A Review of Manufactured Housing Installation Standards and Instructions

U.S. Department of Housing and Urban Development
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FINAL REPORT

A Review of Manufactured Housing Installation Standards and Instructions

Prepared for:
U.S. Department of Housing and Urban Development
Office of Policy Development and Research

Prepared by
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PREFACE

This document "A Review of Manufactured Housing Installation Standards and Instructions" was created to serve as an aid for the U.S. Department of Housing and Urban Development, States, Manufacturers, and other involved in developing installation standards and instructions for manufactured housing as stipulated by the Manufactured Housing Improvement Act of 2000.

This document focuses specifically on installation criteria that are not presently addressed by the National Fire Protection Association Standard 225, "Model Manufactured Home Installation Standard." As manufactured homes become increasingly complex and require significant completion at the site, there arise multifaceted issues that are not considered by the NFPA Standard.

This document raises issues for analysis that can be used by all relevant parties in their discussions regarding needed elements for the development of comprehensive installation standards and manufacturers' installation instructions.

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EXECUTIVE SUMMARY

A detailed document review resulted in two matrices, which are found in Appendices A and B. Appendix A covers several manufacturer's installation instructions (MII's) and the "Manufactured Home Installation Guide" by George Porter, published by the Manufactured Housing Institute (MHI) in 2002. Appendix B covers the National Fire Protection Association (NFPA) Standard 225, plus several state installation standards.

In addition to this highly detailed base data, many other documents were reviewed, including:

- "Manufactured Housing Reference Guide for State Installation Programs," developed by the Installation Committee of the Council of State Administrative Agencies (COSAA) in 1998.
- "Manufactured Home Installation Training Manual," HUD Office of Policy Development and Research, 1999.
- "Guide to Foundation and Support Systems for Manufactured Homes," Manufactured Housing Research Alliance, 2002.
- 24 CFR 3280 and 3282, plus Interpretative Bulletins.

From this database, 63 criteria were developed, each addressing a topic (see list below). For each criterion, a discussion is followed by a possible action, for which advantages and disadvantages are enumerated. Most of these criteria address the contents of installation standards, while some address the content of manufacturer installation instructions.

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INTRODUCTION

Background

As required under the Manufactured Home Improvement Act of 2000 (MHIA), draft Model Installation Standards (MIS) will be developed by the Manufactured Housing Consensus Committee (MHCC), with a target date of December, 2003. The document containing these standards is the National Fire Protection Association (NFPA) Standard 225. Based in part on this document, HUD is required to prepare a final MIS for use by the states as a minimum baseline when writing their own installation standards (as required by the MHIA). The final MIS must also function as a minimum baseline for manufacturers in preparing the Manufacturer's Installation Instructions (MII) required for each home model under the HUD Code that regulates the construction of manufactured housing.

The MHCC chose to retain the basic form and structure of the previous versions of NFPA 225, strictly interpreting "installation" in traditional industry terms. This report is intended to supplement the work of the MHCC, addressing some of the topics that could not be considered fully in that effort. These topics were derived from a review of the existing version of NFPA 225; several state installation standards; several manufacturers' installation standards, and a number of other key documents describing installation techniques. From this review, two spreadsheets (Appendix A and B) were developed detailing the installation requirements from these documents. Finally, from these spreadsheets, 63 criteria were identified that were felt deserving of consideration in drafting the final MIS and subsequent state installation standards (SIS's). These spreadsheets provide raw data that the reader can mine to extract further criteria or information. During this review, a number of major issues emerged, that are discussed below.

Overview of Major Issues

Manufactured housing is undergoing an intense period of transition and re-evaluation. The industry's core market for lower-cost, "traditional" manufactured homes has shrunk, as lenders apply stricter standards for qualifying buyers. As a consequence, the always strong pressure to economize has intensified, in an effort to hold down the first cost of the homes and thus to include more buyers in this market. This pressure leads to the retention of the traditional, economical "pier and tiedown" method of installing homes. At the same time, many non-buyers remain intolerant of these traditional manufactured home designs, as evidenced by continued efforts to restrict their use through zoning constraints. This counter-pressure results in the development of products and installation techniques that attempt to make these affordable homes more closely resemble site-built housing. In addition to adding to the home's cost, these products and techniques introduce new and often complicated installation measures that need to be regulated through installation standards.

At the higher-cost end of the market, change and innovation are the order of the day. Manufacturers are successfully marketing to builders and developers, who want the product to match site-built homes in appearance. Many manufacturers build both modular and HUD-Code products, sometimes using almost identical construction. Cape Cod style homes are being constructed, with occupied or occupiable second floors. Home sections are being stacked one on the other, and homes are being set adjacent, in a so-called "attached" configuration. In one instance, two-story homes were set adjacent. Perimeter frames are now offered by most manufacturers, for installation on perimeter foundations that qualify as "permanent," allowing the homes to be purchased with conventional mortgages. Alongside this relatively simple type of permanent installation are designs where the conventional interior chassis beams are carried by transverse beams spanning across a basement. Even conventional pier-and-tiedown foundations are now often supplemented by perimeter stemwalls, so that the installation will qualify as a permament foundation.

Accessory Structures

Accessory structures challenge efforts to codify and standardize installation regulations. Manufacturers design expandable rooms, tilt-up, or tag-along home components that expand the living space. Because these are built in the factory, although they must be assembled and inspected on site, they are regulated by the HUD Code. By contrast, a sunroom, garage, or other accessory structure (or *add-on,* the term used in the HUD Code) that is included in the initial sale of the home but that is not part of the basic home is *not* regulated by the HUD Code, even if provided by the manufacturer acting as a dealer.

However, the code stipulates in 24CFR Part 3282, section 8(j), with regard to add-ons included as part of the initial sale, that "*the addition of the add-on must not affect the ability of the basic manufactured home to comply with the standards"* (for example, by adding a structural load that was not anticipated in the design of the home). To whom is this requirement addressed? Its incorporation into the HUD Code implies that it is addressed to the manufacturer. This interpretation is reinforced by the inclusion in nearly every MII of a clause stating that an accessory structure must rest on its own supports, rather than being supported by the home. However, nothing is typically said in MII's about how an added structure affects the weatherproofing of the roof (add-on roofs typically tie into the home's roof), nor how lateral and uplift loads are transfered to the home. These matters are of proper concern to states regulating installation.

Even more problematic is the very common practice of adding accessory structures after the initial sale. HUD is clear that it has no jurisdiction over such additions, and does not plan to include requirements concerning such structures in the MIS. Yet such structures commonly take the home out of compliance with the HUD Code (for example, by relying on the home for uplift protection in high winds), may void the home's warranty, and contribute significantly to wind damage during storms. It is appropriate for SIS's to address how someone adding an accessory structure might decide whether and how such a structure can be braced by the home (even assuming it supports its own gravity loads).

Division of Responsibility

A traditional division of responsibility is built into the production, sale, and installation of HUD-Code homes. These homes once were truly mobile, and were bought and sold like automobiles, through dealers and using chattel loans. The HUD Code is written to regulate only the home's construction and transportation, and not its installation (hence the current effort). As homes evolved from trailers to mobile homes to today's manufactured homes, installation has become a larger part of the home's cost. All-purpose contractors have evolved who are responsible for installation, producing today's three-part division of responsibility: manufacturer, dealer/retailer, and installer. For homes built on a basement or conventional site-built foundation, yet another party, the foundation contractor, may be involved; and electrical, plumbing and mechanical work may need to be done by licensed specialists. Who is the equivalent of the general contractor to whom the buyer turns for redress in a site-built home?

Many HUD-Code homes are still bought and sold in the traditional way, but innovations at the high end of the market are challenging this structure. For example, manufacturers would like to sell directly to developers, bypassing the retailer. As HUD-Code homes become more similar to site-built and modular homes, the boundaries separating manufacturer, retailer, installer, and on-site contractors become increasingly dysfunctional, interfering with the consumer's ability to assign responsibility for error. This document suggests some ways of assigning responsibility and mending breaches between the various participants. Particular attention is paid to cases where responsibility is refused by one or the other party in a way that leaves the consumer unable to proceed.

In addition to the division among manufacturer, retailer, and installer, there is a three-way split in responsibility among the site code that regulates foundations and site-built improvements; the HUD Code that regulates the construction of the home; and the state installation standards that are either in place, or are being put in place under the MHIA. Authorities are already in place in many states in the form of SAA's (State Administrative Agencies), and most of these have adopted state installation standards. The new MIS will guide states in the revision of their existing standards, or in the production of new state installation standards.

One way state installation standards (SIS's) can aid in the assignment of responsibility is to specifically assume all responsibilities not clearly assigned under one or the other construction codes. This practice would prevent issues of concern from slipping into the cracks between the construction codes. Something of this sort was intended by the provisions of CFR24 Part 3282 under section 303, where states were encouraged to monitor any alterations made to the home and to oversee its installation.

Manufacturers' Installation Instructions (MII's)

The HUD Code, which was intentionally written not to address installation, in fact lays one of the cornerstones for regulating installation in 3280, Section 306(b). This section requires the manufacturer to *"provide printed instructions with each manufactured home specifying the location and required capacity of stabilizing devices on which the design is based."* Section 306 specifies many requirements relating to ground anchors and ties, at least some of which have become obsolete or inconsistent with today's recommended practice. It may be necessary to revise 3280 to address some of these topics.

The blurring of the boundaries between installation and construction is inevitable if homes are intended to be tied down and not left in a truly mobile state. Beginning with the simple requirements outlined in Section 306, MII's have been greatly elaborated, and have taken on the character of an installation standard designed by the manufacturer. Appendix A is a spreadsheet detailing the requirements of several MII's, broken down by three category levels. It can be seen that MII's are highly detailed with regard to some issues of importance to installation, while covering other issues only cursorily, if at all.

Because of the great variety of procedures used by various manufacturers, and because many of these procedures are unique to the manufacturer (or may even be patented), it is not practical for installation standards to address all the possible matters involved with installing every type of home. However, many relatively new materials and systems are in common enough in use to justify their inclusion as typical installation procedures. In particular, various forms of "permanent foundation" are today in wide use. The Consensus Committee (MHCC) that is drafting NFPA 225 adopted a conservative position by omitting mention of most of these new technologies. State installation standards need to take a broader view and include more of those that are in common use.

