heavy'	Method 1, 2, 3, 5, or 6 with the optional addition of Method 4
'Slight to Moderate'	Method 1, 2, 3, 4, 5, or 6
'None to Slight'	No protection required except as provided by wood decay protection in compliance with Section R317.

TABLE R318.1(2)
SUBTERRANEAN TERMITE PROTECTION METHODS
FOR BUILDINGS WITH UNTREATED WOOD FRAMING

METHOD	DESCRIPTION
1	Chemical termiticide soil treatment in accordance with Section R318.2.1.
2	Termite baiting system installed and maintained in accordance with the *label*.
3	Pressure-preservative-treated wood complying with Section R317, an *approved* naturally durable termite-resistant wood, or an *approved* field-applied wood treatment in accordance with Section R318.2.2 shall be used for all framing members and wood-based sheathing extending from the foundation to at least the top of first story walls or all floor framing, excluding floor sheathing, for floors supported directly on foundation walls or piers.
4	Physical barriers specified, located, and installed in accordance with Section R318.3.
5	Cold-formed steel framing in accordance with Section R505.2.1 and R603.2.1 extending from the foundation to at least the top of the first story walls or all floor framing, excluding floor sheathing, for floors supported directly on foundation walls or piers.
6	Masonry or concrete wall construction extending from the footing to at least the top of first story walls, or basement or crawlspace walls that extend at least 2 feet above grade around the entire foundation. Masonry walls or piers shall be fully grouted or have a solid masonry cap.

~~**R318.1.1 Quality mark.** *(section deleted in its entirety)*~~

~~**R318.1.2 Field treatment.** *(section deleted in its entirety)*~~

318.2 Chemical termiticide treatment. ~~Chemical termiticide treatment shall include soil treatment or field-applied wood treatment.~~ Chemical termiticide treatments shall comply with this section.

R318.2.1. Chemical termiticide soil treatment. The concentration, rate of application and method of treatment of the chemical termiticide shall be in strict accordance with the termiticide *label* and the manufacturer's installation instructions.

R318.2.2. Chemical termiticide field-applied wood treatment. The concentration, rate of application, and method of treatment shall be in strict accordance with the termiticide *label* or, in the absence of a *label*, the manufacturer's *approved* installation instructions.

R318.3 Termite shields and b~~B~~arriers. *Approved* physical barriers and shields, such as metal or plastic sheeting or collars specifically designed for termite prevention shall be located below the lowest point of untreated wood materials in the structure. Such materials shall be installed in a manner that provides a continuous barrier to prevent termites from entering the structure without exposure to detection by visual inspection. ~~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 and exterior foundation walls or slab foundations located below grade shall have an *approved* method of protecting the foam plastic from subterranean termite damage in addition to the requirements of Section R318.1. The clearance between unprotected foam plastics installed above grade and exposed earth shall be at least 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. ~~When 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, foundation stem walls, and crawlspace walls and below slabs on grade where termite protection complies with the "very heavy" condition of Table R318.1(1) using Methods 1 and 4 of Table R318.1(2).
4. Where foam plastic on the exterior of a foundation is terminated above grade with a minimum 3-inch (76 mm) inspection strip located at least 3-inches above the finish grade level.

REASON: The above revisions are based on a thorough review of literature and experience addressing termite hazards and protective methods. There are several beneficial features of this code change proposal:

1. These revisions provide an objective means for local jurisdictions to assess termite conditions and assign a termite infestation probability level (upon which the code requirements are based). This should improve enforcement and compliance.

2. These revisions address a commonly expressed concern with hidden pathways for termite access (particularly in regions with 'very heavy' termite infestation probability). Because hidden pathways existing in a multitude of building constructions, this matter must be addressed comprehensively and not just for cases where select materials or methods of construction are employed that may only create a different or new hidden pathway and not change the fact that unmitigated pathways may already exist. In 'very heavy' termite infestation probability regions, the requirement for use of termite shields (in addition to one of the other methods of protection) addresses the presence of hidden pathways in all foundation constructions, including those where foam sheathing is applied. With the hidden pathway addressed, the only remaining concern is with damage to the foam sheathing when present, which is a separate concern from protecting the building against termite infestation. Therefore, a requirement for protection of foam plastic materials in areas of 'very heavy' termite infestation probability is maintained and improved in Section R318.4 and coordinated with improvements to Section R318.1 as discussed below.

