MINUTES
MHCC MEETING

October 25-27, 2016

Holiday Inn - Capital | Washington, DC

MINUTES
MANUFACTURED HOUSING CONSENSUS COMMITTEE (MHCC) MEETING

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DAY 1: Tuesday, October 25, 2016

Call to Order

MHCC Chairman, Richard Weinert, called the meeting to order at 9:05 a.m. (EDT) and welcomed new committee members: Loretta (Lori) Dibble, Manufactured Housing Association of New Jersey; and Myles Standish, CEO, KIT HomeBuilders West in Caldwell, Idaho and asked that they introduce themselves to the committee. Chairman Weinert reminded committee members to keep on point. Public comments would be allowed only after the committee has had a chance to discuss each topic, if time permits.

Roll Call

Kevin Kauffman, Program Manager of the Administering Organization (AO) Home Innovation Research Labs, called the roll and announced that a quorum was present. Guests were asked to introduce themselves. See Appendix A for a list of meeting participants. Steven Anderson, Rick Hanger, and Leo Poggione were unable to attend the meeting.

Introduction and Opening Remarks

Pamela Beck Danner, Administrator of the Office of Manufactured Housing Programs (DFO), welcomed the MHCC committee members. DFO Danner noted that this is a meeting of the Manufactured Housing Consensus Committee (MHCC) and that the meeting notice was published in the *Federal Register* dated September 27, 2016. DFO Danner also provided background on the creation of the MHCC:

> Section 604(a) of the National Manufactured Housing Construction and Safety Standards Act of 1974, as amended by the Manufactured Housing Improvement Act of 2000 (42 U.S.C. 5401 et seq.) (the Act) establishes the MHCC. Among other things, the MHCC is responsible for providing periodic recommendations to HUD to adopt, revise, and interpret the manufactured housing construction and safety standards. HUD's Manufactured Home Construction and Safety Standards are codified at 24 CFR part 3280. According to Section 604(a)(4) of the Act, the MHCC is required to consider revisions not less than once during each 2-year period.

DFO Danner introduced Edward Golding, Principal Deputy Assistant Secretary (PDAS), Office of Housing, U.S. Dept. of Housing and Urban Development. Mr. Golding shared the story of his son's 4,200-mile trek from Virginia to Oregon. The route primarily went through small towns where the majority of the housing stock was manufactured homes. Mr. Golding reminded the MHCC that their work has a great impact across the county, that manufactured housing typically does not get the attention it deserves, and there will always be the need to balance safety and security with cost. He asked the committee to keep reminding HUD leadership to promote the value that the manufactured housing industry has to offer. DFO Danner thanked PDAS Golding for his time and informed the committee that she was recently able to brief Secretary Castro on manufactured housing issues.

DFO Danner welcomed the MHCC to Washington, D.C., thanked Toni Price and Jane Hofilena, BLH Technologies, for providing the meeting planning logistics and noted that the last face-to-face meeting was held in Louisville, Kentucky in January 2016.

Mr. Kauffman provided a brief summary of meeting procedures to ensure compliance with MHCC Bylaws and that Robert's Rules of Order were followed. He noted that all voting items would be followed-up by letter ballot and that the vote would not be final until the letter ballot is complete by providing members who were not present an opportunity to participate in the process.

Approval of the Minutes

MHCC Motion to approve the August 9, 2016 MHCC Committee meeting minutes.

Maker: Jeffrey Legault Second: James Demitrus
Meeting Vote: Unanimously Approved.

Update on Approved Proposals

Richard Mendlen, Senior Structural Engineer, Office of Manufactured Housing Programs from HUD, provided an update on previously approved proposals by the MHCC.

1. The fourth set of proposed changes (2013-2016) is under development and includes requirements for the fire sprinklers.
2. The third set of proposed changes, which include the carbon monoxide standard, was unofficially sent to OMB for preliminary review.
3. The on-site rule is complete and had a smooth transition thanks to Jason McJury.
4. The final formaldehyde rule was publicly announced by the EPA on July 27, 2016.
5. Updates to the standards incorporated by reference (IBR) are under development.
6. A draft of the RV final rule has been prepared and is under Departmental review.
7. A draft of the Minimum Payment to States Proposed Rule is currently under review at OMB.

Edward Golding informed the committee there is a queuing process and approvals may wait until the next administration. DFO Danner reminded the committee that ALL regulatory analysis is processed by PD&R.

Richard Weinert said the committee now works on a two-year cycle, but the recommendations go stale after a number of years.

When committee members asked for details on the process, they were reminded there was a previous presentation on the rulemaking process and were referred to Appendix E of the December 2014 MHCC meeting minutes.

Technical Systems Subcommittee Report to the MHCC

Chairman of the Technical Systems Subcommittee, William Freeborne, presented the following report to the committee:

LOG 113: **§ 3280.4(b)(1) Incorporation by reference**
NFPA 54 National Fuel Gas Code

Log Item 113 was assigned to William Freeborne to review and submit a recommendation.

LOG 114: **§ 3280.4(i)(20) Incorporation by reference**
UL 60335-2-40, Safety of Household and Similar Electrical Appliances, Part 2-34; Particular Requirements for Motor-Compressors

Log Item 114 was assigned to William Freeborne to review and submit a recommendation.

NFPA 70-2014 Task Group Recommendation
DFO Danner provided background by informing the committee that John Weldy submitted proposed modifications to NFPA 70-2014 based on the assumption that NFPA 70-2014 would be approved as a referenced standard.

Don Iverson, NEMA, informed the committee that the NFPA 70-2014 Task Group decided to approve NFPA 70-2014 with the proposed modifications and submitted NEMA testimony (Appendix B) in support of that action. Mr. Iverson noted that, currently, 35 states have adopted the 2014 edition of the NEC allowing site-built home occupants greater life and safety protection than their manufactured housing counterparts. Mr. Iverson provided definitions of the topics being discussed:

> AFCI (arc-fault circuit interrupter) – a device designed to help prevent fires by detecting an unintended electrical arc and disconnecting the power before the arc starts a fire.
>
> GFCI (ground-fault circuit interrupter) – protects people against shock by monitoring the imbalance of current between the ungrounded (hot) and grounded (neutral) conductor on a given circuit.
>
> TRRs (tamper-resistant receptacles) – have a complex access mechanism that only allows access to the electrical current when both upper prongs are penetrated simultaneously, thus protecting consumers (particularly small children) against shock if a metal object is inserted into the receptacle.

Don Iverson noted the committee's concern regarding cost and provided some additional information from the Ohio Chapter of the International Association of Electrical Inspectors (IAEI) (also included in Appendix B) for review and said NEMA is willing to work with the committee to provide the required cost benefit analysis.

William Freeborne updated the MHCC on the action taken at the Technical Systems Subcommittee meeting held on September 27, 2016. The subcommittee recommends that the MHCC approve NFPA 70-2014 with some modifications: 1) NFPA 70-201 §210.52(E)(3), exclude the requirement for an additional external receptacle for balconies, decks, or porches with an area of less than 20 sq ft; and 2) strike NFPA 70-201 §550.4(A) & (B).

There was a question regarding the exclusion to NFPA 70-2014 §210.52(E)(3). Mr. Freeborne said that the subcommittee decided that an outlet was not necessary for small areas meant only for ingress/egress.

John Weldy said 21 states have adopted the 2014 IRC for single-family homes – only 10 adopted the NEC without amendments. It is a common practice to amend the NFPA 70-2014 and cited an example where his company saved $12 million over the course of a year when the requirement for AFCI on kitchen countertop circuits was amended by the local jurisdiction. The NEC started in 2005 with AFCI and HUD amended them out at the time. Over time the NEC has increased the requirements for AFCI. Mr. Weldy provided an example of a situation where a homeowner may have an old vacuum, which causes the AFCI to trip and result in complaints from the homeowner that there is a problem with the electrical system.

Regarding GFCI, Mr. Iverson said since 1976 the number of electrocutions were reduced from 650 to 160 per year.

James Demitrus said he understands the benefits of the technology, but who is going to pay for it.

There was a question if NFPA 70-2014 was adopted, would it replace 3280 Subpart I.

Jeff Legault said as a manufacturer he would like to keep 3280 Subpart I. The NEC is very complicated and he is not opposed to adopting the NFPA but it should be written *into* 3280 Subpart I. Mr. Legault also agreed with John Weldy regarding the removal of the requirement for AFCIs in kitchen countertops.

Don Iverson said the 2008 NEC does not have the kitchen countertop requirement.

There were questions about why the committee would just change the reference to the standard and there was agreement that the language in the code should be modified.

A motion to accept the proposed language failed consensus and was sent back to the Technical Systems subcommittee for further review.

Public Comment

Mark Weiss, MHARR, said fire incidents are less with manufactured homes when compared to other types of homes, and cost has to be a consideration. Mr. Weiss received clarification from Alan Spencer that the $580/house figure that he provided at an earlier meeting was in fact the cost to the manufacturer, not the cost burden to the consumer. He further said any suggestion that the NEC should be put into the code as a replacement of 3280 Subpart I would set a terrible precedent.

Lois Starkey, MHI, suggested that HUD review service records with IPIA data before making wholesale changes to the code. Ms. Starkey wanted to know what needs to happen for this committee to act as other standards agencies and what regulatory steps can be taken.

Review Current Log and Actions Items (AI)

LOG 119: **§ 3280.508(b) Heat loss, heat gain and cooling load calculations**
John Weldy said these will become obsolete with the DOE Rule. Richard Mendlen said HUD cannot accept a proposed change that includes “latest edition” language.

MHCC Motion to disapprove Log Item 119.
Maker: John Weldy Second: Joseph Anderson
The motion carried.

LOG 120: **§ 3280.508(b) Heat loss, heat gain and cooling load calculations**
Richard Mendlen said HUD cannot accept a proposed change that includes “latest edition” language.

MHCC Motion to disapprove Log Item 120.
Maker: Timothy O’Leary Second: Robin Roy
The motion carried.

LOG 121: **§ 3280.508(d) Heat loss, heat gain and cooling load calculations**
Section 508 will become obsolete with the DOE rule.

MHCC Motion to disapprove Log Item 121.
Maker: John Weldy Second: Richard Nolan
The motion carried.

LOG 122: **§ 3280.511(a)(1) Comfort cooling certificate and information**
MHCC Motion to disapprove Log Item 122.
Maker: Alan Spencer Second: Timothy O'Leary
The motion carried.

LOG 123: **§ 3280.511(a)(2) Comfort cooling certificate and information**
There were questions as to whether this issue is covered in the DOE Rule.

MHCC Motion to table Log Item 123 until the next MHCC meeting.
Maker: Robin Roy Second: Ishbel Dickens
The motion carried.

LOG 140: **§ 3280.403 Requirements for Windows, 3280.404, & 3280.405**
David Tompos said this update allows window manufacturers the ability to use available testing processes and opens the industry up for more competition. He noted that Andersen Windows are not currently approved for manufactured homes. Richard Mendlen agreed that this log item updates the standards proposals that are already approved.

MHCC Motion to approve Log Item 140.
Maker: John Weldy Second: Debra Blake
The motion carried.

LOG 141: **§ 3286.409 Obtaining inspection**
Lois Starkey said this issue was brought up by the MHEI-Manufactured Housing Education Institute (MHI's educational arm) to make item (b) match item (a) and it applied to HUD administered states.

MHCC Motion to approve Log Item 141.
Maker: Jeffrey Legault Second: Alan Spender
The motion carried.

LUNCH BREAK

Final Rule on Formaldehyde Presentation

Erik Winchester, Environmental Protection Agency, gave a presentation, "Formaldehyde Emission Standards for Composite Wood Products," (Appendix C). The Toxic Substance Control Act (TSCA) Title VI became effective on July 7, 2010 and mirrors the California Air Resources Board (CARB) limits. TSCA Title VI directs the

implementation of regulations to ensure compliance with formaldehyde emission standards. Manufacturers will be required to maintain records that prove their suppliers are providing TSCA Title VI compliant products.

There was a question on the definition of *woody grass* – bamboo was given as an example of the most common type of woody grass.

Mr. Winchester said manufactured housing is considered as a finished good under TSCA Title VI. The EPA is working on FAQs for manufactured housing and will hold webinars to assist in the implementation of TSCA Title VI.

Alan Spencer asked if retailers would be responsible for record keeping. Mr. Winchester said yes, there is a three-year minimum for record keeping to prove the retailer bought a TSCA Title VI compliant manufactured home. The EPA is working with HUD on labeling requirements.