AC Letters and an On-Site Completion Rule

One highly important function now performed by MII's is describing the completion of work that is governed by the HUD Code but that cannot be performed in the factory. In this category are marrying home sections, tilting up roofs, stacking double-height homes, setting homes adjacent to each other, folding or sliding out expansion rooms or dormers, and so on. In some cases the extent of the on-site completion of work deviates enough from the requirements of the HUD Code that an on-site inspection by the IPIA or designated agent is required before the home is considered complete. These cases are governed by Alternative Construction (AC) letters, which are issued by HUD after its review and approval or modification of the special construction required.

It is possible that HUD may establish a procedure for regulating the on-site completion (an On-Site Completion Rule, or OSCR) of more routine procedures, such as marrying sections, that are now allowed without IPIA inspection. It is also likely that 3280 and 3282 may be modified in the future, which would allow regulations directly or indirectly affecting installation to be clarified and brought up to date. Several criteria included in the present document might in the future be covered by an OSCR, the AC process, or a change in 3280, in which case they should be omitted from state installation standards.

Document Research and Sources for the Criteria

The criteria are intended to be general in nature, and the possible actions are typically not specific enough to directly constitute regulatory language. To discover these criteria, it was essential to assess some of the details involved with installing manufactured homes. To this end, the first task was to examine many documents in close detail. This raised the problem of organizing information in a way that would easily lead to more general criteria.

This was accomplished for most of the documents reviewed by arranging the information in a pair of spreadsheets (found in Appendices A and B). The spreadsheet in Appendix A summarizes the information in several manufacturers' installation instructions (MII's) and George Porter's "Manufactured Home Installation Guide" by dissecting each requirement into its smallest components, and recording these within a series of three hierarchical categories. This allowed the raw data to be sorted in various ways, which helped to highlight topics that needed addressing in the criteria.

The spreadsheet in Appendix B is organized in a slightly different way to document requirements found in the earlier version of NFPA 225 (prior to the recent work of the Consensus Committee) and a number of existing state installation standards. In this spreadsheet, the entire requirement (typically a paragraph from the standard) is kept together instead of being dissected into its pieces, and the requirements are again categorized. While an attempt was made to use the same categories in the two spreadsheets, they diverge in this regard to some extent.

Additional documents were examined or scanned but not reduced to spreadsheet form. These include:use the same punctuation though out.

- 24 CFR 3280 and 3282 and Interpretative Bulletins.
- *"Guide to Foundation and Support Systems for Manufactured Homes,"* ("MHRA Foundation Guide"), Manufactured Housing Research Alliance, Manufactured Housing Institute, HUD's Office of Policy Development and Research (OPDR), and the Partnership for Advancing Technology in Housing (PATH), 2002.
- *"Manufactured Home Installation Training Manual,"* HUD OPDR, April 1999.
- *"Manufactured Housing Reference Guide for State Installation Programs,"* Council of State Administrative Agencies, 1998.
- *"Permanent Foundations Guide for Manufactured Housing,"* HUD OPDR, September 1996.

Format for Criteria Discussions

For each criterion identified, the topic is discussed, a possible action is suggested, and some advantages and disadvantages of the suggestion are delineated. Criteria are grouped in categories and listed alphabetically under each category.

Criteria range from straightforward "nuts and bolts" matters, through formatting suggestions, to matters relating to procedure and responsibility. In this respect, the criteria deliberately cover a wider scope than the provisions of NFPA 225. It needs to be emphasized that matters extensively covered by NFPA 225, such as how to marry home sections, were omitted from this document. This document supplements but does not replace NFPA 225.

At the time of publishing this document, the Model Installation Standards (MIS) have not been published by HUD. It is possible that HUD will see fit to include versions of some of these criteria in the MIS. In these cases, the criteria here will duplicate provisions of the MIS.

Acronyms Used In This Document

3280	Manufactured Home Construction and Safety Standards and Interpretive Bulletins, 24 CFR 3280
3282	Manufactured Home Procedural and Enforcement Regulations, 24 CFR 3282
AC	Alternative Construction
AF	Alternative Foundations
AHJ	Authority Having Jurisdiction (note that the IRC uses the phrase Jurisdiction Having Authority).
COSAA	Council of State Administrative Agencies
DAPIA	Design Approval Primary Inspection Agency
*HIS	HUD Installation Standards for administering programs in states without their own programs (these may be the same as the MIS).
IPIA	Production Inspection Primary Inspection Agency
IRC	International Residential Code
IS	Any of the three categories of Installation Standards (MIS, SIS, HIS)
MEP	Mechanical, Electrical and Plumbing systems
MHARR	Manufactured Housing Association for Regulatory Reform
MHCC	Manufactured Housing Consensus Committee
MHI	Manufactured Housing Institute (www.manufacturedhousing.org)
MHIA	Manufactured Housing Improvement Act of 2000
MHRA	Manufactured Housing Research Alliance
MII	Manufacturer's Installation Instructions.
*MIS	Model Installation Standards being developed by HUD with advice from the Manufactured Home Consensus Committee, per the 2000 Manufactured Housing Improvement Act
NFPA	National Fire Protection Association (www.nfpa.org)
OMHP	HUD's Office of Manufactured Housing Programs
OPDR	HUD's Office of Policy Development and Research
OS	OSCR
OSCR	Proposed On-Site Completion Rule (refer to discussion below)
PATH	Partnership for Advancing Technology in Housing
PE	Procedural and Enforcement
SAA	State Administrative Agency
SIS	State Installation Standards developed by individual states. This abbreviation is used both for the proposed standards based on the MIS, and existing state standards now in place.

* A distinction is made between MIS and HIS to highlight the opportunity available to HUD to develop a "user-friendly" version of the model standards for its own use in administering the program in states that do not develop their own programs. This version could serve as a model for states instead of the more formal and technical MIS version. This issue is discussed in detail under Criterion 20 below.

ACCESSORY STRUCTURES

1. Door Openings between the Home and an Enclosed Garage

Discussion
California prohibits a required egress door from opening into the garage. NFPA 501A does not directly address this issue, but requires that a 28” exterior door be provided in an accessory structure whenever it covers a door in the home. The IRC specifically forbids the one required exit in a home from requiring travel through a garage. The IRC also requires any door that opens into an enclosed garage to be a 20-minute fire rated door, a 1-3/8” solid core wood door, or a 1-3/8” solid or honeycomb core steel door. Such a door does not have to be labeled, which would greatly raise its cost; and unlike in some earlier codes, it does not have to be self-closing.

Possible Actions
Prohibit a required egress door from the home from opening into an enclosed garage. Require that any door between the home and an enclosed garage meet IRC requirements for such a door.

Advantage:
A natural extension of the prohibition in the IRC.

Disadvantage
May require modifications to the home to receive the garage. In climates where attached garages are desirable, the required second means of egress must be added to replace an egress door opening into the garage.

2. Fire Resistant Wall Between an Enclosed Garage and the Home and its Crawl Space

Discussion
The IRC requires 1/2” gypsum board on the garage side of walls between an enclosed garage and the home, specifically including any floor structure, and the attic. Because the IRC assumes a continuous foundation, it does not address fire-protection between the garage and a crawl space. This issue does arise for manufactured homes, and it makes sense to require that the fire protection extend to include the crawl space.

Possible Action
Require in the MIS that an enclosed garage included in the initial sale have continuous 1/2” gypsum board supported by a 2x4 stud wall or equivalent on the garage side of the wall between the home and the garage, including covering the crawl space.

Advantage
Clarifies reasonable practice.

Disadvantage
None apparent, as this reflects common practice

3. Installation Standards for Add-Ons

Discussion
There is a need for installation standards for add-ons that are included in the initial sale. The reason for such standards is that an add-on effectively becomes part of the home, and if it fails under wind, snow, earthquake or gravity loads, it threatens the occupants and the home. (It is assumed that design standards for add-ons in this category follow 3280 requirements). These standards can follow any or a combination of methods: prescriptive standards for common design types; design by an engineer; numbered standards used as performance design measures; and general performance requirements. The latter has been selected for this criterion, but the others should be considered for the final MIS.

Possible Action
Require in the MIS that any add-on that is included in the initial sale and is produced or sold by the manufacturer meet the following performance requirements:

- The foundations of the add-on must meet the same standards as those for the home.
- The method of anchoring the add-on must not compromise the home's anchoring.
- The joint in the roof between the add-on roof and the main roof must be as water resistant as the home's roof.
- The crawl space (if any) must have the same ground cover and ventilation requirements as the main house.
- The add-on must be secured against the same wind and earthquake loads as the main home.
- The installation of the add-on must not reduce the effectiveness of the installation of the home; if necessary, the home's foundations must be redesigned to take account of the add-on (for example, if the add-on's foundations interfere with the holding capacity of a ground anchor).

Advantage
Avoids repeating all the home installation requirements for the add-on. Regulates the installation of an important part of the home traditionally left unregulated. While 3282 says that the HUD Code does not apply to add-ons not made by the manufacturer, it leaves open the possibility that HUD will in the future regulate them. In any case, states can regulate them even if the MIS does not; and regulations are needed for add-ons produced by the manufacturer.

Disadvantages
HUD only regulates add-ons that are added by the manufacturer acting as a manufacturer (not as a dealer) per 3282.8(j).

4. Structural Support of Add-Ons Added Later

Discussion

HUD enforcement of 3280 and the HIS, and state enforcement of SIS's, ends with the completion of sale at the first occupancy of the home. AHJ's are likely to be interested in whether recently built homes remain in compliance with 3280, as they are not in compliance with local building codes. 3282.303 (d) describes a possible feature of a state program for inspection of used homes at the time of sale, but is otherwise silent about the structural fate of HUD-Code homes after first occupancy.