3. A new Table R318.1(1) is provided to clearly indicate termite protection requirements using various methods or combinations of methods for protection against termites. The effectiveness of the protection required scales with the severity of the termite infestation probability.

4. The list of protection methods is deleted and replaced with new Table R301.1(2) specifying the various methods for clarity and ease of use and enforcement. The methods now listed in Table R301.1(2) have been enhanced to provide enforceable requirements and guidance currently lacking in the code.

5. Exceptions to the need for any amount of termite protection are now clearly listed in Section R318.1.

6. For termite barriers or shields (Method 4 in Section R318.1), the reference to Section R317.1 for location is deleted because Section R317.1 addresses only location of treated lumber for decay control requirements, not location of shields or barriers to prevent termite entry.

7. Old Method 4 in Section R318.1 (naturally termite-resistance wood) is deleted and combined with Method 3 (treated wood) because there is no criteria for degree of resistance or prescription for specific wood species. Therefore, use of naturally durable termite-resistant wood must be approved based on data demonstrating equivalency to treated wood in resisting termite attack.

8. Sections 318.1.1 and 318.1.2 are deleted because quality marking and field treatment requirements are addressed by reference to Section R317 for treated wood (Method 3) in new Table R318.1(2). Section R317 includes references to appropriate AWPA standards.

9. Field-applied wood treatments and chemical soil treatment are now separately addressed in two subsections of Section R318.2 because field-applied chemical wood treatments and field-applied chemical soil treatments are very distinct methods and the field applied wood treatment is more like pressure-preservative-treated wood than it is like chemical soil treatments. Furthermore field-applied chemical wood treatments must be approved on the basis of having equivalency to pressure-preservative-treated wood.

NOTE: Section 2603.8 of the 2018 IBC should be similarly updated to agree with IRC Section R318.4 as modified by this draft proposal.

Appendix B:
1958 FHA Minimum Property Standard: Provisions for Protection Against Termites and Decay

815 PROTECTION AGAINST TERMITES AND DECAY

815–1 OBJECTIVE

To provide protection from damage by termites or decay by the application of suitable construction methods and control measures.

815–2 GENERAL

815–2.1 These standards apply to subterranean termite and decay control measures. In those areas where drywood or dampwood termites present a hazard, additional precautions may be required by the local FHA field office.

815–2.2 The control measures for protection against termites and decay outlined herein are predicated upon full compliance with equally important construction practices required in other sections. These practices include:

a. Adequate drainage for the site and building. See 1202.

b. Minimum clearances between ground and wood. See 805, 806 and 808.

c. Adequate ventilation of structural spaces. See 604.

d. Proper flashing. See 902.

e. Installation of vapor barriers and sheathing paper, when required. See 808, 820, and 904.

815–2.3 The acceptable termite protection measures listed in 815–3 serve as a physical or chemical barrier and it is essential that free inspection of structural wood parts in substructure areas be made periodically. To assure this result, written notice shall be posted in the dwelling by the builder that termite protection has been provided by means of (*name of method*) and that semi-annual inspection should be made to detect the presence of any termites which have been driven into the open by the physical barrier or which may have breached the chemical barrier.

815–2.4 Garages, carports and porches—Protective measures required for the main structure shall also apply to attached garages and carports, any accessory buildings, and to porches attached to dwelling.