There was a question why manufactured housing was singled out. Mr. Winchester said it was DOE's view that it is the intent of Congress to monitor manufactured housing.

Richard Weinert asked about unfinished surfaces. Mr. Winchester provided an example of kitchen cabinets. Under TSCA Title VI, additional testing would not be required if the manufacturer adds a wood veneer to unfinished kitchen cabinets.

Joseph Sadler asked about ready-made bookcases that might be added to the home. Mr. Winchester said furniture manufacturers also are required to comply with TSCA Title VI.

Timothy O'Leary asked about adding laminate to an office area to match the kitchen. Mr. Winchester said TSCA Title VI formaldehyde emission limits currently only apply to wood or woody grass veneers – not to laminate.

Public Comment

Mark Weiss said the TSCA Title VI refers to manufactured housing as a fabricator but excluded site-built housing when the National Association of Home Builders (NAHB) provided their input.

Lois Starkey said EPA is now requiring manufactured homebuilders to do something additional that site-built homebuilders are not required to do.

David Tompos said our industry is already complying; and he is disappointed with the site-built exception. Currently, the HUD standard is more stringent than the EPA Rule and it would be a mistake to delete the additional HUD requirements.

BREAK

U.S. Environmental Protection Agency (EPA) Final Formaldehyde Rule, Log 80—Secondary Method Testing, and HUD's Proposal Regarding Incorporating EPA's Formaldehyde Rule into the HUD Standards

HUD provided the committee with a preliminary working draft of changes to the Manufactured Home Construction and Safety Standards (MHCSS), Formaldehyde Emission Controls for Certain Wood Products (Appendix D) as a result of the EPA Rule. Richard Mendlen read from the Act:

Sec. 4. MODIFICATION OF REGULATION.

Not later than 180 days after the date of promulgation of regulations pursuant to section 601(d) of the Toxic Substances Control Act (as amended by section 2), the Secretary of Housing and Urban Development shall update the regulation contained in section 3280.308 of title 24, Code of Federal Regulations (as in effect on the date of enactment of this Act), to ensure that the regulation reflects the standards established by section 601 of the Toxic Substance Control Act.

Richard Mendlen provided an overview of the preliminary working draft of changes to MHCSS and said it would eliminate the current health notice requirements, incorporate by reference the EPA maximum emission levels of formaldehyde allowed, for hardwood, plywood, particleboard, and medium density fiberboard and incorporates language that is consistent with the EPA Rule.

LOG 80: **§ 3280.406 (new section)**

Richard Mendlen said Log Item 80 proposes the use of small chamber testing and in order to be consistent with EPA language, HUD will accept small chamber testing.

MHCC Motion to assign to the Structure and Design Subcommittee: 1) preliminary working draft of changes to MHCSS as a result of the EPA Rule; and 2) Log Item 80.

Maker: Ishbel Dickens Second: William Freeborne

The motion carried.

The MHCC adjourned at 3:30 p.m. to allow the Technical Systems Subcommittee to meet.

The MHCC reconvened at 4:20 p.m.

Since the committee observed and participated in the discussions held during the MHCC Technical Systems Subcommittee meeting action was swift:

MHCC Motion to recommend that HUD adopt the NFPA 70-2014 as a reference standard as modified below:

- **Provide an exception to NFPA 70-2014 § 210.52(E)(3) as follows:**
  Exception: Balconies, decks, or porches with an area of less than 20 sq ft are not required to have an additional receptacle installed.
- **Provide an amendment to NFPA 70-2014 § 550.4(A) & (B) by striking these two sections.**
- **§ 3280.801(b) In addition to the requirements of this part and Part II of Article 550 of the National Electrical Code (NFPA No. 70-2014~~2005~~), the applicable portions of other Articles of the National Electrical Code must be followed for electrical installations in manufactured homes. The use of arc-fault breakers under ~~Articles 210.12(A) and (B), 440.65, and 550.25(A) and (B) of~~ the National Electrical Code, NFPA No. 70-2014~~-2005 is not required~~ are only required for general lighting circuits. Smoke alarms installed on a dedicated circuit do not require arc fault protection. Wherever ~~However, if~~ arc-fault breakers are provided, such use must be in accordance with the National Electrical Code, NFPA No. 70-2014~~2005~~. Wherever the requirements of this standard differ from the National Electrical Code, these standards apply.**

Maker: William Freeborne Second: Timothy O'Leary

Meeting Vote: 17-0-0

The MHCC meeting adjourned at 4:35 p.m.

DAY 2: Wednesday, October 26, 2016

Reconvene

MHCC Chairman, Richard Weinert, reconvened the meeting at 9:00 a.m. DFO Danner welcomed the committee back into session and asked the committee to take a moment to visit HUD's manufactured housing booth setup in the room. There are two brochures available (Appendix E): 1) *Manufactured Home Dispute Resolution Program (DRP)*; and 2) *Manufactured Home Retailer Frequently Asked Questions (FAQs)*. DFO Danner asked committee members take some for their use and link to them from their websites.

Mr. Kauffman took roll and moved the meeting on to the next item on the agenda.

Review Current Log and Actions Items (AI)

LOG 142: **§ 3286.103 DAPIA-approved installation instructions**

Lois Starkey said this proposal is an editorial change. DFO Danner said the installer would still be required to certify that the home was installed correctly, and in HUD administered states all installers are required to be licensed.

MHCC Motion to approve Log Item 142 as modified.
Maker: Debra Blake Second: Ishbel Dickens
The motion carried with 1 negative vote.

LOG 143: **§ 3280.711 Instructions**

Lois Starkey submitted this proposal in an attempt to alleviate the HUD requirement that a second set of appliance instructions be provided to the consumer. She said the appliance industry is moving to create QR codes for all new appliances.

Ishbel Dickens said there are too many people who still do not know what a QR label means. Garold Miller said the additional second copy is helpful for the secondary homeowner. Loretta Dibble said the two hard copies serve two different purposes.

Jeffrey Legault said the appliance companies do not provide a second set of instructions, and currently, the manufacturers copy them manually. John Weldy agreed and said a conservative estimate of copies is about 200 pages per home. Debra Blake said it is the homeowners' responsibility to know where the manuals that have been provided are kept. It was suggested that if a homeowner loses the first set of manuals, they are likely to lose the second set.

MHCC Motion to approve Log Item 143.
Maker: John Weldy Second: Ishbel Dickens
Meeting Vote: 13-4-0

LOG 144: **§ 3280.304(b)(1)**

Jeffrey Legault said Log Item 144 resulted from a review by the Structure and Design Subcommittee. The reference standard NER-272 is no longer supported and has been replaced by *ICC-ES Evaluation Report, Power Driven Staples and Nails*, ESR-1539, 2014. The committee

modified the submittal by incorporating legislative text (strikethrough and underline) for clarification.

MHCC Motion to approve Log Item 144 as modified.
Maker: John Weldy Second: Richard Nolan
The motion carried.

The MHCC adjourned at 9:52 a.m. to allow the Technical Systems Subcommittee to reconvene.

The MHCC reconvened at 10:20 a.m.

HUD's Recommended Guidelines on Foundation System Requirements in Freezing Climates

Angelo Wallace, HUD; Michael Henretty, SEBA Professionals; and Jay Crandell, P.E., ARES Consulting, addressed the committee. Angelo Wallace gave a presentation updating the committee on the HUD-Administered Manufactured Home Installation Program (Appendix F). Mr. Wallace said since the program's introduction, HUD has conducted installation monitoring inspection in five states: Nebraska, Maryland, South Dakota, New Jersey, and Vermont and installation monitoring inspections will be conducted in two states by November 2016 (Massachusetts and Connecticut). During the monitoring process, it was discovered that there is a need to clarify requirements and provide guidance for proper and compliant applications of Frost Free Foundation (FFF) Systems as an alternative to a conventional (frost depth) footings or a conventional Frost Protected Shallow Foundation (FPSF) design using insulation to protect against ground freezing per the ASCE 32 standard. When this became a known issue, SEBA contacted Jay Crandell, P.E., a noted expert on the topic, to provide additional information and research. Mr. Wallace then turned the meeting over to Mr. Crandell.

Jay Crandell gave a presentation (Appendix G) informing the committee on the research conducted supporting the report submitted to HUD by SEBA Professional Services, *Manufactured Home Foundations in Freezing Climates, An Assessment of Design Installation Practices for Manufactured Homes with Seasonally Frozen Ground* (Appendix H).

Mr. Crandell began his presentation by providing definitions of the following terms:

- *Frost Free Footings* (FFF) are designs that rely on Section 4.2 of ASCE 32-01 standard; and
- *Frost-Protected Shallow Foundations* (FPSF) are designs that rely on all other parts of ASCE 32-01

Mr. Crandell said either approach, if properly executed, can be considered as conforming to HUD Code (24 CFR Ch. XX, 3285.312). The presentation is based on his understanding of practices currently done in the field. The primary question is – *do current designs and installation practices conform to the standard?*

There are three conditions necessary for frost heave:

1. Moist ground or a moisture source below the frost-front in ground
2. Freezing temperatures in the ground
3. Frost-susceptible soil or fill material

Theoretically, if you remove any one of these conditions from the equation, frost heave can be prevented. However, there is a big difference between theory and practice, and it is important to consider *how* the theory is put into practice.

Mr. Crandell noted the key requirements in ASCE 32-01, Section 4.2 for FFF designs included the terms *well-drained*, *not susceptible to frost*, and *design frost depth* and provided detailed examples of how these terms relate to the standard (see Appendix G). He also provided four examples of FFF designs including:

1. Footings on crushed stone pad on subgrade;
2. Footings directly on subgrade;
3. Floating slab; and
4. Monolithic slab

There are three practice recommendations (see SEBA report to HUD for details, Appendix H):

- OPTION #1 – Conventional footings to frost depth
    - Always appropriate where FFF designs or FPSF design prove unsuitable
    - Provides a checklist and a very simple means to determine more risk-consistent (and often more economical) footing depths
- OPTION #2 – FFF Foundations
    - Provides checklist with guidance addressing all of the issues found in the assessment of current practice (conformity with HUD Code and ASCE 32-01)
    - Guidance for assessment of "frost susceptible" and "well drained"
- OPTION #3 – FPSF Foundations
    - Provides checklist for conformity with HUD Code and ASCE 32-01
    - Focuses on proper specification and placement of insulation to prevent frost heave

There are various methods to assess for frost susceptibility, however, the most common is taking a soil sample measuring the grain size distribution.

These guidelines help to strike a balance between engineering and installation, and allows for the use of cost-effective methods when planning a foundation.

LUNCH BREAK

Foundation Systems Requirements in Freezing Climates Q&A

Angelo Wallace, HUD, Michael Henretty, SEBA Professionals, and Jay Crandell, ARES Consulting, addressed questions from committee members.

James Demitrus asked how do you take proper soil samples. Mr. Crandell said it is important to remove the top layer of organic material, take soil boring samples from both ends of the foundation (to the prescribed depth) and send the samples out to an approved lab.

John Weldy asked if local jurisdictions would have enough soil sample data to not require testing. Mr. Crandell said soil is not that uniform. It could be done under certain conditions. Mr. Weldy said 24 CFR 3285.202(b) allows soil records in lieu of testing. Mr. Crandell agreed there are a few cases where boring information and data can be used, but generally the local soil maps are not adequate. The context of 3285.202(b) concerns soil bearing capacity not moisture design for foundations. The tests are easy to conduct and could remove any doubt about how to proceed. Mr. Weldy said in our industry, there are many high-density areas such as parks that we have to deal with, there might not be enough space to do tests on lots that are only 15 ft apart. Michael Henretty said parks can conduct soil samples and keep the records for future use, but the soil tests are required.

Timothy O'Leary said he does business in a rural area and most of the homes are set on private property without access to public sewer lines. Could you use the soil from the perk test sites for testing? Mr. Crandell said yes, that would be a great time to evaluate water table and sub-surface drainage conditions. Mr. O'Leary said two examples shown had a vapor barrier or retarder under the footing. Mr. Crandell clarified that the vapor barrier is placed directly below the concrete, not the insulation. It needs to be done properly.

William Freeborne asked when would using an insulated foundation, compared to a conventional foundation, be recommended. Mr. Crandell said an insulated foundation does raise the cost, he was not sure where the line gets drawn due to cost vs. local frost depth. Sometimes it is cheaper to just dig your footers deeper rather than use the insulated foundation. Michael Henretty added that the further north you go, i.e., Massachusetts, where the frost depth is 30 in., it is more cost effective to insulate the foundations.