It is quite possible in high-wind or earthquake zones that the addition of an attached accessory structure – even if it supports its own gravity loads – will take the home out of compliance by applying lateral or uplift loads to the home that the home is not designed to resist. In addition, the foundations for an accessory structure may interfere with the home's foundations by cutting into the cone of influence of an anchor, or undermining a perimeter pier.

There are at least three important reasons why supporting accessory structures off the home should be allowed if designed by an engineer:

- Site-built homes can support lean-to structures on their sidewalls, allowing great flexibility for the owner to add onto the home. MII's universally prohibit the support of accessory structures off the sidewall, thereby stigmatizing HUD-Code homes as weak and inferior relative to site built homes. This does not seem to be in the interests of the industry, and it reduces the apparent affordability of HUD-Code homes by raising the cost of accessory structures unnecessarily.
- Accessory structures are commonly supported on the home in the absence of effective oversight. If an accessory structure is allowed to be supported by the home if designed by an engineer, this would encourage the use of an engineer by alerting the owner to the need for one.
- Even if an accessory structure supports its own gravity loads, it will transmit lateral loads to the home. In the case of earthquake loads, these lateral loads can cause failure. Allowing the added loads to be engineered and coped with is better than pretending they don't exist.

Possible Action

Require that MII's allow the imposition of (at least) lateral loads from an accessory structure onto the home, if designed by an engineer who has full knowledge of the basis for the structural design of the home. Ideally, the manufacturer would also allow gravity loads to be supported on the home if designed by an engineer.

Advantages

Clarifies an important ambiguity in MII's. By explicitly allowing engineered structures, the homeowner is not left in a situation where it is impossible to safely attach an accessory structure.

Disadvantages
Requires manufacturers to provide information to engineers for use in their design at any time after initial sale.

5. Structural Support of Add-Ons that are Included as Part of the Initial Sale

Discussion
As noted at the beginning of this document, 3282.8(j) requires that *"the addition of the add-on must not affect the ability of the basic manufactured home to comply with the standards."* Traditionally, only gravity loads were considered, and these were dealt with by a blanket requirement, included in almost all MII's, that any add-on (accessory structure) be entirely self-supporting. Because add-ons transmit lateral loads to the home, such a requirement applied to lateral loads would prohibits the installation of any add-on that is not separated from the home by some inches, to allow both structures to move independently.

This is unlikely to be the intent of the manufacturer, and in any case it is unfair to prohibit these common and desired additions (garages, carports, sunrooms). The simplest solution to this problem is for the manufacturer to provide information to the installer on how to add the structural support necessary (if any) to insure that an add-on that is included as part of the initial sale is safely supported. This installation information should explicitly deal with lateral and earthquake loads transmitted to the home from the add-on.

Possible Action
Require in the MIS that the manufacturer provide the necessary information to the installer for supporting the lateral loads transmitted to the home by an add-on that is part of the initial sale. One variation is to require this information only when the manufacturer supplies or sells the add-on, although this provides less relief to the homeowner.

Advantages
This information seems essential to fulfill the requirement in 3282.8(j). Also, by providing information about lateral loading, the manufacturer can easily provide the needed information for supporting gravity loads on the home, rather than simply prohibiting them. This would reduce the cost to the homeowner while leaving full structural control in the hands of the manufacturer.

Disadvantages
Adds responsibilities for the manufacturer – requires that the manufacturer to know and detail the construction of an add-on sold by the dealer.

ALTERNATIVE FOUNDATIONS

6. Common Alternative Strut-and-Cross-Brace Foundation Designs

Discussion

The MHRA Foundation Guide shows a number of similar designs for strut and cross-brace foundation designs that are made by a number of different companies. This is exactly parallel to ground anchors, which are made by different companies and follow a number of different designs, but are regulated by IS with regard to their performance. There is every reason to include these new designs, because many of them, for multi-wide homes in Zone I, do not require ground anchors at all; and in higher wind zones, rely on concrete deadmen instead of ground anchors.

Possible Action

Include a standard describing the most common of the new innovative pier and brace type of anchoring systems, in terms of performance criteria. Separate designs with regard to wind zones and home width. Note the criterion below regarding the compressive capacity of struts, because many of these designs utilize struts.

Advantage

Bring IS up to date by including the most common types of modern anchoring systems. Provides alternatives to ground anchors, the capacity of which is questioned by many studies. Nearly every innovative design is now made by more than one company.

Disadvantage

Difficult to include proprietary designs (if any) in a public standard of this type.

7. Earthquake Requirements – Foundations

Discussion

The lateral loads induced by earthquakes have been shown to be less than Zone I wind loads for most conditions (see HUD's "The Effect of Earthquakes on Manufactured Home Installations"). However, that document notes that the use of strap tie-downs to resist earthquakes is questionable in the absence of sufficient testing to show that they work under periodic loading. That document also notes that piers need to be tied to the chassis beams.

To address the problem of homes being shaken off their foundations (the source of most damage and fires), ERBS (Earthquake Resistant Bracing Systems) have been developed that simultaneously resist lateral loading and prevent the home from dropping more than 2" if it moves off its supports. Also, many manufactured homes in California are set on permanent frost-wall foundations that provide support similar to that provided by conventional foundations in site-build homes.

Many years ago, California tried and failed to make ERBS a requirement for all new homes. Washington state leaves the option up to local jurisdictions. Earthquakes are not limited to those areas, but occur in Missouri and South Carolina as well, although less frequently. California developed a listing of approved ERBS, but has not maintained the list.

Possible Action
Require ERBS in all earthquake-prone areas for homes that are not set on permanent foundations. Develop and maintain a list of acceptable ERBS

Advantages
Provides an important form of public safety.

Disadvantages
Requires periodic evaluation and listing of ERBS; adds substantial cost.

8. Flood-Resistant Foundations

Discussion
The contractor is not privy to the successor to the old FEMA 85 document, nor to the discussions that have occured between FEMA and the industry about the use and application of these new standards. It seems that some flood-resistant foundation details should be included in SIS, and possibly in MII's.

Possible Action
Include flood-resistant foundation details, perhaps reproduced from approved FEMA documents, in SIS and possibly in MII's.

Advantage
Provides approved and recommended details for relatively common and highly safety-related foundation conditions.

Disadvantage
Would be easier (but less effective) to reference the appropriate FEMA documents.

9. Pre-approval of Standard Foundation Designs

Discussion
California pre-approves standard designs, along with earthquake resistant bracing systems. It would seem appropriate for HUD to pre-approve standard designs in order that manufacturers of foundation systems would not have to seek approval from each state. Also, HUD will be administering the installation program of some states, so this would save HUD time as well.

Possible Action
Develop a pre-approval system for foundation designs and systems.

Advantages

Would simplify HUD's administration of state programs. Would eliminate the need for designers to seek approval from each state and from HUD.

Disadvantages

Requires considerable effort.

10. Standard FPSF Foundation

Discussion

Frost-protected shallow foundations (FPSF's) are increasingly common and are approved by the IRC. These foundations offer a significant advantage to manufactured home installations, because they obviate the need to dig to the frost line, while avoiding the problems that might arise with floating slabs. Not having to dig can be a great advantage in older communities where live unmapped electrical lines lie just below the surface.

Possible Action

Include the design of an approved FPSF in IS. This design should not be contingent upon the removal of the insulation from the floor of the home.

Advantage

Allows the use of a helpful new technology that is increasingly popular. By insulating the crawl space, it may be possible to eliminate the insulation from the floor of the home, providing the regulatory problems can be worked out (might require an AC letter).

Disadvantage

Applying the technology to crawl spaces requires them to be sealed and insulated (see discussion under Technical Criteria on crawl space ventilation).

11. Standardized Floating Slab Foundation

Discussion

The MHRA Foundation Guide usefully shows a number of different floating slab systems that various dealers or installers have developed. At least one of these systems could be developed into a standard floating slab design for use anywhere (possibly excepting areas with expansive clay soils).

Possible Action

Include a standard floating slab foundation design that meets agreed-upon engineering standards. Develop a consensus process for establishing the details of such a design.

Advantages

Would provide installers with a proved, highly practical, attractive and useful alternative to ground anchors for use in most climates. Would provide an alternative to gravel-bed floating systems, which do not work with ground anchors.

Disadvantages:
Requires development of required details by some consensus process.

12. Standardized Sill Plate Details

Discussion
A number of details need to be addressed where the perimeter of a manufactured home rests on a perimeter foundation, either over a crawl space or over a basement. For example, the outriggers and front cross-beam of the home need to be held back to make room for the foundation; or provisions have to be made in the design of the foundation to accommodate these metal elements in a way that sheds water and seals up the foundation. While there are a number of specific designs for perimeter frames, they share enough common features that it should be practical to show typical examples and resolve the problems with typical details. The MHRA Foundation Guide includes some of these designs.

Possible Action
Provide typical details, along with caveats and performance criteria, relating to the design of the home's perimeter and the design of the foundation, where the home rests on a perimeter foundation.

Advantage
Such details will create a smooth interface between the site-built components and the factory-built components, and to avoid problems that "fall into the cracks."

Disadvantage
There are several different approaches that need to be examined; possibly some will be missed.

ENVELOPE

13. Storm Shutters

Discussion
No MII's that were examined contained details for building storm shutters that were practical to build and install, and that worked with the actual siding, window design, and framing of a typical manufactured home. Typically, details assumed a double jack stud next to the opening, a detail that seldom if ever occurs in HUD-Code homes. One detail from a major manufacturer calls for attaching the shutters with 5" long, 1/4" diameter nails at 3" on center – clearly impossible and unnecessary. In most cases, inappropriate details were copied from APA, which does not publish usable details for manufactured housing. In many cases, the details were too small to read clearly, in addition to being inapplicable.

It is simple to design storm shutter details that work with vinyl or metal windows set within the framing typical of a HUD-Code home, with typical sidings used. It is possible that the industry and HUD unite behind a standard set of details that would be used by all manufacturers (see "Manufactured Home Installation Training Manual," available through HUD User, which contains the needed details).

Possible Action:
Require MII's and IS's to include workable details for building and attaching storm shutters to homes, using typical details, window designs and siding details found in today's homes.

Advantages:
Section 3280 requires these details, but they are not being provided by current MII's. Including more detailed requirements in IS's supports 3280 and does not conflict with it.