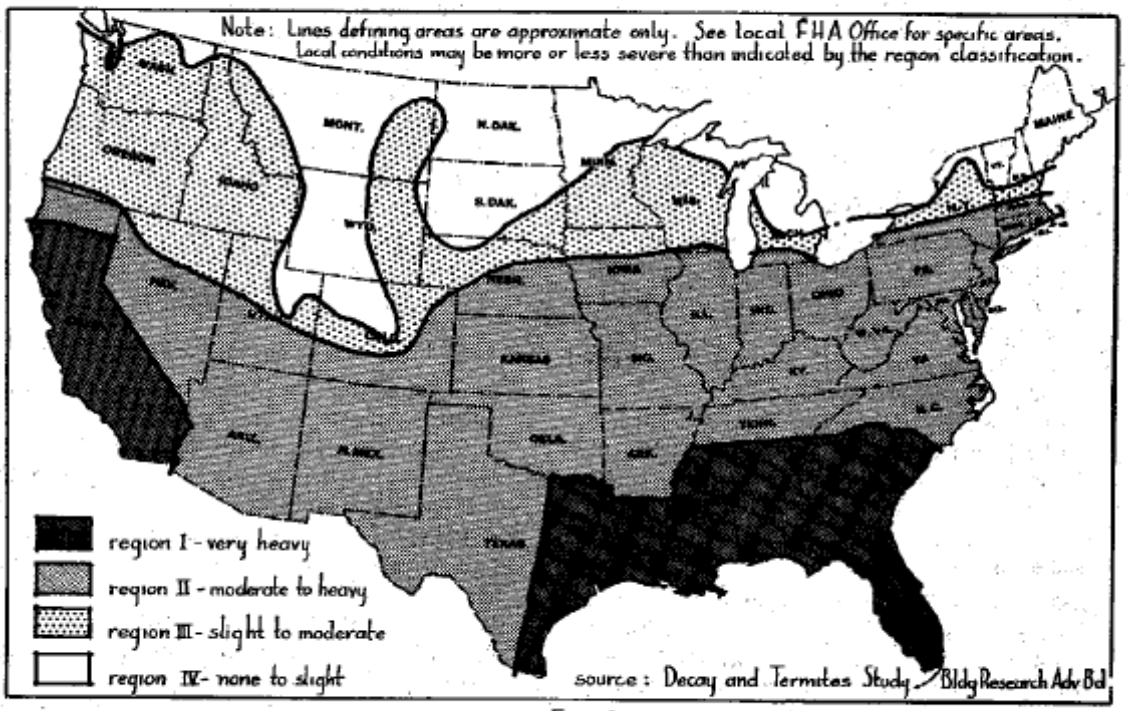


Fig. 2
Geographic Distribution of Termite Infestation

815–3 TERMITE PROTECTION

815–3.1 Provide protection against damage by termites in those areas where they are determined to be a hazard. See Figure 2, Geographic Distribution of Termite Infestation. Application of termite protection shall be as follows:

a. Region I, provide protection in all areas.

b. Region II, provide protection in those areas required by FHA field office.

c. Region III, protection not required except when specifically determined by FHA field office that a hazard exists in a particular area or locality.

d. Region IV, protection not required.

815–3.2 All stumps, roots, fallen timber and other wood or wood product debris shall be removed from building site before completion.

815–3.3 Concrete porch floors, entrance platforms, planters, fences, screens, or other appurtenances shall be separated from the main structure or be protected against entrance of termites.

815–3.4 Where termite protection is required it shall be provided by one or more of the following means:

a. Concrete foundations.

b. Metal shields.

c. Reinforced concrete foundation caps.

d. Soil treatment.

e. Treated lumber.

815–3.5 Concrete Foundations

a. Installation and quality of concrete shall be such that walls shall be free of cracks or porous areas.

b. Concrete foundations cannot be considered as termite protection in:

(1) Slab-on-ground construction unless slab and foundation are placed integrally.

(2) Masonry or masonry veneer construction where the masonry facing or veneer extends below the top of the foundation wall and is less than 8 inches above finish grade.

815–3.6 Metal Shields

a. Materials—Galvanized iron or steel, terne plate, aluminum, copper, or zinc-copper alloy. Minimum thickness and protective coatings shall comply with 708–4, 708–8, 709, 710–1 and 710–3 as applicable. Metal coated building paper shall not be used for shields.

b. Installation:

(1) Shield shall be installed continuous under wood sill plate, girders or other wood construction. In masonry or masonry veneer construction, shield shall extend through wall from interior to exterior. In concrete slab construction, shield shall extend from exterior into slab, embedded not less than 2 inches.

(2) In basementless construction or over masonry piers, shield shall extend at least 2 inches beyond inside face and be turned down at approximately 45 degree angle, at least 2 inches. In basements, shield shall be extended as above or be bent down at least two inches.

(3) Lock or solder seams entire length. Spot soldering not acceptable. Where anchor bolts pass through shield, seal penetration with coal-tar pitch or other materials acceptable to the U. S. Forest Service, U. S. Dept. of Agriculture.

(4) Piping, ductwork or other penetrations through concrete slabs shall be thoroughly sealed with coal-tar pitch or other acceptable materials. Asphalt shall not be used.

(5) Where metal shields are required in concrete slab construction, concrete slab shall be reinforced for temperature with at least 6 x 6—10/10 welded wire fabric.

c. Shields shall be uncovered and visible for inspection at the regular First or Intermediate inspection stages.

d. See Details 44 and 45 for examples of metal shields.