Alan Spencer said we have three foundation types that are allowed and we can do others, if we get them approved. That's where we are from a code perspective, but in the presentation we have somewhat of an issue that creates confusion. In the presentation on alternative foundation designs, "and" is used; HUD code only has "or" in the list of key requirements. Mr. Crandell said from HUD's perspective, "or" is acceptable. Both HUD Code and ASCE 32-01 allow acceptable engineering practice.

It was clarified that these guidelines are a minimum standard for all 50 states, not just HUD administered states.

Mark Weiss asked what we are talking about? Is this simply guidelines or mandatory?

DFO Danner said HUD is submitting the SEBA report to the MHCC as an interpretative bulletin and providing the MHCC 120 days to provide comments. Then HUD will publish the report as an interpretative bulletin and accept comments as required.

Loretta Dibble asked, in the overall models where the frost parameters are, were the snow levels and snow pack included? Most of what was said today is that a soil test for permeability is not the best test for frost, it seems like you need microclimate testing. Most local jurisdictions do require those small local tests. Mr. Crandell said the work that is done in the northern climate did factor in the snow and there was also a sensitivity study. The more precise that you get, the more expensive it becomes – this approach is a practical balance.

Public Comment

Mark Weiss said it is MHARR's view this action goes way beyond regulation and creates an equivalence with language not in the standard. He said he didn't think it qualifies as an interpretative bulletin. Mr. Weiss said he addressed this issue with a letter sent to HUD. A cost estimate needs to be provided and reviewed.

Nader Tomasbi asked about parks with existing foundations that are reused for different homes – will exemptions be available? Mr. Crandell suggested that retroactivity should be discussed. Angelo Wallace noted that newer homes are longer and heavier than homes in the past and exiting slabs may not be sufficient. Mr. Tomasbi said having someone perform a geotechnical analysis on each lot is not the most practical thing to do – it is expensive and is not always easily done or available. Mr. Crandell said cost should not be a barrier, it just involves digging up some dirt, putting it in a bag, and sending it out to a lab. Some labs even have same day return. This is not about removing options; it is about using the options you have appropriately.

Discussion: Appendix C of the SEBA Report

Appendix C – Conforming Designs and Practices for Installing Manufactured Homes in Locations Subject to Freezing Temperatures of the SEBA report provides process options. Michael Henretty said there have been problems with some older parks not using proper drainage. Mr. Henretty suggested that it would be beneficial to have an online database of appropriate foundation designs for installers to use. The MHCC should look at frost susceptible areas. The objective is a generally accepted way to get things done and if it's in the manual, the industry will be better off.

Richard Weinert asked if there was any data collected that guided you to this change? Mr. Henretty said there are no new regulations, the regulations in place are not being properly implemented in the field.

Debra Blake said the regulations are very clear, this is not new information. Why is there a need to provide more guidance? DFO Danner said HUD is responding to the industry since we have been told by many that it is not clear. Therefore, we are trying to provide some guidelines. Mr. Henretty noted that not every state runs a program like Arizona.

Lois Starkey asked about the example provided with the John Weldy, P.E. stamp – would that be a preemptive issue? Mr. Henretty said no, Nebraska, for example, has no state code and almost no cities have any local codes either. If an installer is setting a Clayton house, they can take John Weldy's design and set the house and it would be fine. Other places have lots of little jurisdictions that want the stamp to be from a P.E. located in that state or local area.

Mark Weiss disagreed that these guidelines are nothing new. His opinion was there were many new items.

Alan Spencer said there is still not clear understanding what the process is when we deviate from 3285.

Dominic Frisina said if we can come up with some sort of universal plan that can be shown to a building official, we would save our customers some money.

Timothy O'Leary said the example foundations are designed for skirted insulation. These are instructions on how to comply with a standard that already exists, there does not appear to be anything new. He thanked HUD for addressing this issue and suggested that they should gather as many approved plans as possible.

Debra Blake asked if HUD was open to making some standard designs preemptive to protect the engineer? Richard Weinert said he did not believe that HUD had the authority.

Timothy O'Leary said having the information and providing it to the manufacturer, regardless if it has a stamp or not, is helpful because every home needs to have a foundation plan. The simpler it is, the cheaper the process becomes.

Joe Sadler noted that an engineer may not want to have their design potentially misused.

John Weldy said this is a complicated issue and kudos to HUD and SEBA for taking this on. He said we built 35,000 homes last year, and we didn't once use the foundation that was used as an example, it is a complicated design and people would bring other less complicated designs.

Chairman Weinert thanked Michael Henretty and Angelo Wallace for their time and participation.

MHCC Motion to create an Action Item for Home Foundations in Freezing Climates and send the item to the Regulatory Subcommittee in order for the MHCC to provide comments to HUD within 120 days (due to HUD by February 23, 2017).
Maker: Ishbel Dickens Second: Joe Sadler
The motion carried.

Technical Systems Subcommittee Report to the MHCC

Action on the following log items was swift as the MHCC participated in the Technical Systems Subcommittee meeting.

LOG 113: **§ 3280.4(b)(1) Incorporation by reference**
NFPA 54 National Fuel Gas Code

MHCC Motion to approve Log Item 113.
Maker: William Freeborne Second: John Weldy
The motion carried.

LOG 114: **§ 3280.4(i)(20) Incorporation by reference**
UL 60335-2-40, Safety of Household and Similar Electrical Appliances, Part 2-34; Particular Requirements for Motor-Compressors

MHCC Motion to approve Log Item 143.
Maker: William Freeborne Second: Debra Blake
The motion carried.

The MHCC adjourned at 3:15 p.m. to allow the Structure and Design Subcommittee to meet.

The MHCC reconvened at 3:55 p.m.

DFO Danner introduced Nandini Rao, Acting Associate Deputy Assistant Secretary for Risk Management and Regulatory Affairs. Ms. Rao said it was interesting to see how the MHCC reaches consensus.

The MHCC adjourned at 4:00 p.m.

DAY 3: Thursday, October 27, 2016

Reconvene

MHCC Chairman, Richard Weinert, reconvened the meeting at 9:00 a.m. and DFO Danner welcomed the committee back into session.

Mr. Kauffman took roll and passed the meeting back to Mr. Weinert.

The MHCC adjourned at 9:05 a.m. to allow the Regulatory and Structure and Design Subcommittees to meet.

The MHCC reconvened at 11:25 a.m.

Structure and Design Subcommittee Report

Since the committee observed and participated in the discussions held during the MHCC Technical Systems Subcommittee meeting, action was swift.

Motion to approve the Preliminary Working Draft, MHCSS Formaldehyde Emission Controls for Certain Wood Products.
Maker: Jeff Legault Second: Joseph Sadler
The motion carried.

Motion to disapprove Log Item 80.
Maker: Joseph Sadler Second: Jeffrey Legault
The motion carried.

The Committee reviewed the Structure and Design Subcommittee's recommended language for TSCA Title VI Compliance and provided modifications.

Motion to recommend that HUD add § 3280.5 (i) The statement: "TSCA Title VI Compliant".
Maker: Joseph Sadler Second: Richard Weinert
The motion carried.

Motion to recommend that HUD include the following questions in the Proposal Rule's Preamble for Formaldehyde Emission Controls for Certain Wood Products:

1. **Should HUD continue to require formaldehyde testing for treatment after certification of surface finishing post EPA rulemaking? Can this testing be done in a large or small chamber?**
2. **If testing for treatment after certification of surface finishing is to continue, what should the formaldehyde limits be?**
3. **If the testing for treatment after certification is eliminated, should the whole house ventilation be increased? What effect would this have on indoor air quality?**
4. **What sort of measures could HUD take to assess or mitigate sources of formaldehyde?**

Maker: Jeffrey Legault Second: Ishbel Dickens
The motion carried.

Regulatory Subcommittee Report

Since the committee observed and participated in the discussions held during the MHCC Regulatory subcommittee meeting, action was swift.

LOG 135: § 3285.603 Water supply

Motion to approve Log Item 135.
Maker: Debra Blake Second: Ishbel Dickens
The motion carried.

Debra Blake said the Frost Free Foundations proposal should be discussed before many of the MHCC committee members roll off the committee in December 2016. The following teleconference meetings were scheduled:

- Monday, November 28, 2016, 1:00 p.m. – 4:00 p.m.(Eastern) – MHCC Regulatory Subcommittee teleconference
- Monday, December 12, 2016, 1:00 p.m. – 4:00 p.m. (Eastern) – MHCC teleconference

Public Comment Period

There were no public comments at this time.

Wrap-up

DFO Danner presented certificates to the following members leaving the committee as of December 31, 2016 to thank them for their service and dedication to the industry:

- Richard Weinert
- Ishbel Dickens
- William Freeborne
- Jeffery Legault
- Leo Poggione (not present)
- Steven Anderson (not present)

DFO Danner thanked Richard Weinert for his long-time service to the MHCC beginning as a committee member in 2002 and his Chairmanship since 2011. Mr. Weinert was presented with a ceremonial gavel.

Chairman Weinert said MHCC service was difficult in the early years, however, the committee has evolved and members have become more collaborative. The collaboration makes the difficult task of reaching a consensus easier. Mr. Weinert said, with all due respect, he would like to see some changes to the process by eliminating some of the bureaucracy. HUD's jurisdiction should end when the certification label is affixed to the home – on-site rules, and other local issues, increase costs and lessen competition. Mr. Weinert used his ceremonial gavel to adjourn the meeting

The MHCC meeting adjourned at 12:10 p.m.

MHCC MEETING
October 25-27, 2016

APPENDIX A:
Participant List

MANUFACTURED HOUSING CONSENSUS COMMITTEE MEETING

October 25–27, 2016 • Holiday Inn Washington Capitol • Washington, DC

Post Meeting Participant List

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MHCC MEETING

October 25-27, 2016

APPENDIX B:
NFPA 70-2014 Adoption Testimony

Don Iverson, NEMA

Manufactured Housing Consensus Committee
NEMA Testimony re Proposal to Adopt the 2014 Edition of the National Electrical Code®
October 25, 2016

On behalf of the National Electrical Manufacturers Association (NEMA), my name is Don Iverson and I am here today to urge the Manufactured Housing Consensus Committee (MHCC) to adopt and move forward the Technical Systems Subcommittee proposal to reference the 2014 edition of NFPA 70 (National Electrical Code®) in the Manufactured Housing Construction and Safety Standards.

NEMA has long supported adoption of the most recent edition of the National Electrical Code® (NEC) by state and local jurisdictions. We maintain that this is the best way to ensure a uniform and up-to-date standard of safety for home occupants. Current codes mean safer and more economically prosperous communities. As of today, 35 states have adopted the 2014 edition of the NEC. When a state or jurisdiction adopts an edition of the NEC, those requirements become effective for new homes. But residents of new manufactured homes in these states will not be protected by the same requirements for electrical safety. Rather, manufactured homes built today, tomorrow or 10 years from now would be governed by an outdated version of the NEC (from 2005). This creates a significant disparity that the MHCC has an opportunity to help correct here today.

By way of background, the NEC focuses on the proper installation of electrical systems and equipment to protect home residents and occupants from hazards arising from the use of electricity in their homes. As new technologies for electrical safety arrive to the marketplace, and existing technologies become more readily available, each edition of the NEC (published on a three-year cycle) contains increased protection for home residents. For instance, in 2005 the NEC required arc-fault circuit interrupters (AFCIs) only in bedrooms. But now, the 2014 edition requires AFCIs on almost every electrical circuit in the home that supplies a receptacle.

An AFCI is a protection device designed to help prevent fires by detecting an unintended electrical arc and disconnecting the power before the arc starts a fire. The National Fire Protection Association estimates that in 2014 in the United States, over 23,000 home fires were attributed to electrical malfunction. These fires resulted in hundreds of deaths and injuries and over $900,000,000 in damages. Though it is hard to believe, these staggering numbers actually represent a decrease since 2004[1]. It is no coincidence that, since that time, NEC requirements for AFCIs have increased.

Another example of enhanced protection required by the 2014 NEC is with regards to ground-fault circuit interrupters (GFCIs). In the current edition of the NEC, GFCI protection requirements have expanded to include dishwashers, receptacles within six feet of any sink, and receptacles within six feet of a bathtub or shower stall. While the 2005 edition required GFCIs

[1] https://www.usfa.fema.gov/downloads/pdf/statistics/res_bldg_fire_estimates.pdf

in kitchens, bathrooms and laundry rooms, many receptacles located in close proximity to a water source were left unprotected.