Disadvantages
None apparent.

FOOTINGS

14. Designing for Live-Load Deflection – Footing Thickness

Discussion
Although no engineer would make this mistake, most installers and homeowners are likely unaware that most of the load for which a pier footing is designed occurs only after installation (or may never occur). Design live loads occur when heavy furniture is moved into place, when snow or wind loads the roof, or when a large group of people stand together near the pier.

Footings made of wood, ABS plastic, and split concrete pads are widely used in the industry. Unlike stiff concrete footings of the type used in site-built homes, these thin footings will deflect internally when live loads are applied (in the manner of a lily pad supporting a frog), moving the home out of level. This behavior is the consequence of their geometry and low modulus of elasticity. As there is no predicting when an individual pier might be fully loaded, that pier may go out of level at any time in the life of the home.

A general rule might be that footings can extend no further from the edge of the layer above than its thickness. This rule should be applied only to non-reinforced concrete, wood, or plastic footings. Properly reinforced concrete footings, or properly designed steel plates would be exempt from this rule. Testing showing that the footing does not deflect internally more than some amount (1/4") when the live load is applied could be accepted in lieu of the design rule. Note that this deflection would be internal to the footing, and would not reflect the deflection that occurs as a result of the entire footing compressing the soil, which is typically a much smaller deflection.

Possible Action
Require that no layer of any footing extend more then its thickness beyond the edge of the layer above (include a diagram explaining the rule). Allow an exception if tests show that the footing does not deflect internally more than 1/4” (or some other amount) when the design live load is applied.

Advantages
Would eliminate a cause of homes going out of level as a result of variations in live loads. Would bring HUD-Code foundations more nearly into line with the performance of site-built foundations at a small cost.

Disadvantages
Would likely prohibit (or require the redesign of) ABS footings, and would prohibit many designs of wood footings. Would add to the cost of homes.

FORMAT

15. Explanatory Material

Discussion
Illinois includes within the body of the standard text explanations for how to physically accomplish various requirements, showing options. Similar documents often include explanatory material in sideboxes or insets, to distinguish this material from the standards themselves. Included in the explanations could be illustrations of the wrong way to install anchors, etc. Other possibilities are illustrating the use of a torque probe and penetrometer, and the proper use of a water level. References to source material can be included for further information. Example calculations for sizing footings would be very helpful to users.

Possible Actions
Recommend to states the inclusion of explanatory material. If possible, include such material in the Model Installation Standards; this would insure that explanatory material would be included in the HIS.

Advantages
Providing explanatory material is a good way to make complex technical matters simpler to understand and to help homeowners and inexperienced installers do the right thing. Explanations will help clarify topics that might not be fully agreed-upon by the writers and reviewers of the standards.

Disadvantages
Requires extra effort. The text of any explanatory material produced by HUD may need to be reviewed by various industry stakeholders to insure that they do not include unnecessary strictures, or unsound or impractical methods.

16. Illustration of Standards Refered to by Reference

Discussion
Illinois helpfully shows illustrated DOT and ASME requirements, and underground requirements for LPG tank location and anchorage. North Carolina repeats the building code requirements for installing underground piping and utilities. Illustrating how to achieve the compaction required by referenced standard could also be helpful. The illustrations would be drawn from the documents that are refered to by reference, but that are unlikely to be available to the installer.

Possible Action
Suggest to states the inclusion of explanatory material drawn from standards included by reference. Also, include such explanatory material in the HIS.

Advantages
Helps installers, who are unlikely to own copies of the referenced standards. Makes proper installation much more likely, and can provide important safety information (as with gas tanks).

Disadvantages
Introducing explanatory derived from referenced sources assumes that IS will be kept up to date and that the material will be periodically reviewed and revised. These are optimistic assumptions.

17. Spanish-Language Version

Discussion
Some installers are recent immigrants from Latin America who would benefit from a Spanish-language version. One possibility is for HUD to produce the MIS and HIS in both an English and a Spanish version

Possible Action
Recommend to states to publish a Spanish-language version of their standards. If funding allows, HUD could publish a Spanish-language version of the model standards.

Advantages
As many users of the standards will be Spanish-speaking, encouraging that standards be written in their language would be a useful step toward making it easier for non-professionals to follow the standards accurately.

Disadvantages
None apparent.

18. Standardized Format

Discussion
Standardizing the numbering system for all installation standards across the country would be a major boon to manufacturers and installers. It would encourage the use of the same numbering system in MII's, and would help installers avoid missing important provisions located in unfamiliar places within the document. Would bring Installation Standards in line with the single HUD Code in format, and would match the current nationwide standardization in the site-built industry (with the IRC).

Possible Action
Require states to use a standardized numbering format.

Advantages
An industry standard numbering system would be a boon to installers and regulators.

Disadvantages
Some states already have standards in place that they would prefer to update to meet the new HUD standards, rather than write entirely new standards. HUD would also have to check each format for compliance. Flexibility makes possible the use by individual states of some of the more user-friendly formats suggested below.

19. Table of Contents, Index, Table of Definitions and Acronyms, and List of Contacts

Discussion
Many users may be unfamiliar with terms commonly used in the industry. Including these along with the standards can help clarify the intent of the standards. For example, Idaho provides an excellent example of a thorough set of definitions.

Possible Actions
Include with the final Model Installation Standards a Table of Contents, Index and Table of Definitions and Acronyms. Recommend that SIS's and the HIS include a List of Contacts relevant to the individual state.

Advantages
A Table of Definitions and Acronyms will help those who are not fluent in the use of engineering language and terms. Other tables and references will make the document more user-friendly.

Disadvantage
Additional administrative effort is required.

20. User-Friendly Format and Style

Discussion

It is possible to meet the requirements of rule-making and also produce a stylistically clear and user-friendly document. HUD's experience with the Fair Housing Act is a case in point. The Act itself is written in legal language, which is very hard to decipher and apply to actual building projects. HUD developed two documents, both of which were accepted as "safe harbors" under the Act and published in the Federal Register. One was written in "building code" language, with a numerical format (similar in format to the document being produced by the Consensus Committee). The other was a guideline called "A Manual to Assist Designers and Builders in Meeting the Accessibility Requirements of the Fair Housing Act," HUD Office of Fair Housing and Equal Opportunity and the Office of Housing, Revised April 1998. This document was lavishly illustrated and showed various design strategies that would meet the requirements of the Act

Other examples drawn from manufactured housing installation standards include those of Washington state, which uses a question and answer format that engages the user and helps formulate issues in a constructive and informative manner. Colorado uses ordinary language and good illustrations to the same effect.

Possible Action

In addition to the basic Model Installation Standards, HUD would develop a parallel document (the HIS) written in a user-friendly format and style. The HIS would serve two purposes: it would be a user-friendly model for use by states as an optional model for writing their own standards; and it would be a user-friendly version of the standard for HUD's own use in administering installation standards in those states that do not develop their own standards.

Advantages

As many users of the standards will be non-professional, developing a version of the standards written in a user-friendly format would be a very useful way of insuring that the standards addressed the real in-the-field needs of the installers. Providing a user-friendly, easy to understand HIS version for HUD's own use would minimize HUD's administrative costs for those states that do not adopt their own standards.

Disadvantages

A contractor must be retained to write the user-friendly version, and to prove to HUD that it follows the basic standard and can be put forward as a "safe harbor" for its users (i.e. can be published in the Federal Register).

FOUNDATION DETAILS

21. Crawl Space Details at an Open Deck

Discussion
Increasingly, manufactured homes are built with open decking over part of the floor. Some MII's and SIS's require that the vapor retarder be omitted from under the deck, but do not require that the area under the deck be separated from the main crawl space. This is inconsistent, because leaving this area open undermines the purpose of the vapor retarder, which is to prevent water from migrating into an enclosed crawl space.

The typical solution to this condition, used universally in site-built housing, is to enclose the crawl space between the deck and the area under the main part of the home. In addition, the area under the open decking should be drained so that it does not send water back toward the main crawl space.

Possible Action
Require in IS's and MII's that enclosed crawl spaces exclude any area covered by open decking, and that the enclosure separates the crawl space from the area under the decking. Also require that the area under the open decking be drained away from the main crawl space.

Advantages
Not separating an open deck from the crawl space encourages water accumulation within the crawl space. It also would not permit ventilating at 1/1,500 per IRC. It would also leave the crawl space open to mosquito breeding.

Disadvantage
Inconvenient; requires special skirting details between the deck and the house.

22. Crawl Space Ventilation

Discussion
Fifty years after the requirement first found its way into HUD's Property Standards (and thence into all building codes) the ventilation of enclosed crawl spaces is under close scrutiny by the building science community. To date, building scientists have found that under many circumstances ventilation of an enclosed crawl space will *create* serious condensation. For example, the surfaces in a crawl space are likely to be below the dewpoint of warm humid ventilation air entering in the spring and summer, especially in maritime and hot-humid climates. They have found that if significant amounts of water are present in a crawl space, only very high levels of ventilation such as provided by a completely open (screened) enclosure can evaporate the water. Most important, many studies have shown that covering an enclosed crawl space with a vapor-resistant membrane or slab is far more effective than ventilation in solving moisture problems.

This fact has been reflected in the current IRC, which allows the amount of ventilation to be cut by 90% if a continuous ground vapor barrier is present. Some manufacturers now incorporate the IRC language into their MII's.

<u>Possible Action</u>
The MIS should require that manufacturers include the following provision from the IRC (R408.2 Exception 2):

The total area of ventilation openings may be reduced to 1/1,500 of the under-floor area where the ground surface is treated with an approved vapor retarder material and the required openings are placed ao as to provide cross-ventilation of the space. The installation of operable louvers shall not be permitted.

The vapor retarder material can be a continuous concrete slab, or a vapor-retarding membrane with a perm rating of 0.06 or less. The vapor-retarding membrane need not run under the footings.