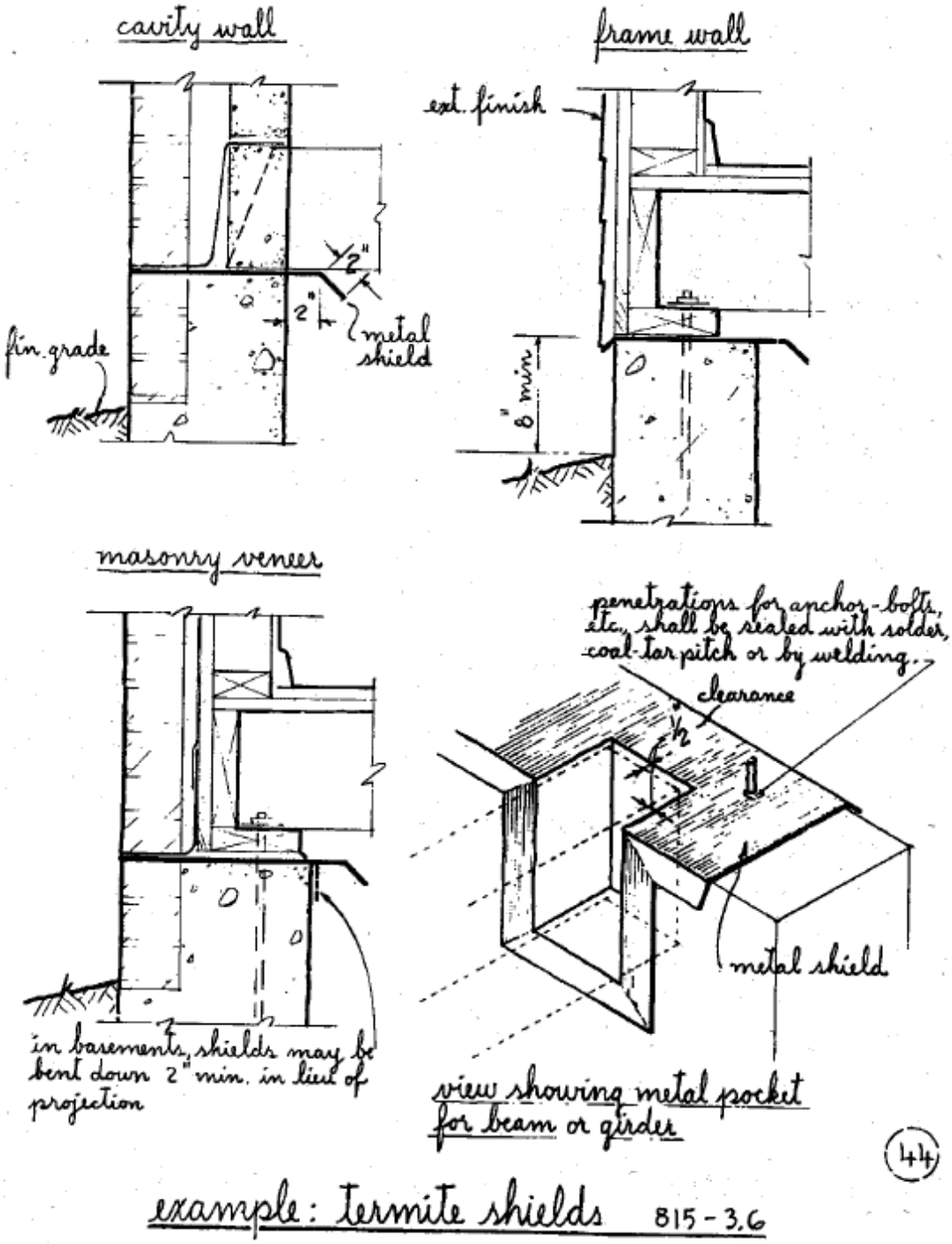
815–3.7 Reinforced Concrete Foundation Caps

a. Capping, for termite protection, shall be of concrete at least 4 inches thick.