GFCIs protect people against electric shock by monitoring the imbalance of current between the ungrounded (hot) and grounded (neutral) conductor of a given circuit. Since 1976 the number of home electrocutions has decreased from about 650 per year to 160[2]. In 2009 (the last year for which this information is available), the U.S. Consumer Product Safety Commission estimates 70 home electrocutions[3]. Over that same period of time, the NEC code requirements for GFCIs have increased to require more GFCIs in new homes. The decrease in home electrocutions could be due to a variety of factors, but the correlation between the increased presence of GFCIs in American homes and the decrease in electrocutions is clear.

Tamper-resistant receptacles (TRRs) are, unfortunately, not required by the 2005 edition of the NEC but are required in the 2014 edition everywhere a receptacle is installed below 5.5 ft, with a few exceptions. These devices look like ordinary receptacle outlets, but have a complex access mechanism that only allows access to the electrical current when both upper prongs are penetrated simultaneously. This design was implemented to prevent consumers (such as small children) from inserting a metal object into the receptacle. I think we can all agree that the safety benefits of these devices are obvious.

TRRs have been required since the 2008 edition of the NEC, which means that they are required for new homes in all but five states. They are currently not required for manufactured homes in any state. This is unfortunate since every year 2400 children are treated in emergency rooms for injuries caused by inserting common household objects, such as keys, paperclips, and hairpins, into electrical outlets[4].

Before closing, I would like to take a few minutes to discuss cost. NEMA acknowledges that increased requirements for new safety technology or more safety devices can result in a higher construction cost. Over the last six months NEMA has worked to demonstrate to the MHCC Technical Systems Subcommittee Task Force that was assigned to examine the proposed adoption of the NEC that the costs in question are not overly burdensome, particularly in light of the protections they afford. Specifically, NEMA has provided information from the Ohio Chapter of the International Association of Electrical Inspector's (IAEI) cost analysis during the states adoption process. We have attached that information along with a written version of my comments here today.

The MHCC bylaws require that any proposed changes to the Manufactured Housing Construction and Safety Standards include "…a cost benefit analysis consisting of the costs associated with the proposal and related benefits that would result from the change." We understand that this can be a difficult requirement to fulfill, but if the proposal to update the NEC

[2] https://www.cpsc.gov/PageFiles/111685/2003electrocutions.pdf
[3]; see also https://www.cpsc.gov/PageFiles/136139/2009electrocutions.pdf; for information prior to 1993 please contact info@cpsc.gov.
[4] http://www.nfpa.org/public-education/by-topic/top-causes-of-fire/electrical/tamper-resistant-electrical-receptacles

reference to 2014 is adopted by the full MHCC, NEMA will be happy to work with the Committee to develop, synthesize and provide this information. Thank you.

About NEMA

Headquartered in Rosslyn, VA and founded in 1926, NEMA is the trade association of choice for the electrical equipment and medical imaging manufacturing industry. The approximately 400 member companies manufacture products used in the generation, transmission and distribution, control, and end-use of electricity. Total U.S. shipments for electroindustry products exceed $100 billion annually.

"Let the Code Decide"

OHIO CHAPTER
International Association of Electrical Inspectors

Understanding the Cost Impact of the 2008 NEC

The impact of additional Arc-Fault Circuit Interrupters and the new Tamper Resistant Receptacles in the 2008 NEC has prompted controversy driven by the misunderstood cost impact of moving from the 2005 NEC to the 2008 NEC. The NEC provides for the safe use of electricity from fire and shock. Technology over the years has enhanced that protection with minimal cost impact. Circuit breakers protect the home from overloaded circuits to prevent fires and GFCIs are well recognized in the safe use of electricity to protect us and our children from shock hazards. The GFCI entered the home in the 1970s, AFCIs became part of the NEC in the 1999 NEC and the tamper resistant receptacle in the 2008 NEC.

We will show that the impact of adding AFCI protection and Tamper Resistant Receptacles will have minimal impact on affordable housing. Keep in mind the NEC establishes the requirements for the safe electrical operation of a home. Additional circuits that include extra lighting, specific known loads, or a desire to separate circuits for isolation purposes is an additional cost that may be incurred that is once again not driven by the NEC. The additional lighting loads or appliances are not code driven, they are upgrades similar to windows, roofing configuration, or brick vs siding.

This report has been prepared by the following Ohio Chapter Board of Director Members; Oran P. Post, Electrical Inspector for the City of Tallmadge, Ohio and Thomas E. Moore, Electrical Inspector for the City of Beachwood, Ohio and Tim McClintock, Building Official/Electrical Inspector for Wayne County, Ohio. All three Board Members have extensive experience with the code development process.

This report provides an impact statement based entirely on the 2008 NEC requirements for three different homes. The first is a 900 sq ft home to help understand the impact to affordable housing. The other two homes are typical size homes and will include a 1700 sq ft home and a 2100 sq ft home.

The findings are based on prices obtained at a local electrical distributor and other verifiable resources as follows:

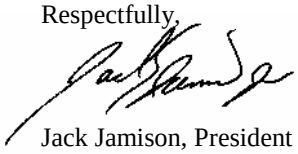
Combination AFCI	$36.34
Standard Receptacle	$.50
Tamper Resistant Receptacle	$1.25
Standards GFCI Receptacle	$8.00
Tamper Resistant Receptacle with GFCI	$14.85

Results

900 sqft Home	$160.18 for 900 sq. ft. dwelling unit or $.18/sq. ft.
1700 sqft Home	$205.27 for 1700 sq. ft. dwelling unit or $.12/sq. ft.
2100 sqft Home	$241.36 for 2100 sq. ft. dwelling unit or $.11/sq. ft

The 2008 NEC impact is minimal at less than a 20 cents per sq ft.

Respectfully,



Jack Jamison, President

*Cost Analysis for a new dwelling based on the minimum 2008 NEC requirements (900 Sq ft)					
2008 NEC Code Section	**Description of Code Requirement**	**Total Required Branch Circuit/Devices**	**Cost per 2005 NEC**	**Cost per 2008 NEC**	**Cost Difference**
	GENERAL LIGHTING LOADS				
220.12, Table 220.12 & 220.14(J)	900 sq. ft. X 3VA = 2700 VA/120 Volts = 22.5 Amps = 1.5 or 2 circuits. 2 general purpose 15 Ampere circuits which includes family rooms, dining rooms, living rooms, parlors, libraries, dens, bedrooms, sunrooms, recreation rooms, closets, hallways, or similar rooms or areas is required.	2	$3.25	$36.34	$33.09
			$25.00[1]	$36.34	$11.34
	DINING ROOM				
210.52(A), 220.12, 220.14(J)	210.12(B) requires the dining room outlets to be protected by an arc fault circuit interrupter. 210.52(B)(1) requires this circuit to be on a 20 ampere circuit.	1	$3.25	$36.34	$33.09
	KITCHEN				
210.52(C), 210.11(C)(1), 220.14(J), & 406.11	2 Kitchen small appliance branch circuits supplying 2 Tamper Resistant GFCI Receptacles serving the kitchen countertop.	2	$8.00	$14.85	$13.70
210.52(C), 210.11(C)(1), 220.14(J), & 406.11	2 Kitchen small appliance branch circuits supplying 6 Tamper Resistant receptacles located as required by 210.52(B)(1)	6	$.50	$1.25	$4.50
	BATHROOM				
210.52(D), 210.11(C)(3), 220.14(J), & 406.11	1 Tamper Resistant GFCI recptacle required for bathroom	1	$8.00	$14.85	$6.85
	GARAGES				
210.52(G), 220.14(J), & 406.11	1 Tamper Resistant GFCI receptacles required for attached garages & unattached garages with power.	1	$8.00	$14.85	$6.85
	OUTDOOR & BASEMENT RECEPTACLES				
210.52(E), 220.14(J), & 406.11	2 Tamper Resistant/Weather Resistant receptacles (front & rear of Dwelling)	2	$.50	$7.03	$13.06[2]
210.52(G), 220.14(J), & 406.11	1 Tamper Resistant GFCI required for unfinished basements	1	$8.00	$14.85	$6.85
	LAUNDRY				
210.52(F), 210.11(C)(2), 220.14(J), & 406.11	1 Tamper Resistant GFCI Installed for the Laundry within 6 feet of laundry sink	1	$8.00	$14.85	$6.85
	GENERAL PROVISION RECEPTACLE OUTLETS				
210.52(A), 220.12, 220.14(J), & 406.11	which includes family rooms, dining rooms, living rooms, parlors, libraries, dens, bedrooms, sunrooms, recreation rooms, closets, hallways, or similar rooms or areas	32	$.50	$1.25	$24.00
				TOTAL	**$160.18**

Footnotes

1. Standard AFCI breakers as required by the 2005 NEC
2. Alternative method protecting outdoor receptacles fed from basement GFCI receptacle

This analysis is based on 2-wire home runs for branch circuits. The following consists of alternative wiring methods and their respective prices;
250ft NM-B-14/2/2-CU-WG……$114.66
250ft NM-B-14/3-CU-WG……$75.87
250ft NM-B-14/2-CU-WG…..……$54.13

$160.18 for 900 sq. ft. dwelling unit is a cost of $.18/sq. ft.
Not a whole lot to pay for safety!
Any extra wiring or devices above and beyond this is the choice of the builder and not mandated by the NEC.
***Prices obtained from Leff Electric Supply (see attached quote), Lowes, & Home Depot**

*Cost Analysis for a new dwelling based on the minimum 2008 NEC requirements (1700 Sq ft)					
2008 NEC Code Section	**Description of Code Requirement**	**Total Required Branch Circuit/Devices**	**Cost per 2005 NEC**	**Cost per 2008 NEC**	**Cost Difference**
	GENERAL LIGHTING LOADS				
220.12, Table 220.12 & 220.14(J)	1700 sq. ft. X 3VA = 5100 VA/120 Volts = 42.5/15 Amps = 2.8 or 3 circuits. 2 general purpose 15 Ampere circuits which includes family rooms, dining rooms, living rooms, parlors, libraries, dens, bedrooms, sunrooms, recreation rooms, closets, hallways, or similar rooms or areas is required.	3	$3.25	$36.34	$66.18
			$25.00[1]	$36.34	$11.34
	DINING ROOM				
210.52(A), 220.12, 220.14(J)	210.12(B) requires the dining room outlets to be protected by an arc fault circuit interrupter. 210.52(B)(1) requires this circuit to be on a 20 ampere circuit.	1	$3.25	$36.34	$33.09
	KITCHEN				
210.52(C), 210.11(C)(1), 220.14(J), & 406.11	2 Kitchen small appliance branch circuits supplying 2 Tamper Resistant GFCI Receptacles serving the kitchen countertop.	2	$8.00	$14.85	$13.70
210.52(C), 210.11(C)(1), 220.14(J), & 406.11	2 Kitchen small appliance branch circuits supplying 8 Tamper Resistant receptacles located as required by 210.52(B)(1)	6	$.50	$1.25	$6.00
	BATHROOM				
210.52(D), 210.11(C)(3), 220.14(J), & 406.11	1 Tamper Resistant GFCI recptacle required for bathroom	1	$8.00	$14.85	$6.85
	GARAGES				
210.52(G), 220.14(J), & 406.11	1 Tamper Resistant GFCI receptacles required for attached garages & unattached garages with power.	1	$8.00	$14.85	$6.85
	OUTDOOR & BASEMENT RECEPTACLES				
210.52(E), 220.14(J), & 406.11	2 Tamper Resistant/Weather Resistant receptacles (front & rear of Dwelling)	2	$.50	$7.03	$13.06[2]
210.52(G), 220.14(J), & 406.11	1 Tamper Resistant GFCI required for unfinished basements	1	$8.00	$14.85	$6.85
	LAUNDRY				
210.52(F), 210.11(C)(2), 220.14(J), & 406.11	1 Tamper Resistant GFCI Installed for the Laundry within 6 feet of laundry sink	1	$8.00	$14.85	$6.85
	GENERAL PROVISION RECEPTACLE OUTLETS				
210.52(A), 220.12, 220.14(J), & 406.11	which includes family rooms, dining rooms, living rooms, parlors, libraries, dens, bedrooms, sunrooms, recreation rooms, closets, hallways, or similar rooms or areas	46	$.50	$1.25	$34.50
				TOTAL	**$205.27**

Footnotes

1. Standard AFCI breakers as required by the 2005 NEC
2. Alternative method protecting outdoor receptacles fed from basement GFCI receptacle

This analysis is based on 2-wire home runs for branch circuits. The following consists of alternative wiring methods and their respective prices;
250ft NM-B-14/2/2-CU-WG……$114.66
250ft NM-B-14/3-CU-WG……$75.87
250ft NM-B-14/2-CU-WG…..……$54.13