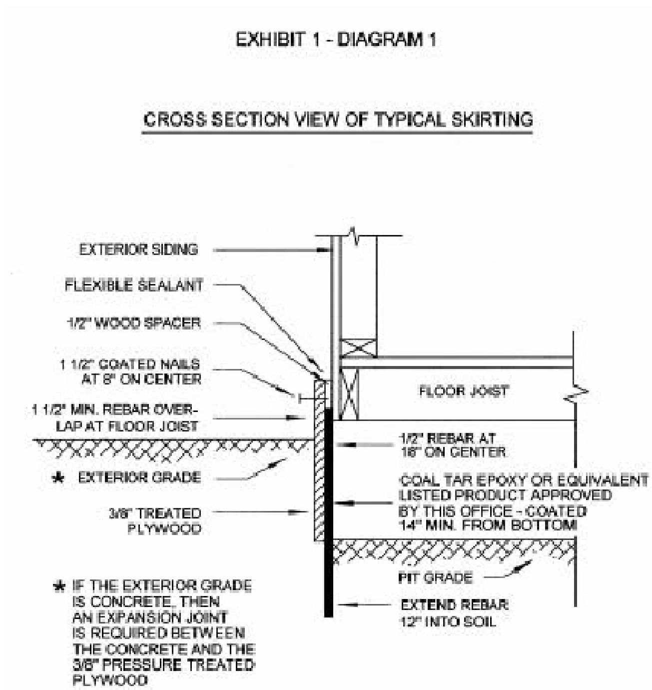
<u>Advantage:</u>
This will bring IS's up to current practice and eliminate a major source of moisture problems in crawl spaces.

<u>Disadvantage</u>
The industry has not been part of the long debate on this topic.

23. Retaining Earth at Recessed Crawl Spaces

<u>Discussion</u>
The attached drawing from the Arizona SIS shows a solution to retaining earth at a recessed crawl space. The detail has at least two flaws: relying on sealant instead of overlapped flashings as the primary form of water protection; and leaving the end-grain of the plywood exposed to water. It is a dry climate detail, and even then is not a long-term solution.

While this detail may not be recommended, it is not clear what details should be included. A variety of materials are used to retain earth: concrete, concrete block, and treated wood, as well as a variety of proprietary products.



A detail of the type shown above or any substitute for such a detail adds a horizontal load to the home's floor structure, albeit a small load. This may be explicitly prohibited by the MII for the home. Also, if a full stem wall is used, it will support the sidewall of the home (discussed in another criterion) unless specific measures are taken to hold it well away from the home's floor structure. The model IS should provide guidance in the development of these complex details without restricting unnecessarily the freedom of design that keeps costs down.

Possible Action
Require that MII's provide at least one durable and water-resisting method for constructing a recessed crawl space; or explicitly prohibit the use of a recessed crawl space anywhere around the home's foundation. The detail should also show how the crawl space must be drained (see other criterion above on that subject). Require that any similar detail shown in a SIS or HIS be overridden by any requirements in the MII with regard to the structural use of recessed crawl spaces stem walls to support the home, or the structural support of the stem wall by the home.

Advantages
This sort of requirement is in keeping with similar requirements in 3280 for showing at least one way of accomplishing needed functions. Recessed crawl spaces are popular because they reduce the visible height of the foundations.

Disadvantages
None apparent.

24. Termite Protection

Discussion
Anecdotal evidence indicates that termites are found in HUD-Code homes, but no data on the frequency of the problem is known to the authors of this report. Ideally, before adopting measures in IS's and MII's for termite mitigation, a survey would be made to gain some measure of how serious the problem is, in what parts of the country damage occurs, and where in the home it occurs. However, in absence of a survey, relatively simple measures can be taken.

Some termite mitigation measures are related to criteria:

- Ability to inspect for termites could influence the required minimum clearances under the home (for example, requiring the chassis beam to be at least 18" above grade at all points so inspectors can easily look at all piers).;
- Single-piece concrete caps could be required over all concrete block piers to drive termites out into the open before they attack wood blocks and shims;
- An adequately-sized inspection hatch into the crawl space is needed in any case;

.

Other measures dedicated to termite mitigation might include:

- Prohibit the use of wood footings (which are likely to be eaten, causing foundation failure);

- Prohibit the use of wood in the foundations;
- Require that insulation be left off a short section of water piping for inspection (termites can tunnel within or under the insulation from ground into the floor structure without detection otherwise).

Whatever measures are decided on, there needs to be a termite zone map or other means of separating areas of serious infestation from those with few or no termites.

Possible Action
From existing sources, develop a termite severity map (there is a good one in the MHRA Foundation Guide, page 2.9) and require that it be included in all SIS's, HIS, and MII's. In areas of high termite severity, prohibit the use of wood footings. For all homes, require that concrete block piers be capped with a one-piece 4" concrete cap, or with a two-piece cap having a fully mortared joint. Leave an inspection length of uninsulated piping at the water service entry. Require the inclusion in SIS's, HIS and MII's of a strong recommendation to have the crawl space under the home inspected for termites at regular intervals (preferably every 6 months). For stem-wall foundations, use treated wood sill plates and install a termite shield to force the tunnels into the open for inspection. Clean up wood scrap and remove any direct wood connection between the ground and the home.

Advantage
In the absence of a survey with up-to-date information to the contrary, termite damage is likely to be relatively common, especially in areas with Formosan termites. Taking simple measures to mitigate the problem should help reduce property damage at little cost.

Disadvantage
Slightly raises cost in some areas by prohibiting some uses of wood in foundations.

GROUND ANCHORS AND TIES

25. Anchor Testing

Discussion
The anchor tests performed by the MHRA, as modified by later tests and by tests in saturated soils, are far from perfect; yet they are significantly more accurate than the previous assumption that an anchor would carry a 3,150-pound load regardless. Some MII's now incorporate reproductions of the MHRA spacing charts.

Possible Action
At a minimum, incorporate the MHRA tests into IS's and MII's, at least until more accurate tests are completed.

Advantage
Uses the most accurate data available for the configuration and spacing of ground anchors.

Disadvantage
Some argue that ground anchors should not be allowed at all.

26. Continuous Lateral Tie-Down Straps

Discussion
Some MII's and SIS's allow long tie-down straps to be run from an anchor head on one side of the home, twice around the chassis beam, to an anchor head on the other side of the home. This practice is not sound engineering and should not be allowed, because the strap can slip around the beam. Each strap length should be directly attached mechanically to a beam or vertical tie.

Possible Action
Define a "strap length" to be the length between an anchor head and a beam, or a vertical tie. Alternatively, specifically prohibit continuous wrap-around ties.

Advantage
Eliminates a faulty engineering practice.

Disadvantage:
A very slight increase in cost.

27. Galvanized Straps

Discussion
Florida has mandated fully galvanized tie-down straps, with four times the amount required by 3280. This is a prudent requirement for any climate, because the homeowner believes the straps are working, rusting straps cannot resist the design load, and straps are very thin and highly subject to rust. The enhanced coating provides normal and reasonable galvanized protection.

Possible Action
Require that all anchor straps be zinc coated at a rate of 0.6 oz per square foot on both sides of the strap.

Advantage
Provides reasonable galvanized protection for crucial components.

Disadvantage
Small increase in cost.

28. Ground Anchors in Saturated Soils

Discussion

According to 3280.306(b)(2)(iii), MII's must require:

(iii) That ground anchors should be embedded below the frost line and be at least 12 inches above the water table; This requirement is impractical. The water table at a site rises and falls. In other cases where its maximum height is crucial (as in the design of septic systems) it is necessary to use the historically high level when it is known, or to take measurements during periods of highest annual water level (typically March to May, which is the law in Massachusetts). 3280 contains no guidelines for determining the height of the water level, making the requirement difficult to enforce. In some areas (as along the Gulf Coast), the water table stays so high that it is impossible to use ground anchors without the augur being below the water table. It is presumed that they are used anyway, in violation of 3280.

It is understood (but there is no documentation in hand) that recent tests by FEMA have determined how ground anchors should be rated when they are embedded in saturated soil of various kinds. Although it is understood that the primary purpose of such tests was to determine the holding capacity in unusual flooded conditions, the same data could be used to set the holding capacity of augurs in permanently saturated soils.

The dilemma posed for this criterion is that regulating through the MIS the capacity of ground anchors below the water table implies violating a requirement of 3280. If there is a consensus that the required notice about ground anchors below the water table is to be removed from 3280 or its successor, it may be possible to add provisions to SIS's, HIS and MII's with the understanding that the conflict with 3280 will be temporary.

Possible Action

Include in SIS's, HIS, and MII's the holding capacity for ground anchors in saturated soil of various types. This might be done by way of a de-rating factor applied to normal anchor capacity. This possible action assumes that the capacity data are available.

Advantage

Clarifying this situation removes a "disconnect" within the standards and allows the safe use of ground anchors where they would otherwise be prohibited.

Disadvantage

None apparent other than contradicting (or "expanding upon") 3280.

29. Ground Anchors Installed at a Small Angle to the Horizontal

Discussion

One MII shows ground anchors installed at 32 degrees from the horizontal. This is unsound engineering practice, because at this shallow angle, the augur will be too close to the surface, so that the cone of earth resistance will break out.

In this same detail, the ground anchor is tilted at an angle between the angles of near-side and far-side straps. Depending on the load distribution, the anchor might be pulled either up or down by the resultant force of two strap ties. Thus, the installer needs to put a stabilizer plate on both sides of the anchor. This condition also occurs when an anchor is attached both to a vertical tie and an angled tie.

<u>Possible Action</u>
Prohibit ground anchors from being installed at an angle with the horizontal greater than X degrees, where "X" is in the vicinity of 45 degrees. When ground anchors are installed at an angle such that it is possible for it to be pulled either to one side or the other (as when the shaft angle splits the angle between two ties), install a stabilizer plate on both sides of the shaft (unless the plate is integral to the shaft).

<u>Advantage</u>
Follows good engineering practice.

<u>Disadvantage</u>
None apparent.

30. Lateral Ties Attached to the Bottom of Chassis Beam

<u>Discussion</u>
Designers of foundation systems seem to agree that lateral ties should not be secured to the bottom of the chassis beam. This could appropriately be included as a requirement in IS.