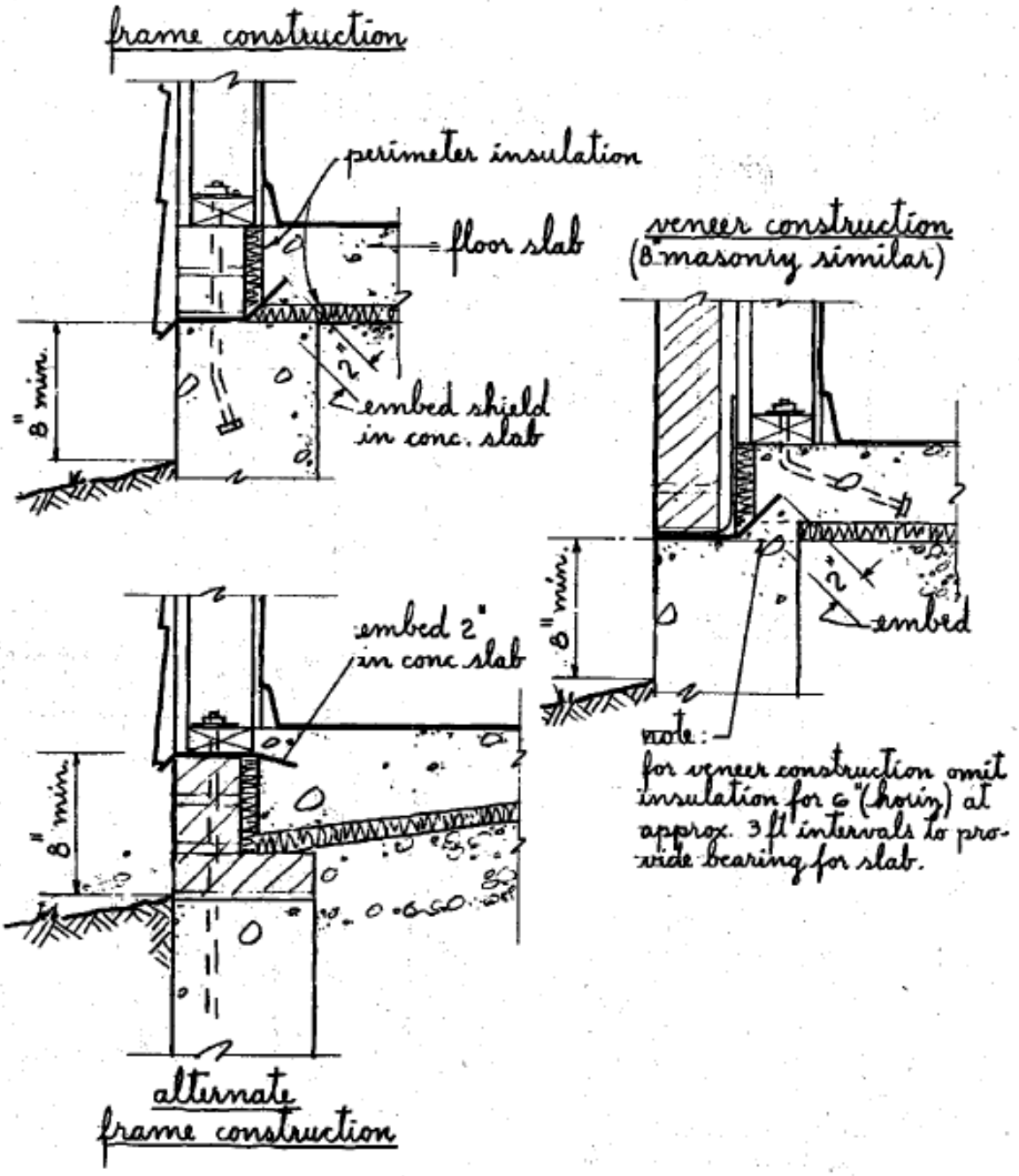
b. Reinforce longitudinally with two No. 3 bars or equivalent. Reinforcing shall be placed so that concrete will completely surround steel.

c. Place continuous in one operation on top of all unit masonry foundation walls and piers. Capping shall be full width of wall and extend through voids in masonry veneer or faced masonry walls.

d. Concrete capping is not acceptable termite protection for slab-on-ground construction.



example: termite shields 815 - 3.6



(45)

example: termite shields for slab-on-ground constr. 815-3.6

815–3.8 Soil Treatment

a. Chemicals and concentrations—To soil areas to be treated, apply one of the following chemicals at not less than the designated concentration:

Chemicals	*Concentrations*
Aldrin	0.5% applied in oil solution or water emulsion.
Benzene hexachloride	0.8% of gamma isomer applied in oil solution or water emulsion.
Chlordane	1.0% applied in oil solution or water emulsion.
Dieldrin	0.5% applied in oil solution or water emulsion.
DDT	8.0% in oil solution.
Lindane	0.8% in oil solution or water emulsion.
Trichlorobenzene	1 part to 3 parts oil.