$205.27 for 1700 sq. ft. dwelling unit is a cost of $.12/sq. ft.
Not a whole lot to pay for safety!
Any extra wiring or devices above and beyond this is the choice of the builder and not mandated by the NEC.
***Prices obtained from Leff Electric Supply (see attached quote), Lowes, & Home Depot**

*Cost Analysis for a new dwelling based on the minimum 2008 NEC requirements (2100 Sq ft)					
2008 NEC Code Section	**Description of Code Requirement**	**Total Required Branch Circuit/Devices**	**Cost per 2005 NEC**	**Cost per 2008 NEC**	**Cost Difference**
	GENERAL LIGHTING LOADS				
220.12, Table 220.12 & 220.14(J)	2100 sq. ft. X 3VA = 6300 VA/120 Volts = 52.5/15 Amps = 3.5 or 4 circuits. 2 general purpose 15 Ampere circuits which includes family rooms, dining rooms, living rooms, parlors, libraries, dens, bedrooms, sunrooms, recreation rooms, closets, hallways, or similar rooms or areas is required.	4	$3.25	$36.34	$99.27
			$25.00[1]	$36.34	$11.34
	DINING ROOM				
210.52(A), 220.12, 220.14(J)	210.12(B) requires the dining room outlets to be protected by an arc fault circuit interrupter. 210.52(B)(1) requires this circuit to be on a 20 ampere circuit.	1	$3.25	$36.34	$33.09
	KITCHEN				
210.52(C), 210.11(C)(1), 220.14(J), & 406.11	2 Kitchen small appliance branch circuits supplying 2 Tamper Resistant GFCI Receptacles serving the kitchen countertop.	2	$8.00	$14.85	$13.70
210.52(C), 210.11(C)(1), 220.14(J), & 406.11	2 Kitchen small appliance branch circuits supplying 8 Tamper Resistant receptacles located as required by 210.52(B)(1)	6	$.50	$1.25	$6.00
	BATHROOM				
210.52(D), 210.11(C)(3), 220.14(J), & 406.11	1 Tamper Resistant GFCI recptacle required for bathrooms	2	$8.00	$14.85	$6.85
	GARAGES				
210.52(G), 220.14(J), & 406.11	1 Tamper Resistant GFCI receptacles required for attached garages & unattached garages with power.	1	$8.00	$14.85	$6.85
	OUTDOOR & BASEMENT RECEPTACLES				
210.52(E), 220.14(J), & 406.11	2 Tamper Resistant/Weather Resistant receptacles (front & rear of Dwelling)	2	$.50	$7.03	$13.06[2]
210.52(G), 220.14(J), & 406.11	1 Tamper Resistant GFCI required for unfinished basements	1	$8.00	$14.85	$6.85
	LAUNDRY				
210.52(F), 210.11(C)(2), 220.14(J), & 406.11	1 Tamper Resistant GFCI Installed for the Laundry within 6 feet of laundry sink	1	$8.00	$14.85	$6.85
	GENERAL PROVISION RECEPTACLE OUTLETS				
210.52(A), 220.12, 220.14(J), & 406.11	which includes family rooms, dining rooms, living rooms, parlors, libraries, dens, bedrooms, sunrooms, recreation rooms, closets, hallways, or similar rooms or areas	50	$.50	$1.25	$37.50
				TOTAL	**$241.36**

Footnotes

1. Standard AFCI breakers as required by the 2005 NEC
2. Alternative method protecting outdoor receptacles fed from basement GFCI receptacle

This analysis is based on 2-wire home runs for branch circuits. The following consists of alternative wiring methods and their respective prices;
250ft NM-B-14/2/2-CU-WG……$114.66
250ft NM-B-14/3-CU-WG……$75.87
250ft NM-B-14/2-CU-WG…..……$54.13

$241.36 for 2100 sq. ft. dwelling unit is a cost of $.11/sq. ft.
Not a whole lot to pay for safety!
Any extra wiring or devices above and beyond this is the choice of the builder and not mandated by the NEC.
***Prices obtained from Leff Electric Supply (see attached quote), Lowes, & Home Depot**

LEFFELECTRIC
Leff/Akron Electric
711 Johnston St
AKRON OH 44306
Fax: 330-379-9865

Quotation

QUOTE DATE	QUOTE NUMBER
02/26/08	S1269245

ORDER TO:
Leff/Akron Electric
711 Johnston St
AKRON OH 44306
330-379-9800

PAGE NO. 1

QUOTE TO:
CASH ACCT TAXABLE (AKRON)
711 JOHNSTON STREET
AKRON, OH 44306

SHIP TO:
CASH ACCT TAXABLE (AKRON)
711 JOHNSTON STREET
AKRON, OH 44306

CUSTOMER NUMBER	CUSTOMER P/O NUMBER	RELEASE NUMBER	SALESPERSON
6056	post		House Account

WRITER	SHIP VIA	TERMS	SHIP DATE	FREIGHT ALLOWED
Pat Hinman		Cash On Delivery	03/22/08	No

ORDER QTY	DESCRIPTION	Net Prc	Ext Prc
1ea	LEV T5320-I IVY NEMA5-15R DPLX RCPT	125.00/c	1.25
1ea	LEV T7599-I IVY 15A-125V GFCI RCPT	1485.00/c	14.85
1ea	GE THQL1115AF 15A PLUG IN AFCI CB	36.34/ea	36.34
1ea	LEV TWR15-GY 15A WTR RST DLXRCPT	703.13/c	7.03

LEFFELECTRIC
Leff/Akron Electric
711 Johnston St
AKRON OH 44306
Fax: 330-379-9865

Quotation

QUOTE DATE	QUOTE NUMBER
02/26/08	S1269261

ORDER TO:
Leff/Akron Electric
711 Johnston St
AKRON OH 44306
330-379-9800

PAGE NO. 1

QUOTE TO:
CASH ACCT TAXABLE (AKRON)
711 JOHNSTON STREET
AKRON, OH 44306

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AKRON, OH 44306

CUSTOMER NUMBER	CUSTOMER P/O NUMBER	RELEASE NUMBER	SALESPERSON
6056	post		House Account

WRITER	SHIP VIA	TERMS	SHIP DATE	FREIGHT ALLOWED
Pat Hinman		Cash On Delivery	03/29/08	No

ORDER QTY	DESCRIPTION	Net Prc	Ext Prc
1ea	P&S 1595-TRWR 15A 125V RCPT	18.48/ea	18.48
1ea	P&S 3232-TRWR 15A 125V WR RCPT	2.32/ea	2.32

Ohio Chapter IAEI

Understanding the Cost Impact of the 2011 NEC

The 2011 *NEC* addresses the latest advances and green technologies. New Article 694, Small Wind Electrical Systems, updates to solar power requirements in Article 690, and revisions to Article 625 to address charging systems for plug-in hybrid electric vehicles, are what headline the major changes. Additionally, several minor revisions have been made to the 2011 *NEC* in an effort to clarify requirements, improve readability, and enhance usability of the *Code*.

The NEC establishes the minimum requirements for the safe electrical operation of a home. Many of the changes in the 2011 *NEC* impacting dwelling occupancies primarily affect those portions of the electrical system in the home that are characterized as optional upgrades and only apply when optional upgrades are made to a dwelling. These optional elements include GFCI protection for receptacles located in close proximity to optional sinks, electric radiant in-floor heating cables and requirements for ceiling fan support. These new requirements ensure a minimum level of safety for occupants are maintained when these upgrades are made. These are upgrades similar to windows, countertops or brick vs siding.

The following report is a case study utilizing a 2,348 square foot dwelling that will clearly illustrate the important safety enhancements and minimal cost impact based entirely on the 2011 NEC requirements.

The cost impact for this dwelling is as follows:

Minimum Code Cost Impact:
Deletion of 20 sq ft exception for balcony, porches & decks: **$0**
Large Foyer receptacle requirement: **$22.92**
Ground Rod Requirements: **$23.05**
Grounded conductor at switch locations
Unfinished Basement: **$0**
Slab on Grade/no attic: **$22.40**
Tamper Resistant Receptacle (new exception) Credit: **$1.44**

Total Minimum Code Cost Impact:
w/unfinished basement: **$44.53**
w/slab/no attic: **$66.93**

<u>Optional</u> Upgrades and Cost Impact:
GFCIs for sinks: **$9.98**
Ceiling fan boxes: **$25.20**
Heating cables for kitchen masonry floor: **$140.32**
Total <u>Optional</u> Upgrades: **$175.50**

*Cost Analysis for a sample new dwelling based on the minimum 2011 NEC requirements (2348 sq ft)			
2011 NEC Code Section	**Description of Code Requirement**	**Cost Impact**	
	Receptacle requirements for porch, balcony, or deck	**Materials**	**Cost**
210.52(E)(3)	Requires a porch, balcony, or deck to have at least one receptacle outlet installed within its perimeter. Depending upon the location of the outdoor receptacle as required by 210.52(E)(1) and (E)(2), the required receptacle as prescribed by this section could serve both requirements.	Single gang box: WP/TR GFCI receptacle: WP cover: 14-2-G per ft: **Sample Code House:** Receptacles on the front and rear meet the requirements of 210.52(E)(1), (2) & (3) **Cost Impact:**	$.41 $15.25 $4.17 $.39 **$0**
	Receptacle requirements for large foyers greater than 60 sq	**Materials**	**Cost**
210.52(I)	Foyers that are not part of a hallway in accordance with 210.52(H) and that have an area that is greater than 60 ft2 shall have a receptacle(s) located in each wall space 3 ft or more in width and unbroken by doorways, floor-to-ceiling windows, and similar openings. Layout of will vary from dwelling to dwelling. Cost analysis provided is for a worst case scenario for the sample code house	Single gang box: TR Receptacle: Cover: 14-2-G per ft: **Sample Code House:** Single gang boxes @ $.41 X 3 TR Receptacle @ $1.17 X 3 Receptacle Cover @ $.21 X 3 14-2-G $.39 per ft X *45 ft **Cost Impact:** * Conductor lengths are estimates and can vary from project to project	$.41 $1.17 $.21 $.39 $1.23 $3.51 $.63 $17.55 **$22.92**
	Ground Rod Requirements	**Materials**	**Cost**
250.53(A)	A single rod, pipe or plate electrode is required to be supplemented by an additional electrode as specified in 250.52(A)(2) through (A)(8) unless the rod, pipe or plate electrode meets 25 ohms resistance or less to earth in accordance with the exception.☐	8 ft ground rod: 8 ft #4 CU Conductor: Ground Clamp: **Sample Code House:** **Cost Impact:**	$11.50 $10.33 $1.22 **$23.05**
	Grounded Conductor requirements at Switch locations	**Materials**	**Cost**
404.2(C)	404.2(C) requires a grounded conductor be provided at most switch locations. Exception # 2 Cable assemblies for switches controlling lighting loads enter the box through a framing cavity that is open at the top or bottom on the same floor level, or through a wall, floor, or ceiling that is unfinished on one side.	14-2-G per ft: 14-3-G per ft: **Cost impact:** **Sample Code House:** 404.2(C) Exception #2 **Unfinished Basement: Cost Impact:** **Slab on Grade/no attic: Cost Impact** 14 switch locations x *10 ft per run = 140 ft 14-3-G x .11 per ft *This measurement will vary depending upon layout of wiring system, i.e., supply located at switch, close proximity of outlet to switch location, etc.	$.39 $.55 **$.16** **$0** **$22.40**
	New Exception for Tamper Resistant Receptacle	**Materials**	**Cost**
406.12	New Exception relaxes the tamper resistant receptacle requirement under the following conditions: 1) Receptacles located more than 1.7 m (5½ ft) above the floor; (2) Receptacles that are part of a luminaire or appliance; (3) A single receptacle or a duplex receptacle for two appliances located within dedicated space for each appliance that, in normal use, is not easily moved from one place to another and that is cord-and-plug connected in accordance with 400.7(A)(6), (A)(7), or (A)(8); or (4) Nongrounding receptacles used for replacements as	Standard 15 amp duplex receptacle Tamper Resistant Receptacle **Cost <u>reduction</u> per device location:** **Sample Code House:** refrigerator receptacle laundry receptacle **Total savings**	$.45 $1.17 **$.72** $.72 $.72 **$1.44**

	permitted in 406.4(D)(2)(a).	This relaxation in the rule will vary in savings from house to house. Additional locations may include garage door opener receptacles, other fixed in place appliances such as dishwasher, microwave oven, etc	
	***OPTIONAL UPGRADES**		
	GFCI Requirements for Sinks	**Materials**	**Cost**
210.8(A)(7)	The 2008 NEC requires laundry; utility and wet bar sinks to have GFCI protection under this section. the 2011 NEC will require receptacles within 6 ft of <u>all</u> sinks to have GFCI protection (other than kitchens which require GFCI protection per 210.8(A)(6) The only sinks mandated by the residential building code are kitchen and bathrooms. Therefore, the cost impact will only affect those dwellings where the option to add an additional sink is provided; similar to other non code related upgrades like countertops, brick veneer, etc.	**<u>Optional Upgrade</u> cost increase:** Standard receptacle: GFCI receptacle: Difference per receptacle: **Sample Code House:** One <u>optional</u> sink: two receptacles-GFCI (feed through one to another) =	 $.45 $10.43 $9.98 **$9.98**
	Ceiling Fan Box Requirements	**Materials**	**Cost**
314.27(C)	Ceiling-mounted outlet boxes in dwellings with "spare" switch-leg conductors installed require a ceiling box listed for sole support of a ceiling fan.	**<u>Optional Upgrade</u> cost increase:** Standard Ceiling Box: Box Listed for fan support: Difference per box: **Sample Code House:** Four <u>optional</u> boxes $6.30 X 4	$1.11 $7.41 $6.30 **$25.20**
	GFCI Protection of Electrical Heating Cables in Kitchen	**Materials**	**Cost**
424.44(G)	The 2008 NEC requires GFCI protection under this section for bathrooms and hydromassage tub locations. The change in the 2011 NEC will require kitchen masonry floors with electric radiant heating cables to have GFCI protection.	**<u>Optional Upgrade</u> cost increase:** Standard 20 amp 2-pole circuit breaker: GFCI circuit breaker: Difference per breaker: $140.32 **Sample Code House:** One breaker:	 $9.53 $149.85 **$140.32**