<u>Possible Action</u>
Require the attachment of lateral ties or supports to the top of chassis beams, to prevent rollover failure. Specifically allow attachment of longitudinal supports or ties to the bottom of chassis beams.

<u>Advantage</u>
Uses agreed-on good engineering practice.

<u>Disadvantage</u>
None apparent.

31. Surface Attachment of Vertical Ties

<u>Discussion</u>
Several MII's allow vertical ties to be field attached to angle clips face-screwed to the underside of the framing. This loads the screws in pull-out and loads the angle eccentrically, both of which are unsound engineering practice (for example, Simpson does not rate any fastenings in direct tension unless they are embedded in concrete).

Possible Action
Prohibit the attachment of required ties to any fitting secured to wood that is loaded in direct pullout; and prohibit the loading of angles eccentrically unless they are engineered to resist the load without bending or tearing.
-
Advantage
Eliminates unsound engineering practice.

Disadvantage
Reduces installation flexibility and may slightly raise cost.

INTERIOR DETAILS

32. Earthquakes – Connections and Straps

Discussion
In addition to foundation protection, a number of measures are easily accomplished that can reduce the likelihood of personal injury or fire as a result of an earthquake:
- Flexible connections to all gas appliances and LP gas tank;
- Effective strapping of the water heater in all normal configurations (flat on a wall, in a corner, and in a closet);
- Cabinet door latches, refrigerator restraints and other measures to keep interior furnishings from flying around in an earthquake.

These measures include work that could be done in the factory, or under an OSCR. However, in the absence of including them in any revisions to 3280, they could be included in IS's and MII's as part of the installation process.

Possible Action
For homes to be set in earthquake-prone areas, require in IS's and MII's that water heaters and refrigerators be tied down, and include effective diagrams covering all common installations showing how to do this. Require in IS's and MII's that all gas connections be made with flexible hoses long enough to prevent fire in the event of an earthquake; and illustrate measures such as cabinet latches that can be applied by the owner to make the home safer during earthquakes. These requirements can be written so that they can be satisfied by future changes to 3280 or its successor.

Advantages
Homeowners are reluctant to take precautions against earthquakes because of their infrequency. By including measures as part of the installation process, public safety is enhanced.

Disadvantages
Adds some cost. Should be covered by 3280. Not all measures are required in site-built housing.

MARRYING SECTIONS

33. Below-Grade Crossover Ducts

Discussion
If a crossover duct is larger than the distance between the chassis beam and the home, a trench is required to install it (this is specifically called for by several MII's). Unless the trench is drained, it can fill with water, placing the duct in water, which is unsafe. The Colorado SIS provides a good set of options for below-grade crawl spaces that could be applied to the case at hand: drain to daylight or provide a sump pit and automatic pump. Colorado also allows drainage into permeable soil providing that ground water is well below the crawl space floor. However, this approach is not recommended because it would conflict with the requirement for a ground vapor barrier.

Possible Action
Require that the ground under the crossover duct be drained or be provided with a sump pit and automatic pump.

Advantage
Prevents the possibility of the crossover duct lying in a puddle of water which might be contaminated by microorganisms or chemicals on the surface.

Disadvantage
Might better be included as part of a general requirement for draining recessed crawl spaces.

34. Cosmetic Details at Married Sections

Discussion
MII's typically cover the cosmetic details involved in marrying sections, such as matching plaster finishes, closing up door jambs, and completing carpeting. SIS's likewise deal with these issues, because they were originally intended to provide guidance for the installation of used homes. It seems inappropriate to include them in the MIS for new homes. However, it is essential that the homes be closed up and completed on site.

Possible Action
Omit from the MIS any details or specifications that are primarily cosmetic. Include a general requirement that the home sections be completely joined with no noticeable gaps between them.

Advantage
Provides consistency.

Disadvantage
None apparent.

35. Structural Connections between Home Sections

Discussion

Structural connections between the homes are part of the structural design of the home and should not be dictated by SIS's for new homes, providing they are included as part of the proposed OSCR.

Possible Action

Prohibit the inclusion in SIS's and the HIS of any requirements regarding the structural connection between new homes, providing that these connections are included as part of the proposed OSCR. These requirements must be included in MII's, however.

Advantages

Removes potential conflicts regarding bolting requirements between MII's and SIS's/HIS.

Disadvantage

Such requirements are traditionally included in SIS's. Also, SIS's will include them with regard to the installation of used homes, which may be confusing.

MEASUREMENT

36. Quantifying Performance

Discussion

Numerical measurement, especially of tolerances, is an important aspect of any performance standard or criterion. As an example, the California SIS defines the extent to which a tie can elongate before it is considered to fail:

(*h) Failure of a component of the anchoring equipment consists of the following occurrences:*

(1) The tie stretches to a length more than two percent greater than the length of the tie prior to the application of the test load; or [etc]

Care is needed to avoid setting arbitrary numerical standards. For example, both crawl-space and roof ventilation requirements in building codes are arbitrary. They were intended to be temporary and subject to review and testing, but were left unchanged for 50 years.

Possible Action

Wherever possible, write technical performance in terms of quantifiable measures that are justified by research and testing, using a consensus process.

Advantages

Use of numerical criteria will increase the number of performance-based criteria in the standard. Numerical criteria decrease ambiguity and reduce the likelihood of disputes.

Disadvantages
Numerical criteria need to be justified, which can require extensive review and discussion that may be outside the allotted timeframe..

MECHANICAL, ELECTRICAL AND PLUMBING (MEP)

37. Cleanouts in Waste Piping

Discussion
Idaho specifies that there must be a cleanout for every 135 degrees of pipe bend in the waste line. 3280.606(b)(1)(iii) details a less severe requirement, for cleanouts every 360 degrees. The ambiguity in this case is where the factory-designed and -produced piping ends and the field-designed piping begins. This ambiguity might be cleared up by including overseeing the installation of the waste piping under any OSCR.

Possible Action
Prohibit state IS's from regulating any waste piping constructed in the factory and shipped loose. Include the oversight of installing waste piping constructed in the factory in any proposed OSCR.

Advantage
Prevents states from overriding the HUD Code.

Disadvantage
None apparent.

38. Conflicts Between Site-Installed MEP and Structure or Concealed MEP Runs

Discussion
All MII's require that field-installed telecom cable within walls not break electrical or plumbing lines. This places the installer in a bind unless he knows where these lines run. A drawing supplied by the manufacturer showing electrical and plumbing runs including information about the height and location of horizontal runs would resolve this problem. One MII prohibits cutting "major structural elements" when installing a gas dryer, without defining what those might be (how is an installer to determine where shear walls are, for example?).

Possible Action
Require the following: in MII's which stipulate that the installer of telecom cable or other MEP items within the walls of the home is responsible for conflicts with structure, electrical wiring, and/or plumbing: then the MII must provide documentation showing where such structure, wiring, and/or plumbing occurs in the home.

Advantage
Would resolve a disconnect between a requirement in the MII and the availability of the information needed to fulfill the requirement.

Disadvantage
Requires coordination between the exact model of the home and the MII (this might be resolved by defining general locations rather than specific runs).

39. Dryer and Other Vents near Floor Level

Discussion
Many MII's require that the installer terminate a dryer exhaust above the snow line. Snow depths vary, and the assumption that snow will seldom if ever rise above the skirting is unfounded. The typical diagram found in MII's and IS's shows the dryer vent discharging through the skirting, which violates the requirement for discharge above the snow line.

This disconnect between two requirements can be easily addressed by requiring that MII's and IS's illustrate how to route vents to exit above the floor. The manufacturer would in the design of the home need to address and resolve any conflict between the above-floor vent duct runs and piping or electrical work.

Possible Action
Require that MII's and IS's for homes that may be set in heavy snow areas include a description of how the dryer vent and any other vent that discharges near floor level can be elevated to discharge above a high snow level.

Advantage
Resolves a contradiction between two separate requirements.

Disadvantage
Requires design changes to accommodate the elevated vents. Would be easier simply to delete requirement that the vent terminate above snow level.

PROCEDURE

40. Periodic Updating

Discussion
SIS's and HIS are likely to contain explanatory material drawn from site building codes and referenced standards, for example, diagrams of an approved method for installing a LP Gas tank. These codes and standards are regularly revised. A parallel issue was raised by the Consensus Committee with regard to dating referenced standards.

It seems appropriate that SIS's and the HIS be periodically reviewed and updated.

Possible Action
Require that SIS's and HIS be updated at some regular interval, perhaps every 5 years.

Advantage
Follows the cycle of updates typically adopted by referenced standards and codes.

Disadvantage
Difficult to enforce.

41. Seals Certifying Installations and Accessory Structures

Discussion
Minnesota has such a system. The seal stays with the home or accessory structure just like the HUD Code seal.

Possible Action
Recommend in the MIS the use of seals.

Advantages
Certifies that a process is completed.

Disadvantages
There may be several authorities involved in regulating an installation, resulting in a potential multiplicity of seals.

RESPONSIBILITY

42. Elements of Installation Requiring Various Approvals

Discussion
Washington state includes a list of alterations to a home that require state approval in its SIS. Throughout the installation process, the installer must know whether an item is covered by 3280 (and its extension through an AC letter or an OSCR) or by the IS. As this issue is confusing to all parties, a list defining the different jurisdictions makes good sense.

Possible Action
Include in SIS's and the HIS a list of installation elements that require approval under the IS, under an AC letter or OSCR, and under the AHJ.

Advantage
Helps clarify a confusing process.

Disadvantage
The list will likely have omissions, which will be confusing.

43. Extent of Local Jurisdiction

Discussion
The state of Washington regulations clearly defines the division of jurisdiction between local and state authorities. It would seem impossible for HUD to be involved in making this distinction for states in general. HUD, however, could require in the MIS that the state make the distinction where applicable. A provision might read that the state (or HUD in lieu of the state) is responsible unless it specifically delegates responsibility to a local jurisdiction. Such a requirement would prevent the installer from being confused as to where the authority lies. In the case of the HIS, such a provision would clarify that the local jurisdiction has no sway.