Note:

(1) Other materials may be used provided:

(a) They are determined to be acceptable by the FHA, Architectural Standards Division, Washington, D. C.; or,

(b) They meet a 5 year test conducted by the U. S. Forest Service, U. S. Dept. of Agriculture; or,

(c) They contain one or more of the above mentioned chemicals in the concentrations recommended.

(d) In all cases, evidence is provided that no toxic effects to humans, beneficial plant or animal life will result from their use.

(2) Some of the listed chemicals are toxic to animal and plant life. They should be applied only with caution by an experienced person. Where individual water-supply systems are proposed, precautions must be taken to prevent infiltering and endangering the water-supply.

b. Application

(1) Basement or crawl space construction:

(a) Apply to critical areas along foundation walls, around piers and under slabs of porches and entrance platforms.

(b) Apply at a rate of 1 gallon per 2½ lineal feet per foot of depth along both sides of foundation walls, piers, etc.

(c) Under porch floors and entrance platforms, apply over-all treatment at rate of 1 gallon per 10 square feet.

(d) Voids of unit masonry foundation walls and piers, apply to voids at rate of 1 gallon per 5 lineal feet.

(2) Slab-on ground construction:

(a) Apply an over-all treatment under entire surface of floor slab including porch floors and entrance platforms. Apply at rate of 1 gallon per 10 square feet, except that if fill under slab is gravel or other coarse absorbent material, apply at rate of 1 gallon per 7 square feet.

(b) Apply to critical areas along both sides of foundation wall at rate of 1 gallon per 2½ lineal feet per foot of depth.

(c) Voids of unit masonry foundation walls, apply to voids at rate of 1 gallon per 5 lineal feet.

(3) Treatment shall not be made when the soil or fill is excessively wet or immediately after heavy rains, to avoid surface flow of the toxicant from application site. Unless the treated areas are to be immediately covered, precautions shall be taken to prevent disturbance of the treatment by human or animal contact with the treated soil.

c. Guarantee

(1) Upon completion of the soil treatment and as a condition for its final acceptance, the builder shall furnish to the owner, with a copy to the FHA field office, a written guarantee providing:

(a) That the chemical having at least the required concentration and the rate and method of application complies in every respect with the standards contained herein, and

(b) That the builder guarantees the effectiveness of the soil treatment against termite infestation for a period of not less than 5 years from date of treatment. Any evidence of reinfestation within the guarantee period will require retreatment, without cost to the owner, in accordance with the FHA standards.

(2) The guarantee shall be in a form acceptable to FHA and shall be drawn in favor of the owner, successor or assigns.

815–3 TERMITE PROTECTION, *Continued*

815–3.9 Treated Lumber

a. All wood to be treated shall be done by a pressure method (full or empty-cell process) in accordance with Interim F. S. TT–W–571d "Wood Preservative, Treating Practice" or the published standards of the American Wood Preservers' Association and with the following:

(1) Moisture content of lumber shall be not greater than 30 percent except that Douglas Fir may be treated green if it does not have a high percentage of sapwood.

(2) Douglas Fir framing lumber having a least dimension of 2 inches (nominal) or more shall be incised on both wide faces before treatment.

(3) Preservative used for treating lumber to be painted or which will come into contact with finish materials shall be a paintable type.

(4) All treated lumber shall be suitably identified as to the name of the treater, preservative used, and the retention in pounds per cubic foot.

(5) All lumber shall be seasoned after treatment to moisture content required for non-treated lumber.

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.

c. Framing lumber should be cut to length before treatment. When cutting, notching or drilling is necessary, treat exposed portions with a 95 percent solution of the same preservative used in initial treatment, by a three minute dip or a thorough brush coating. Exposed portions of board lumber and other thin material shall be similarly protected.

d. Plywood to be treated shall be Exterior type complying with 705–6. Plywood shall be pressure treated by full cell process in accordance with the American Wood Preservers' Association tentative standard for the treatment of plywood recommended by Committee T–9. Treated plywood shall be suitably identified as to the name of the treater, preservative used, and retention in pounds per cubic foot. Brush coat all cut edges with a 95 percent solution of the same preservative used in initial treatment.