*Cost Impact Analysis does not include labor. Attached materials quote is based on over the counter prices. Purchase in larger quantities may warrant further savings.

Total Cost Impact for Sample Code House:

Unfinished Basement: **$44.53**

Slab/no attic: **$66.93**

<u>Optional Upgrades</u> and Total Cost Impact for Sample Code House:

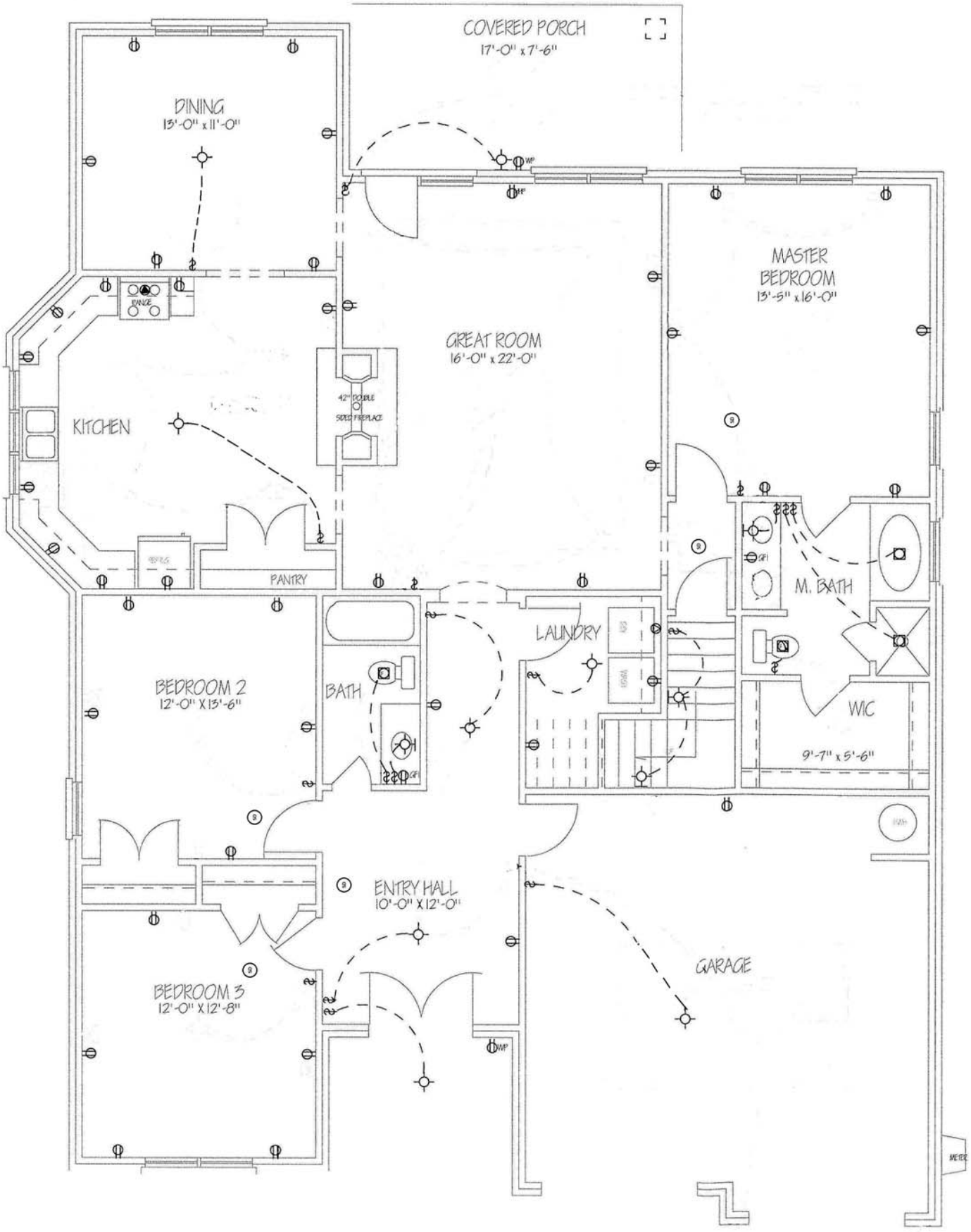
The cost impact is only invoked when optional upgrades are made to a dwelling. Accordingly, upgrades are characterized as added comforts and not mandated for meeting minimum construction safety codes. However, to ensure a minimum level of safety for occupants is maintained when these optional upgrades are employed, requirements have been included to address these in the 2011 NEC.

GFCIs for sinks: **$9.98**

Ceiling fan boxes: **$25.20**

Heating cables for kitchen masonry floor: **$140.32**

Total <u>Optional Upgrades</u>: **$175.50**


COVERED PORCH
17'-0" x 7'-6"
DINING
13'-0" x 11'-0"
MASTER BEDROOM
13'-5" x 16'-0"
GREAT ROOM
16'-0" x 22'-0"
RANGE
42" DOUBLE SIDED FIREPLACE
KITCHEN
PANTRY
M. BATH
LAUNDRY
BEDROOM 2
12'-0" X 13'-6"
BATH
WIC
9'-7" x 5'-6"
ENTRY HALL
10'-0" X 12'-0"
GARAGE
BEDROOM 3
12'-0" X 12'-8"
WP
GFI
METER

Quote No. 00079006

WOLFF QUOTATION

WOLFF BROS. SUPPLY INC.

SOLD TO

WOLFF-WOO CNTR TRADE -CASH *
565 N APPLECREEK RD
WOOSTER OH 44691-9599

SHIP TO

NEC PRICES *
WOOSTER OH 44691-9599

Quote Prepared By: MIKE HUTTINGER (330) 264-5900 EXT. 225

CUSTOMER NO.	CUSTOMER ORDER NO.	SLSM.	ENTRY DATE	WHS	PRINT DATE	ORDERED BY	PAGE
31345	NEC COST IMPACT	2	01/14/2011	WOO	01/14/2011	TIM M	1

Qty.	Item Number	Description	Price	Ext. Price
1	ALM1099N	BOX FG NAIL ON 1G SW 22.5CU	.4134 EA	.41
1	LEVTWR15W	TR/WR 15A 125V COMM DUP REC WH	9.3103 EA	9.31
1	LEVW7599TRE	GFCI RECP 15A 125V TR/WR BLACK	15.2500 EA	15.25
1	LEV5320ICP	15A DUPLEX RECP IVORY	.4507 EA	.45
1	LEVPJ8I	PLATE 1G DUP MID NYL IV	.2107 EA	.21
1	MUL30550	WP DUPLEX RECEPTACLE CVR VERT	4.1667 EA	4.17
1	WCNMB14/2GCT	14/2 W/GRD NM-B CU WIRE X PC	392.7300 MF	.39
1	LABWCNMB14/2G	CUT CHARGE-14/2 W/GRD NMB CU	.0003 EA	.00
1	WCNMB14/3GCT	14/3 W/GRD NM-B CU WIRE X PC	545.9700 MF	.55
1	LABWCNMB14/3G	CUT CHARGE-14/3 W/GRD NMB CU	.0003 EA	.00
1	PP8438	5/8X8FT CU CLAD GRD ROD 10MIL	11.4974 EA	11.50
8	WCBARES4CT	4 BARE SOLID COPPER WIRE XPC	1291.8100 MF	10.33
1	LABWCBARES4	CUT CHARGE-4 SOLID BARE COPPER	.0004 EA	.00
1	NERRC625	5/8"BZ 10SOL-2STR GRD ROD CLMP	1.2188 EA	1.22
1	LEV7599I	GFI RECP 15A 125V SLPRO IV	10.4268 EA	10.43
1	ALM9351NK	BOX FG NAIL ON RND 4IN SPDKLMP	1.1143 EA	1.11
1	RAC294	BOX STL CEIL/FAN 4"OCT 2-1/8DP	7.4100 EA	7.41
1	QOHOM220	06528 2P 20AMP BREAKER	9.5294 EA	9.53
1	QOHOM220GFI	2POLE 20AMP GFI BREAKER	149.8533 EA	149.85
1	LEVT5320I	TR RECEPT DUPLEX 15A 125V IV	1.1699 EA	1.17

*Quotation does not include **SALES TAX** if applicable.*

Subtotal 233.29
Plus Tax
Total

Prices are subject to change without notice. # Special order items may not be returnable.
DELIVERY CHARGES: A delivery charge will be added to deliveries that are less than $500; deliveries $500 and over will be prepaid. UPS and special freight charges will also be invoiced.

Medina
6078 Wolff Rd
Medina, OH (330) 725-3451
(330) 225-2240 (330) 773-1020

Wooster
565 N Applecreek Rd
Wooster, OH (330) 264-5900
1-800-233-5717

Akron
1200 Kelly Ave
Akron, OH (330) 773-0200
1-800-444-1446

Sandusky
2800 W. Strub Rd
Sandusky, OH (419) 626-1996
1-800-626-1993

QCP1

Residential Code of Ohio Regulated Dwelling Unit Cost Impact Based on 2014 NEC	*Cost Impact
Cost of typical dwelling unit based on minimum code requirements	**$151.47**
Optional upgrades include laundry areas, dishwasher, additional garage car space, and a receptacle located within 6' of a kitchen sink not installed to serve countertops.	**$169.31**

* This Cost Impact Analysis does not include labor. See Cost Analysis breakdown below.
****Cost Impact for Optional Upgrades:** The cost impact is only invoked when optional upgrades are made to a dwelling unit. Accordingly, upgrades are characterized as added comforts and not mandated for meeting minimum construction safety codes. However, to ensure a minimum level of safety for occupants is maintained when these optional upgrades are employed, requirements have been included to address these in the 2014 NEC.