Possible Action
Include a procedural requirement in the MIS that any SIS, and the HIS, define the extent of local juridiction over matters covered by the IS, with the state (or HUD) retaining jurisdiction unless it is delegated to the locality.

Advantage
Prevents installers from being confused by local authorities claiming jurisdiction and requiring added measures.

Disadvantage
May not work legally.

44. Manufacturer's Responsibility for Installation

Discussion
Some MII's state that the manufacturer is not responsible for set-up, yet that MII provides detailed requirements for setup. This should be clarified in some way, for example, that the manufacturer is responsible for the methods, but the installer is responsible for the means and execution.

Possible Action
Define who is responsible for set-up. The responsibility may be split, with the manufacturer responsible for methods, and the installer responsible for means and execution.

Advantage
This seems to be a basic requirement for making two separate entities work together.

Disadvantage
None apparent.

45. Relative Status of MII and IS

Discussion

States are not consistent on the role of the MII versus the adopted installation standards. One state developed an Appendix Chapter that is used whenever MII do not stipulate certain installation requirements, when clarification is needed, or when the manufacturer's instructions state that the topic is left to the AHJ. Others stipulate that MII must be followed, unless a specific requirement is provided in the law that would override the MII. Most provide detailed requirements for elements installed on site, such as piers, but leave set-up requirements to the MII.

Site codes resolve this problem in a simple way: use the stricter of two competing standards; and if they conflict, determine which governs. This latter must be the MIS, because both the IS and the MII must be based on the MIS per statute. Relying on the MIS to resolve a contradiction prevents states from enforcing IS that are in conflict with MII requirements under the MIS.

Possible Action

Require that: (1) if the requirements of an MII and an IS are not the same but do not contradict each other, use the stricter of the two standards; and (2) if the requirements of an MII and an IS contradict each other, use the corresponding requirement in the MIS.

Advantage

This seems to be a basic requirement for making two separate sets of instructions work together.

Disadvantage

Manufacturers may wish to make the MII dominant (but this may conflict with the statute).

46. Split Responsibility for Site Preparation Between Owner and Installer

Discussion

North Carolina makes it clear that if the installer does not inspect the site before setting and discovers the need for major grading etc., he is then responsible. If he does inspect, the owner is responsible unless the contract states otherwise. This is an example of a state installation standard defining the terms of the contract between the owner and installer. A similar problem has arisen with regard to compensation to the owner for the reuse of running gear. The question for HUD becomes: should the MIS regulate any aspect of the owner-installer contract, or should HUD stay out of this area and relegate any disputes that might arise to the dispute resolution process?

Some disputes are so common and so contentious (like the running gear compensation issue) that HUD is forced to intervene. It might make sense to analyze the relationship between installer and owner and intervene within these standards to avoid later conflicts. The other side of the argument is that HUD has enough to do without getting involved in adjudicating the contract between owner and installer. In addition, the exact terms of such a contract likely have to follow particular state law.

The contractor is not qualified to suggest action in this matter. It is raised because it arises in existing SIS's.

47. State Installation Requirements that Exceed 3280

Discussion
While in theory 3280 does not regulate installation, 305(c)(1)(ii)(B) wind table, footnote 2, does not require that the horizontal projection of the roof be included in the wind load. These loads are applied under 306(a) to the design of tie-down systems. California requires that the roof be included in the calculations, which exceeds the requirements of 3280, but does not directly contradict it. Similarly, the contractor believes but has not checked that Florida tie-down regulations are more severe than 3280.

There is no apparent reason that states cannot apply more severe wind standards to the installation of the home than are defined in 3280, provided they do not directly contradict 3280.

Possible Action
As with differing requirements between MII and State IS, require that the stricter standard governs, and that if there is a direct contradiction, 3280 governs.

Advantage
This seems to be a basic requirement for making two separate entities work together.

Disadvantage
States wishing to enforce stricter standards that happen to directly contradict 3280 will object to the possible action.

SAFETY

48. Comprehensive List of Safety Measures

Discussion
In addition to standardizing the format of safety measures (see Format Criteria), it is possible to develop a comprehensive list of safety measures that ought to be (or must be) included in IS's and MII's. The North Carolina SIS has a model list of safety concerns. For example, a typical requirement that is seldom mentioned is that anchor drillers should wear long leather gloves, as they are likely sooner or later to hit an unmarked and unmapped live electrical line.

Possible Action
Develop a comprehensive list of safety measures that must be included in all MII's and IS's. Include on the list the use of long leather gloves when drilling for anchors.

Advantages
Safety is a key concern, and a comprehensive list would insure that safety measures are fully covered. Such a list should be relatively simple to develop.

Disadvantages
None apparent.

49. Standard Format for Safety Messages

Discussion
All MII and state standards include alerts, cautions, bold-faced messages and other provisions alerting the installer and homeowner to hazards. These tend to vary in format, placement, size, etc. Standardizing these will help make them more visible. Similar formatting requirements may be commonly used in regulating consumer product user instructions, which could be mined for examples.

Possible Action
Require a standard format for all safety measures in all MII's, SIS's and HIS.

Advantage
Increased visibility should draw attention to safety concerns.

Disadvantage
None apparent.

SITE PREPARATION

50. Defining "Low-Lying Areas" and Regulating Installation in Low-Lying Areas

Discussion
Outside of flood plains (which need special regulation), homes need to be protected from local flooding. In the ideal case, a subdivision ordinance would regulate the control and disposal of water in the immediate surroundings of a site; and would require individual site drainage plans to show how water leaves the site and enters the area-wide control and disposal system. However, some manufactured homes are placed in rural areas that are not regulated by an AHJ with regard to area-wide drainage. The issue at hand is whether IS's and MII's should include such requirements to cover those cases where there is no functioning AHJ regulating drainage. These would provide measurable performance standards.

There are no statistics available to show how many manufactured homes are set in areas without functioning AHJ's that require site and subdivision drainage plans. Also, the difficulty in devising precise requirements is reflected in the vagueness of existing requirements in MII's and IS's concerning overall drainage: typically, they might say "drainage is required" without providing any measurable performance standard.

Possible Action

Require that homes not in a flood plain be elevated sufficiently that the ground under the home does not flood during a rain event with a 25-year recurrence interval (or possibly a 50-year recurrence interval). Coupled with such a requirement must be a source of the required rainfall data. Diagrams showing typical drainage solutions are also appropriate.

Advantage

Provides protection for homeowners in rural or other areas without detailed subdivision ordinances.

Disadvantage

Discussion is needed within the industry regarding the rain event for which the drainage should be designed. Requires finding a source for the rain data. Difficult to enforce. Might be handled as part of flood requirements.

51. Installation On Non-Level Sites

Discussion

Traditionally, MII's and SIS's deal primarily with a home placed on a level site. Today, 80% of the homes produced are multi-section, so that any variation in topography will be noticeable across the width of the home. Also, homes are more likely to be installed on private sites that may have irregular terrain. Drainage around and under the home is a crucial issue, as reflected in the universal requirement of MII's and SIS's that the area under the home be kept dry.

Relatively simple recommendations can take care of the vast majority of non-level sites, leaving extreme variations as special cases to be dealt with by an engineer. For example, the North Carolina SIS shows a cross section diagramming how to tie a home down when one side is lower than the other.

Possible Action

Include in IS and MII instructions about how to set homes on sloping sites; and on how to grade around homes on sloping sites. Set a reasonable limit on the slope being covered, leaving steeply sloping sites to be engineered individually.

Advantages

Will make the standards much more useful and applicable to a much wider range of conditions.

Disadvantages
None apparent.

52. NFPA 501A

Discussion
The important issues of fire separation distance and the installation of fuel equipment are covered by NFPA 501A. While the distances are not large, they provide a minimum level of protection, and can be overridden by more severe standards by the AHJ.

Possible Action
Include NFPA 501A by reference

Advantage
Easily covers some crucial matters.

Disadvantage
Installer may not have access to the code, and its provisions might better be included directly in an IS.

53. Road-Like Access onto the Site

Discussion
3280 regulates transportation over roads and streets, but is silent on transportation onto and across the site. 3280.903(c) allows the following exception to an engineering analysis (one that is commonly used in the industry):
(c) In place of an engineering analysis, either of the following may be accepted: (1) Documented technical data of suitable highway tests which were conducted to simulate transportation loads and conditions; or (2) acceptable documented evidence of actual transportation experience which meets the intent of this subpart.
In this paragraph, and through the discussion of transportation in Subpart J of 3280, the assumption is made that travel over highways, roads and streets constitutes the only transportation stresses that the home will encounter. It is impractical in the design of a home to assume that the home will be subject to indefinite amounts of racking and other stresses as a result of transport across ditches and irregularities on the site.

However, the transfer of the home from street to site often produces more severe stresses than travel on relatively smooth roads. Movement diagonally over ditches or over irregular or muddy ground can occur on the site. Many cases occur where homes are badly racked being moved onto the site. Inadequate bridging over low spots using plywood is often ineffective in preventing damage. It is logical that movement over the site not stress the home any more than movement over the highway approved under 3280.903(c).

Possible Action
Include a requirement that movement of the home on site be over terrain that is no more irregular than the streets over which the home's structure was approved under 3280.903(c). Leveling can be accomplished by grading, and/or by bridging devices designed to carry the home's weight (not sheets of plywood).

Advantages
Extends the existing performance standard for transportation to cover a presently uncovered part of the journey. Prevents cost-cutting during installation (by inadequate access roads) that undermines the integrity of the home. Does not introduce any requirement beyond that already covered by 3280.

Disadvantages
None apparent.

54. Soil Heaving – Surface Stone Bed

Discussion
Successful and inexpensive foundation designs have been designed that allow the home to "float" on the surface of soil in freezing climates and in areas with expansive clay soils. One design that is widely used in Maine, Oregon, and no doubt elsewhere in the U.S. (and in Canada) is to set the home on a well-drained stone bed and allow the ground to heave under the home. This design appears not to work with buried anchors, because the anchors will be embedded below the frost line and will not rise with the home. Thus, when the home rises, the ties will be overloaded. If the ties are loosened to provide the needed slack, they no longer function to protect the home from wind. As it is theoretically possible to replace augur or arrowhead anchors with deadmen, the suggested action is not to prohibit such foundations, but to insure that the anchor and the home rise and fall together.