Appendix C:
Excerpts from 1956 NAS study: "Protection Against Decay and Termites in Residential Construction"

The purpose of this study is to provide the Federal Housing Administration with authoritative answers and opinions regarding the need for decay and termite protection in the various geographic areas of the country, and if a need is determined to exist, the type and degree of protection necessary.

The conclusions and recommendations of the special Advisory Committee are to the effect that:

1. Sound construction practices are of primary importance in decay and termite control.

2. Local experience should govern in determining the relative severity of decay or termite hazards.

3. The application of control measures should be in direct relation to potential damage.

The Committee also recognizes that no blanket recommendations respecting decay and termite protection can be made. Decay hazard is nation-wide, although more severe in the South Central and Southeast and less severe in the arid Southwest. Termite hazard is almost nation-wide, although definitely of greater magnitude in the southern latitudes.

In addition to technically sound construction practices, several methods of providing protection against decay and termites are known; this is particularly true of the latter. These recommendations therefore will contain alternative methods of protection.

Also, such decay and termite protective measures must vary with the type of construction. This Committee has considered three: (1) slab-on-ground; (2) crawl-space houses; and (3) basement houses.

The recommendations which follow are organized to delimit geographic regions and parts of buildings based upon problem severity, establish acceptable protective measures, and to set forth general principles of protection applicable to all construction types.

GEOGRAPHIC AREAS

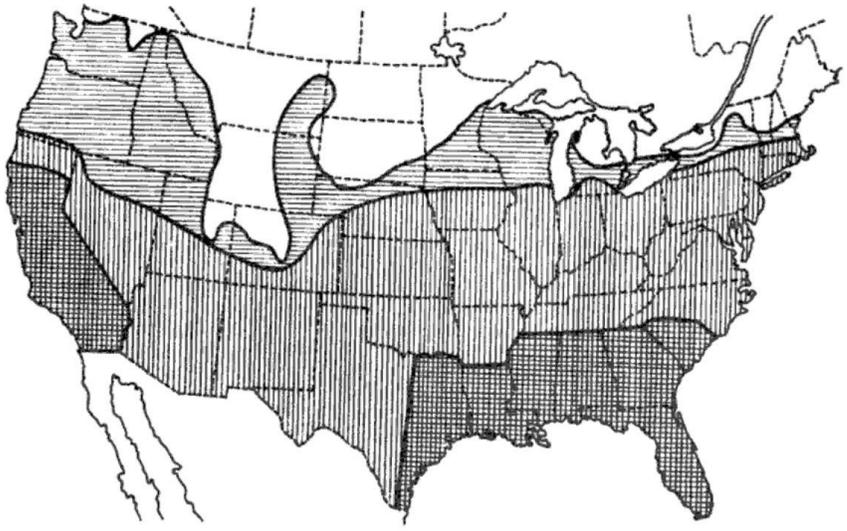
Protective measure requirements should be applied in direct relation to the severity of the decay or termite problem and for the individual locality. Local experience should govern in determining the applicability of area delimitations.

1.0 TERMITES

Based upon the known relative incidence of subterranean termite damage, three specific regions have been delimited (See Fig. 1, p. 24). Geographic areas should be established for the application of protective measure requirements, and these areas should adhere insofar as practicable to these regions. When it is known that within a given geographic area the termite problem is more or less severe for a specific locality than is indicated by the area designation, requirements should be adjusted.

2.0 DECAY

Decay is a potential hazard in all geographic areas of the nation. In the absence of specific area maps applicable to the incidence of decay, the areas delimited for termite incidence may be considered to apply in a general way. However, the need for protective measures for decay may be more or less severe for a specific locality or geographic area than is indicated by area designations. Therefore protective measure requirements for these areas should be adjusted to the hazard.



GEOGRAPHIC DISTRIBUTION OF TERMITES

Fig. 1

Note: Local conditions may be more or less severe than indicated by the region classification. Such known local conditions should take precedence in determining the applicability of protective measures.

1.0 TERMITES

To prevent subterranean termite attack where there is a known hazard, appropriate physical or chemical barriers must be employed. In addition, when such barriers are employed as the sole means of protection, all substructure areas between earth and wood must be accessible to inspection.