Cost Analysis breakdown for RCO regulated dwelling units based on the minimum 2014 NEC requirements

2014 NEC Code Section	Description of Code Change	*Cost Impact	
	GFCI protection for receptacles installed in laundry areas in dwellings	**Materials**	**Cost**
210.8(A)(10)	New requirements for GCFI protection of 15 and 20 amp 125-volt receptacles located in laundry areas. The 2011 NEC only required GFCI protection in these areas when a receptacle was installed within 6' of a laundry sink per 210.8(A)(7).	TR GFCI receptacle: **Cost Impact:**	$14.67 - **$14.67**
	AFCI protection expanded to laundry and kitchen areas	**Materials**	**Cost**
210.12(A)	New requirement to expand The AFCI protection of branch circuits supplying the outlets and devices in kitchen and laundry areas. This includes both the two required small appliance branch circuits (210.11(C)(1) and one required laundry area branch circuit (210.11(C)(2).)	AFCI breaker: Replaces standard breaker: **Cost Impact:** :	$46.40 -6.44 (3 Branch Circuits total) **119.88**

	15 and 20 ampere Receptacles in wet locations	Materials	Cost
406.9(B)(1)	New revision requires the use of an "extra duty" outlet box hood for all receptacles installed in a wet location. Receptacles are required on the front and back of one and two family dwellings in accordance with 210.52(E)(1).	Extra Duty" weatherproof cover: Standard in-use weatherproof cover: **Cost Impact:**	$13.22 -6.52 (2 covers) **13.40**
	Receptacle Outlets required in garages	**Materials**	**Cost**
210.52(G)(1)	New requirement to install a receptacle outlet for each car space in a dwelling unit garage. Only required for an attached or unattached dwelling unit garage with electric power.	Single gang new work box: Tamper resistant 15 amp receptacle: Duplex receptacle cover: Average 10' of 14-2 WG type NM-B cable: **Cost Impact per garage space in excess of one:**	$ .35 1.04 .24 1.92 **$3.52**
	GFCI protection for dishwashers in dwellings	**Materials**	**Cost**
210.8(D)**	New requirement to require GCFI protection for dishwashers installed in dwellings. Dishwashers are not required and may be installed as an option. This cost is included as most dwellings include a Dishwasher.	TR GFCI receptacle: Replaces standard 15 amp TR receptacle: **Cost Impact:**	$9.96 -1.04 **$8.92**
	GFCI Protection for receptacles in kitchens other than countertops	**Materials**	**Cost**
210.8(A)(7)**	Revised to require GFCI protection of 125-volt, 15 and 20 ampere receptacles installed within 6 Ft. of a kitchen sink that are not covered by the countertop rule in 210.8(A)(6). These receptacles are not required and could be installed for optional equipment.	TR GFCI receptacle: Replaces standard 15 amp TR receptacle: **Cost Impact:**	$9.96 -1.04 **$8.92**

Shopping Cart

CHECKOUT NOW

Add $8.68* to your cart to receive FREE Shipping on eligible items. See Details

	Ship To Home or Pick Up In Store	Unit Price	Quantity	Item Total
 Square D by Schneider Electric QO 15 Amp Single-Pole Circuit Breaker Model # QO115CP	Ship to Home (From $2.99) Est. Arrival Date: OCT 29 - OCT 31 Pick Up in Store Free 29 In Stock Today at: Maple Heights #3804 Maple Heights, OH 44137 Change Pick Up Store	$6.44	1 ADD TO LIST REMOVE	$6.44
 Leviton SmartLockPro 15 Amp Slim Tamper-Resistant Duplex GFCI Outlet (3-pack) - White Model # M12-X7599-R3W	Ship to Home (From $3.00) Est. Arrival Date: OCT 31 - NOV 4 Pick Up in Store Free 22 In Stock Today at: Maple Heights #3804 Maple Heights, OH 44137 Change Pick Up Store	$29.88	1 ADD TO LIST REMOVE	$29.88 (3 Pack) 9.96@

Promotion Code

Questions? We can help.

See our online FAQs or phone us:

Online Customer Support:
1-800-430-3376

Major Appliances:
1-800-455-3869

Call 7 days a week - 6 a.m. to 2 a.m. EST

Norton SECURED powered by VeriSign

Merchandise Subtotal	$36.32
*Estimated Shipping	$5.99
Sales Tax (determined in later step)	----
Estimated Subtotal	**$42.31**

* Shipping is calculated on lowest rate shipping method available other shipping methods available on next page

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We accept the following payment methods: DISCOVER MasterCard VISA PayPal

RECOMMENDATIONS INSPIRED BY YOUR RECENT BROWSING HISTORY

WOLFF BROS. SUPPLY INC.

QUOTATION

WWW.WOLFFBROS.COM

Quote No. 00020899

SOLD TO
Michael Huttinger Trade Acc T
565 N Applecreek Rd
Wooster OH 44691-9599

SHIP TO
Michael Huttinger Trade Acc T
565 N Applecreek Rd
Wooster OH 44691-9599

Quote Prepared By: PHIL BUMGARDNER
(330) 264-5900 EXT. 243

565 North Applecreek Road
Wooster, OH 44691-9599

TERMS: Customer is responsible for verifying that material purchased is correct for the application. No materials are to be returned without our permission. Cut lengths of pipe, cable, and fabricated items are not returnable. Special order returns also require manufacturer approval. All returned items except defectives must be in like-new condition and packaged as originally received. Returnable items must be returned within 90 days of invoice date. Returns are subject to a Wolff Bros. Supply minimum 15% restocking fee. All special order returns are subject to additional manufacturer restocking fees plus return freight and handling costs. Item credit pricing will be net of restocking charges. For defective material, no allowances will be made beyond the manufacturer's warranty. Claims for billing discrepancies or pricing errors must be made within 10 working days of invoice date. A 2% per month service charge will be invoiced to your account on all past due balances.

CUSTOMER NO.	CUSTOMER ORDER NO.	SLSM.	ENTRY DATE	WHS	EXP. DATE	ORDERED BY	PAGE
67302	VERBAL	673	10/16/2013	WOO	10/31/2013	TOM MOORE	1

Qty.	Item Number	Description	Price	Ext. Price
1	QO120CAFI	1P 20AMP COMBO ARC FAULT BRK	46.4000 EA	46.40
1	LEVAFTR2I	AFCI RECEPT 20A TR 120V IV	30.5000 EA	30.50
1	INTWP3100C	WP IN USE OUTLET COVER CLEAR	6.5225 EA	6.52
1	INTWP1010MXD	WP IN-USE DIE-CAST VERT 1G	13.2188 EA	13.22
1	PNS1595TRI	GFCI REC TPR-RES 5-15R 15A IV	14.6666 EA	14.67
1	ALM1096N	BOX FG NAIL ON 1G SW 18CU	.3470 EA	.35
1	PNS3232TRI	REC 5-15R DPLX TR 15A 125V IV	1.0448 EA	1.04
1	PNSTP8I	WALLPLATE 1G DUPLEX NYL IV	.2393 EA	.24
250	WCNMB14/2G	14/2 W/GRD NM-B COPPER X CL	191.7600 MF	47.94

*Quotation does not include **SALES TAX** if applicable.*

Subtotal **160.88**
Plus Tax
Total

Prices are subject to change without notice. # Special order items may not be returnable.
DELIVERY CHARGES: A delivery charge will be added to deliveries that are less than $500; deliveries $500 and over will be prepaid. UPS and special freight charges will also be invoiced.

QCP2

MHCC MEETING
October 25-27, 2016

APPENDIX C:
Formaldehyde Emission Standards for Composite Wood Products Presentation

By Erik Winchester, EPA

Formaldehyde Emission Standards for Composite Wood Products

National Program Chemicals Division
Office of Chemical Safety and Pollution Prevention

Presentation Overview

1. Background TSCA Title VI
2. Regulation summary
3. Regulated products
4. Product exemptions
5. Emissions limits
6. Compliance timeline
7. Exemptions for products
8. Impacted entities—rule framework
9. Responsibilities under Title VI
10. Stockpiling
11. Partial third-party certification exemptions & reduced testing
12. Petition for additional laminated products exemptions

Background on TSCA Title VI

- On July 7, 2010, the Formaldehyde Standards for Composite Wood Products Act was signed into law to become the Toxic Substance Control Act (TSCA) Title VI.
- TSCA Title VI establishes formaldehyde emission standards identical to the California Air Resources Board (CARB) limits.
- TSCA Title VI directs the implementation of regulations to ensure compliance with formaldehyde emission standards.

Regulation Summary

- TSCA Title VI requires that composite wood products be tested and certified to ensure only compliant products enter the product supply chain.
- Composite wood products must be certified by an EPA-recognized third-party certifier, also called an EPA TSCA Title VI TPC.
- Composite wood products covered under TSCA Title:
  1. Hardwood Plywood
  2. Medium-Density Fiberboard, including thin-MDF
  3. Particleboard
- The new regulation includes a number of areas to ensure compliance including recordkeeping, reporting, and labeling.
- All applications and notifications submitted to EPA under the final rule must be done through the EPA Central Data Exchange at: https://cdx.epa.gov

Regulated Products — *Definitions*

Regulated composite wood products under TSCA Title VI include:

1. **Hardwood Plywood (HWPW):** Hardwood or decorative panel that is intended for interior use and composed of an assembly of layers or plies of veneer, joined by adhesive with a lumber core (or any other special core or special back).
2. **Medium Density Fiberboard (MDF):** Panel composed of cellulosic fibers made by dry forming and pressing a resonated fiber mat.
3. **Particleboard (PB):** A panel composed of cellulosic material in the form of discrete particles (as distinguished from fibers, flakes, or strands) that are pressed together with resin.
4. **Laminated Product:** Product with wood, or woody grass veneer affixed to a composite wood platform by a fabricator as a finished product or a component part.

Emissions Limits

Regulated products must meet the emission standards beginning the date 1-year after publication of the final rule:

Product	Emission Standard*
Hardwood Plywood – Veneer Core	0.05 ppm of formaldehyde
Hardwood Plywood – Composite Core	0.05 ppm of formaldehyde
Medium-Density Fiberboard	0.11 ppm of formaldehyde
Thin Medium-Density Fiberboard	0.13 ppm of formaldehyde
Particleboard	0.09 ppm of formaldehyde

* Standards are the same as CARB's Phase 2 standards

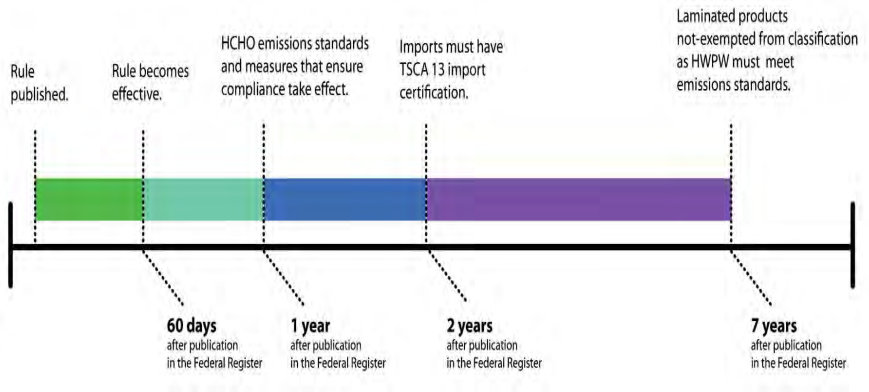
Compliance — *Composite Wood Product Manufacture-by date*

- Composite wood products and finished goods containing these products that are sold, supplied, offered for sale, or manufactured must comply with the rule as of the manufacture-by date.
- **Composite Wood Product Manufacture-by date** = date 1-year after date of publication of the rule in the *Federal Register.*
- Under TSCA "manufacture" includes import, so "manufactured-by" = "imported-by" date for imported composite wood products or finished goods containing them.
- Composite wood products or finished goods manufactured/imported before the specified manufactured-by date are not subject to the rule.
  - They can be incorporated into finished goods at any time. Retailers, fabricators, and distributors are permitted to continue to buy and sell these composite wood products and laminated products, as well as finished goods that incorporate these products.
  - Must have records documenting panels or finished good containing regulated composite wood was in the inventory or imported prior to the manufacture-by date.

Compliance — *Laminated Products Manufacture-by date*

- **Laminated Products Manufacture-by date** = the date 7 years after date of publication of the rule in the *Federal Register*
- Before this date all laminated product producers must comply with the general requirements for fabricators.
- After this date, laminated product producers must either obtain an exemption from the definition of HWPW or comply with the testing, certification, and recordkeeping requirements for HWPW producer in addition to requirements for fabricators.
- Producers of HWPW exempt laminated products must maintain records that demonstrate eligibility for the exemption in order to claim the exemption.