Possible Action
Require that home set on "floating foundations" above soil that is likely to heave have tie-down anchors located such that they move with the home. This can be accomplished either by anchors in a slab on which the home is set, or with deadmen anchors, or with strut-and-brace type anchoring systems.

Advantage
Allows the safe use of economical surface foundation systems in heaving soils.

Disadvantage
None apparent.

SKIRTING

55. Designing for Live-Load Deflection – Skirting

Discussion
In a traditional pier and tie-down foundation, the sidewalls of the home are supported on the cantilevered floor joists assisted to some extent by steel outriggers. The cantilever must deflect under live loads until the joists and outriggers deform enough to carry the loads. It is very likely that the skirting will be installed at a time when the maximum live load is not in place. Therefore, it can be expected that the sidewalls of the home will deflect under design live loads, possibly as much as an inch or more.

Skirting must be designed to accommodate this deflection, which is certain to take place. There are three ways it can do this: (1) accept and support the additional loads; (2) flex out of the way; or (3) be designed with a slip joint that allows the deflection without loading the skirting. In support of the first option (which is becoming increasingly popular), the MII needs to include the worst-case expected live load that needs to be supported. In support of the last option, the MII will need to include the separation required to allow the needed flexure under combined floor and roof live loads.

In the case of the expected deflection, resistance to flexure in the floor system occurs as a result of composite action of the joists, floor deck, and outriggers. These data cannot be calculated by the installer. In the case where the skirting supports the load, however, standard tables could be used, as the loads depend only on the tributary load distance of the floor and on the live and dead loads. As no life safety issues are involved, these could involve only a modest safety factor to prevent material cracking.

Possible Action
Require MII's to include tables showing the loads that need to be supported by structural skirting (unless the manufacturer chooses to prohibit such skirting); and include the amount of deflection that needs to be accommodated by the skirting if it is non-structural.

Advantages
Provides needed information to the installer for the proper use of a variety of skirting options. The needed clearance for sidewall deflection is now provided by some MII's.

Disadvantages
Adds some complexity to the MII.

STRUCTURE

56. Heavy Snow Loads

Discussion
Consider this provision from Arizona, which prohibits designing to heavier snow loads unless authorized:

1. Under 24 CFR 3282.11 and 3280.305 of the HUD regulations, the authority having jurisdiction may not require manufactured homes to be built or installed to a snow load greater than 20 pounds per square foot unless they have received approval from HUD.

California and other states define the counties with their individual snow loads. Washington state leaves this up to local jurisdiction. In general, there seems to be little uniformity in how the Department has established snow loads per 3280.305(c)(3)(ii), which states:
(ii) For exposures in areas (mountainous or other) where snow or wind records or experience indicate significant differences from the loads stated above, the Department may establish more stringent requirements for homes known to be destined for such areas. For snow loads, such requirements are to be based on a roof snow load of 0.6 of the ground snow load for areas exposed to wind and a roof snow load of 0.8 of the ground snow load for sheltered areas.
Explicit permission is given the Department to establish more stringent standards, but nothing is said about the way in which such standards should be administered. At least one company working in the mountainous northwest routinely designs homes to meet very high snow loads, depending on the location.

Because the option of installing a ramada is always available, it is reasonable to clarify heavy snow load requirements in an OSCR or MIS.

Possible Action
Require that where the ground snow load required by the AHJ is more than 1.66 times the snow load shown on the table in 3280.305 in windy areas, or 1.25 times that load in still areas, that the home either be designed for 60% or 80% of the ground snow load respectively; or that a ramada be constructed over the home that resists the ground snow load.

Advantages
Including snow loads in this document would clarify the current ambiguity with regard to enhanced snow loads. This is not necessarily a matter for 3280 enforcement because a Ramada can always be used if the home is not designed for the enhanced load.

Disadvantages
It can be argued that this is a matter for 3280 enforcement.

57. Lateral Loads On Concrete or Concrete Masonry Foundation Walls

Discussion
The IRC requires that any concrete masonry or concrete foundation that retains more than 4’ of unbalanced fill must be permanently braced at the top and bottom, and cannot be backfilled until it is so braced. (The alternative is to build such walls as cantilevered or mass retaining walls. This is impractical in affordable housing from a cost standpoint and should not be considered). Many MII’s prohibit the transfer of horizontal loads from foundation walls into the home’s floor system. It is inconsistent that homes with an

integral perimeter-supported frame have such a prohibition; but in any case, some engineering solution is required for bracing the walls if the home is not allowed to perform this function.

Possible Action
Require that if an MII prohibits the imposition of lateral loads from the top of foundations walls onto the home's floor structure, that the MII show an alternative method of supporting these loads, such as cross-beams (that might also support the home's chassis beams). Requiring that the wall be designed as a retaining wall should *not* be allowed.

Advantage
Defines the needed optional construction to avoid loading the home's floor system where such loading is deemed unacceptable to the manufacturer. Would assist the buyer in making true cost-comparisons between manufacturers, by factoring in the extra cost of cross-beams or other construction needed, compared with a home that is designed to resist lateral loads without such beams.

Disadvantage
Alternative is to require that all permanent foundations be designed by a registered engineer.

TESTING

58. MEP Testing

Discussion
For MEP systems, the tests in MII's and SIS's universally duplicate the corresponding tests required at the factory by 3280. The argument for duplicating the tests is that the MEP systems may have been damaged in transit and need to be retested in accordance with 3280. This would imply that these tests should be part of an On-Site Rule (because they are part of completing the home on site).

Possible Action
Include MEP testing as part of the OSCR. They would still be included in MII's. If no OSCR is enacted, they should stay in IS's.

Advantages
These rules logically come under the On-Site Rule.

Disadvantages
It may not be worth the effort to remove the existing tests out of IS's.

59. Performance of Hinged Roofs

Discussion
Because the flashing and roofing details at roof hinges and at ridges is not explicitly mentioned in 3280, there are no existing performance standards for these details. It would be appropriate that such standards be included in the proposed OSCR. Also, if such standards were not adopted, it would be appropriate to include them as part of the MIS.

Possible Action
Require that the detail at roof hinges and at ridges provide water-resistance equal to that of the main roof.

Advantage
This would provide a useful check on some critical items of work, and would likely reduce consumer complaints.

Disadvantage
May add cost if existing details are inadequate (but might save an equivalent cost in call-backs).

60. Performance of Marriage Wall Gasketing

Discussion
The gaskets or sealant that is typically applied to the joints between home sections is sometimes misapplied, or applied in the factory and damaged or dislodged while mating the sections. As with roof joints, there is no performance requirement in 3280 because the joining of sections is not dealt with (except for requirements concerning MEP crossovers and connections).

There is no simple test to determine whether gaskets are properly applied: only a blower-door test, which costs around $200, can determine this. An alternative to a performance test is a performance specification, but in the absence of testing, the requirement would be hard to enforce.

Possible Action
Include a reasonable performance specification for the gasketing between home sections. It would be helpful to include "safe harbor" examples of gasketing that would automatically meet the specification, such as foamed-in-place urethane.

Advantage
A performance specification would provide the basis for redress in dispute resolution.

Disadvantage
In the absence of testing or a complaint, the specification might be hard to enforce, although a safe harbor might be used by the manufacturer to avoid callbacks.

61. Performance of Site-Installed Siding

Discussion

Because the details of site-installed siding are not explicitly mentioned in 3280, there are no existing performance standards for these details. It would be appropriate that such standards be included in the proposed OSCR. Also, if such standards were not adopted, it would be appropriate to include them as part of the MIS.

Possible Action

Require that the details of siding at window and door openings, corners and eaves provide water-resistance equal to that of the siding installed in the factory.

Advantage

This would provide a useful check on some critical items of work, and would likely reduce consumer complaints.

Disadvantage

May add cost if existing details are inadequate (but might save an equivalent cost in call-backs).

62. Structural Testing to Determine the Extent of Transportation Damage and Repair of Such Damage

Discussion

MII's and states (such as Colorado) note that transportation damage can take the unit out of code compliance. They then require testing of the plumbing, electrical and fuel-burning systems. Should other tests be required, and if so, what tests? The repair of transportation damage was mentioned under the OSCR Draft Notice of Proposed Rule-Making. Specifically, can any feasible test detect shearing of hurricane ties and/or fasteners and other hidden structural defects? A more general question: is there any kind of transportation damage that can make the home unsafe in high-wind or earthquake conditions, but that would not be noticeable under ordinary conditions? And if there are, is this a topic worth dealing with? The conditions that would trigger a test, the test itself, the repairs required if damage is found, and who is responsible, all need to be addressed.

Possible Action

Include as part of Dispute Resolution provisions that if there is evidence of transportation damage (for example, extensive or severe cracking of finishes), require that a typical vulnerable connection be opened for inspection (for example, a floor tie near the non-hitch end of the home). If not included as part of Dispute Resolution, include such a provision as part of the OSCR; or if not OSCR, part of the IS's.

Advantage

Would address the problem of a home being (unknown to the owner) out of compliance with 3280 and therefore of less value and potentially unsafe. A test might involve selective examination of hidden connections, triggered by observation that the home was improperly transported (for example based on severe cracking of finishes).

Disadvantage
May not conform to the format or intent of the Dispute Resolution provisions.

TRAINING

63. Training and Experience for Specialists

Discussion:
Most MII's and some SIS's limit the qualifications for specialists to generalities like "qualified" or "trained." These requirements could to be spelled out, perhaps in reference to state-sponsored training programs. Requiring a certain level of training and experience may reduce the possibility of installation by an inexperienced owner.

Possible Action
Include specific qualifications for specialists needed for the installation of manufactured homes, perhaps in conjunction with training requirements.

Advantage
Defining minimum uniform standards for training and experience seems a necessary element of procedure. Also, when HUD administers the standards, such definition is essential.

Disadvantages
Such standards may conflict with state laws (this problem may be resolved by defining which take precedence if there is a conflict). They may not permit owner installation.

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