Recommended construction methods to minimize the danger of termite attack, and suggested applications of other protective measures are set forth in Section V, where, in the opinion of the Committee, construction methods alone will not be sufficient.[1]

2.0 DECAY

Dry wood will not decay. Wherever there is danger of exposing wood to prolonged or continuous wetting either through direct moisture contact or condensation, such wood must be preservatively treated or be of a durable species, as is indicated by the severity of the decay hazard.

Recommended construction methods designed to avoid wetting of wood, and suggested applications of other protective measures are set forth in Section V, where, in the opinion of the Committee, wood dryness is not practicable to obtain through construction methods alone.[1]

IV
DIFFERING OPINION

(Mr. Gardner G. Garlick, V. P. & Tech. Dir., Protection Products Mfg. Co.)

It is common knowledge that treating the sills and lower portions of a house will not stop termites, as they will tube around treated wood to reach untreated wood above. Therefore, the chemical and physical barriers recommended by the Advisory Committee plus proper and accepted methods of construction, constitute the best known protective measures against termite attack.

It is known that wood having a moisture content below 20 per cent will not decay. Therefore, if lumber is kept dry, protection against decay is achieved. To control decay it is not necessary to provide a treatment which poisons the wood against decay organisms, nor is it necessary to specify that such treatment be applied by pressure to assure deep penetration.

NOTE: This dissenting viewpoint in the NAS study challenges that treated lumber along provides an effective barrier to access of termites to untreated lumber and implies that combinations of protective measures are necessary (e.g., chemical and physical barriers). It is presumed that this is applied in regions with a significant termite hazard, consistent with the NAS study delineation of hazard regions and application of protective measures.

V
SUPPORTING INFORMATION

INTRODUCTION

Conflicting opinions have been evident regarding the degree of protection necessary, the merits and relative merits of various protective means, and particularly the susceptibility of various constructions in any given geographic area. Observations by various individuals and groups have shown that there has been a lack of complete unanimity of approach to the soltuion of these problems, or in the acceptance of decay and termites as a substantial economic problem.

APPLICATION OF PROTECTIVE MEASURES

The application of protective measures and construction methods which follow, are organized by geographic regions and by construction type. In order to ascertain the applications for a given construction type in a given region, it will be necessary to refer to:

a) All regions - All construction types;

b) All regions - Given construction type;

c) Given region - All construction types;

d) Given region - Given construction type.

6.0 REGION I - SLAB-ON-GROUND (See map, p. 24).

6.1 Termite and Decay Control

Until such time as it is known that slabs-on-ground can be built so as not to be penetrated by termites anywhere within the perimeter of the foundation walls, the soil beneath and around all slabs-on-ground in this region should receive an approved toxic treatment. (See 2.0, pp. 26-29.)[2]

Preservatively treat all structural framing lumber; i.e., sills, etc., in contact with masonry foundations or slab in accordance with specifications "a" or standards "b," unless the heartwood of a durable species is used.

7.0 REGION I - CRAWL-SPACE AND BASEMENT HOUSES (See map, p. 24.)

7.1 Decay Control

Preservatively treat all structural framing lumber in contact with masonry foundations within 24 in. of the exterior grade (18 in. for joists, and 12 in. for beams and girders from interior grade in crawl-space houses)[2], in accordance with specifications "a" or standards "b," unless the heartwood of a durable species is used.[3]

7.2 Termite Control

In addition to decay control measures, one of the following measures should be required for termite protection:

a) Termite shields;[4]

b) An approved "critical area" soil treatment;[5]

c) Foundation walls and piers of poured concrete;[6]

d) A 4 in. deep poured reinforced concrete cap on top of unit masonry foundations.[1]

9.0 REGION II - SLAB-ON-GROUND (See maps, pp. 24 and 35.)

9.1 Termite Control

Except in local areas of this region (arid Southwest) where termites are known not to be a problem, the same provisions for control as stipulated for Region I, should be applied.[2]

10.0 REGION II - CRAWL-SPACE AND BASEMENT HOUSES (See maps, pp. 24 and 35.)

10.2 Termite Control

Except in local areas of this region (arid Southwest) where termites are known not to be a problem, the same provisions for termite control as stipulated for Region I should be applied.[1]

NOTE: In Region III, the NAS study employs requirements of Region I only if there is a known termite hazard (otherwise hazard is considered to require no special action).