Timeline — Compliance Dates



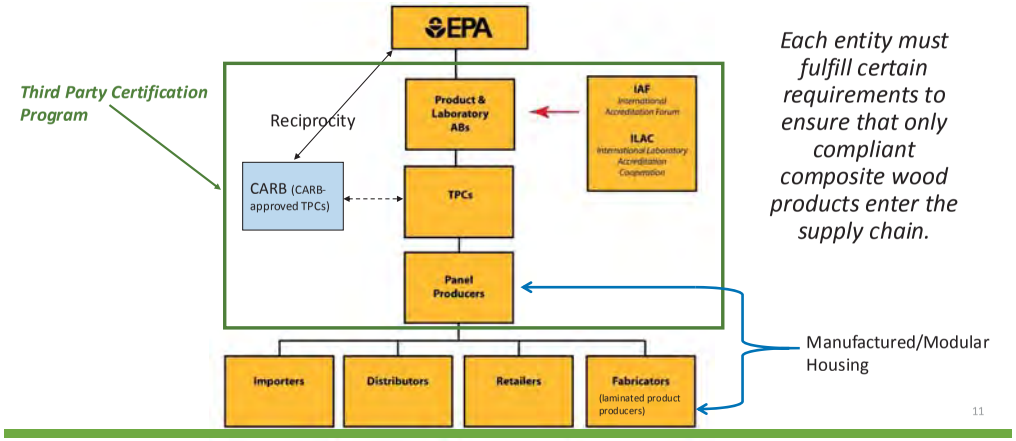
Exemptions — Products

The following products are exempted from the final rule:

1) Hardboard
2) Structural plywood
3) Structural panels
4) Structural composite lumber
5) Military-specified plywood
6) Curved plywood
7) Oriented strand board
8) Glued laminated lumber
9) Prefabricated wood I-joists
10) Finger-jointed lumber
11) Wood packaging (e.g., pallets, crates, spools, dunnage)
12) Composite wood products used inside a new vehicle other than a recreational vehicle, such as:
    - Rail cars, boats, and aircraft
13) Windows that contain composite wood products if the windows contain less than 5% composite wood product by volume.
14) Exterior doors and garage doors that contain composite wood products, if:
    - The doors are made from composite wood products manufactured with NAF of ULEF resins; or
    - The doors contain less than 3% composite wood product by volume.

Finished goods previously sold/supplied or purchased for purposes other than resale are exempt.

Impacted Entities – Rule Framework



Each entity must fulfill certain requirements to ensure that only compliant composite wood products enter the supply chain.

Responsibilities Under TSCA Title VI — *Accreditation Bodies*

- ABs must apply to and be recognized by EPA after entering in a recognition agreement with the Agency (*must do this before ABs can accredit TPCs under TSCA Title VI*)
    - Two categories of ABs: Laboratory and/or Product

Under TSCA Title VI, **accreditation bodies (ABs)** are responsible for the following:

1. Ensuring third-party certifiers (TPCs) and/or their laboratories meet international voluntary consensus standards by determining the accreditation eligibility and accreditation of TPCs and/or laboratories.
2. Providing notifications to EPA for specific events pertaining to status change of TPCs or change to AB information.
3. Maintaining records and submitting annual reports to document TPC compliance with requirements for assessment, reassessment, and surveillance on-site assessments.
4. *Laboratory ABs* must also verify the accuracy of proficiency testing programs.

Responsibilities Under TSCA Title VI — *Third Party Certifiers*

- TPCs must apply to and be recognized by EPA before certifying any composite wood products.
- CARB TPC Reciprocity: During 2-yr transition period, CARB TPCs may certify composite wood products **after** being recognized by EPA (do so by the 1-yr date) without yet having received accreditation from an EPA-recognized AB.
- Before the 2-yr transition period ends, CARB TPCs must obtain accreditation by an EPA-recognized AB to retain EPA recognition under reciprocity.

Under TSCA Title VI, **third party certifiers** are responsible for the following:

1. Certifying that composite wood products are produced in accordance with 40 CFR Part 770 and comply with ISO/IEC 17065:2012(E).
2. Providing notifications to EPA about status changes for panel producers and TPCs.
3. Maintaining records and submitting annual reports to document panel producer's compliance with quality assurance and quality control standards.
4. Using laboratories that have been accredited to ISO/IEC 17025:2005(E) by an EPA-Recognized Laboratory AB.
5. Identifying an "agent for service" located in the U.S. if not a domestic entity.
6. Acting impartially in accordance with their accreditation when performing activities under the EPA program by taking steps to address any conflicts of interest.

Responsibilities Under TSCA Title VI — *Panel Producers*

Under TSCA Title VI, **panel producers** are responsible for the following:

1. Applying for and receiving third-party certification of regulated products by an EPA-recognized TPC.
2. Conducting quality control tests on a regular basis to ensure regulated composite wood products meet emission standards.
   - For particleboard and MDF, at least **once per 8-hour shift** for each product line for each production type (unless reduced testing has been approved)
   - For HWPW, varies (x times per week or month) by square feet of product produced
3. Meeting reporting and recordkeeping requirements, and ensuring that all quality control requirements are met.
4. Labeling products they produce either separately or by the bundle.

Responsibilities Under TSCA Title VI — *Fabricators/Laminated Product Producers*

Fabricators (including laminated product producers) are responsible for the following:

Years 1-7 onward

1. Ensure they purchase only compliant composite wood products, whether unfinished panels or incorporated into component parts or finished goods.
2. Keep (3 yrs min) records documenting supplier's information if they purchase products directly from a wood product mill.
3. Maintain additional records if they fabricate laminated products.
4. Labeling any finished goods they produce or every box/bundle containing finished goods they produce.

Year 7 onward

5. Get non-exempt laminated product tested and certified by an EPA-approved TPC 7 years after the rule is published in the Federal Register.

Responsibilities Under TSCA Title VI — *Fabricators/Laminated Product Producers*

- Fabricators may also be laminated product producers.
- A laminated product producer is:
  - a manufacturing plant or other facility that manufactures (excluding facilities that solely import products) laminated products on the premises.
- A laminated product is:
  - a product in which a wood or woody-grass veneer affixed to a regulated composite wood product platform under TSCA Title VI.
  - a component part used in the construction or assembly of a finished good.

Laminated products made with:

Formaldehyde-based resins (other than phenol-formaldehyde) to attach a veneer to composite wood products **must be tested and certified to meet the HWPW emission standard 7 years after rule promulgation.**

Phenol-formaldehyde (PF) resin or NAF resin to attach a veneer to an already compliant platform **are *exempt from testing and certification***

Responsibilities Under TSCA Title VI *Importers, Distributors, & Retailers*

Importers, distributors, and retailers are responsible for the following:

1. Ensuring they purchase only compliant composite wood products, whether unfinished panels or incorporated into component parts or finished goods.
2. Ensuring labels stay intact on individual items ***or*** on file if items were purchased by the bundle and sold separately (label information must be made available to potential customers upon request).
3. Using a method sufficient to identify the supplier of the panel or finished good, and linking the information on the label to the product.
4. Importers must *also* provide an import certification for all imports 2 years after publication of the final rule.

Other Provisions: Stockpiling

- Regulated entities are not permitted to sell any composite wood products or finished goods containing composite wood products if they have been stockpiled.
- Products are considered stockpiled when:
  - manufacturing or purchasing composite wood products between July 7, 2010 and 180 calendar days after promulgation of the final regulations at an average annual rate 20 percent greater than the amount manufactured or purchased during the 2009 calendar year, *for the purpose of circumventing* the TSCA Title VI emission standards.
  - Not stockpiling if manufacturing or purchasing products for legitima business reasons: higher rate because of increased demand, natural or planned business expansion, etc.

Other Provisions: Petition for Additional Laminated Product Exemption

- Laminated products that use PF or NAF resins to attach a veneer to an already compliant platform are exempt from the definition of HWPW and the testing and certification requirements that become effective 7 years after the publication of the final rule.
- Any person may petition the Agency to expand the exemption for laminated products from the definition of the term “hardwood plywood”.
  - Petitions should include all available and relevant information, including but not limited to studies conducted and emissions data to support the petition
- EPA will review each submitted petition and, where appropriate, publish a proposed rule in the Federal Register based on the petition with a public comment period of generally 30 days before taking a final action.

Summary: Manufactured & Modular Housing

- Regulated by both EPA and HUD (but not modular homes).
- Under TSCA Title VI manufactured and modular homes are considered finished goods.
- Manufacturers are fabricators, but also potentially laminated product producers, distributors and retailers.
- As a fabricator you are required to:
  - Label each manufactured home as “TSCA Title VI Compliant”; no specific requirement on where the label must go, EPA and HUD are discussing this.
  - Keep records (3 yrs min) showing that all regulated composite wood products and component parts or finished goods containing regulated composite wood used to fabricate the home are compliant.
- If also a laminated product producer, distributor and retailer then must follow the labeling, recordkeeping and testing /certification requirements for those groups.

For More Information

Erik Winchester, Chief
Fibers and Organics Branch
202-564-6450
winchester.erik@epa.gov

Visit EPA's website for updates:
http://www.epa.gov/formaldehyde

MHCC MEETING
October 25-27, 2016

APPENDIX D:
Preliminary Working Draft Manufactured Home Construction and Safety Standards Formaldehyde Emission Controls for Certain Wood Products

By HUD

10-13-2016

PRELIMINARY WORKING DRAFT

MANUFACTURED HOME CONSTRUCTION AND SAFETY STANDARDS

FORMALDEHYDE EMISSION CONTROLS FOR CERTAIN WOOD PRODUCTS

PART 3280—MANUFACTURED HOME CONSTRUCTION AND SAFETY STANDARDS

The authority citation for part 3280 continues to read as follows:

1.Authority: 42 U.S.C. 3535(d), 5403, and 5424

1. Add the following definitions to § 3280.302 to read as follows:

§ 3280.302 Definitions.

* * * * *

Refer to 40 CFR 770.3 for definitions applicable to Subpart D and E only.

* * * * *

§ 3280.308 Formaldehyde emission controls for certain wood products.

(a) Formaldehyde emission levels. Refer to 40 CFR § 770.10 for maximum formaldehyde emission levels for hardwood plywood made with a veneer core, medium density fiberboard, thin medium density fiberboard, and particleboard. These emission standards apply whether the composite wood product is in the form of a panel, a component part, or incorporated into a finished good.

(b) Product certification and continuing qualification. Refer to 40 CFR §§ 770.7, 770.15, 770.20, and 770.21.

(c) Panel identification. Refer to 40 CFR § 770.45 for labeling requirements.

(d) Treatment after Certification. Deleted.

(e) Finished good certification label. Each manufactured home must be provided with a finished good certification label indicating that the home has been produced with panels or products that comply with the maximum formaldehyde emission requirements of this Part and 40 CFR Part 770.

(f) Non-complying lots. Refer to 40 CFR § 770.22.

§ 3280.309 Health Notice on formaldehyde emissions. Deleted.

* * * * *

§ 3280.406 Air chamber test method for certification and qualification of formaldehyde emission levels. Refer to 40 CFR §§ 770.15, 770.20, and 770.24.

§ 3280.407 Quality control testing for formaldehyde levels. Refer to 40 CFR §§ 770.20(b).

PART 3282—MANUFACTURED HOME PROCEDURAL AND ENFORCEMENT REGULATIONS

The authority citation for part 3282 continues to read as follows:

1.Authority: 42 U.S.C. 3535(d), 5403, and 5424

1. Add new section 3282.212 to read as follows:

* * * * *

3282.212 TSCA Title VI Recordkeeping Requirements. Manufacturers must maintain bills of lading, invoices or comparable documents that include a written statement from the supplier that the component parts or finished goods are TSCA Title VI compliant for a minimum of three years from the date of purchase.

* * * * *

2. Add new section 3282.257 to read as follows:

* * * * *

3282.257 TSCA Title VI Recordkeeping Requirements. Retailers and distributors must maintain bills of lading, invoices or comparable documents that include a written statement from the supplier that the

component parts or finished goods are TSCA Title VI compliant for a minimum of three years from the date of purchase.

MHCC MEETING

October 25-27, 2016

APPENDIX E:
HUD Brochures

By HUD Office of Manufactured Housing Programs

HUD Manufactured Home Dispute Resolution Program (DRP)

The HUD DRP is intended to address defects in construction, safety and installation. The program is not intended to address cosmetic issues and contractual agreements. If you believe there is a construction, safety or installation issue with your home, be sure to notify the retailer, manufacturer or installer first.

Your request for dispute resolution should include:

- The name, address, and contact information of the homeowner;
- The name and contact information of the manufacturer, retailer, and installer, to the extent available;
- The date the report of the alleged defect was made;
- The name and contact information of the recipient or recipients of the report of the alleged defect;
- The date of installation of the manufactured home affected by the alleged defect; and
- A description of the alleged defect;
- Photos, if applicable.

The HUD Manufactured Home DRP was established in HUD regulation Title 24, Subtitle B, Chapter XX, Part 3288. For more information about the Program, please visit the HUD Dispute Resolution Program website at www.huddrp.net or visit the HUD Office of Manufactured Housing Programs website at www.hud.gov/mhs.

www.huddrp.net

Manufactured Home Dispute Resolution Program (DRP)

Office of Manufactured Housing Programs

U.S. DEPARTMENT OF HOUSING AND URBAN DEVELOPMENT

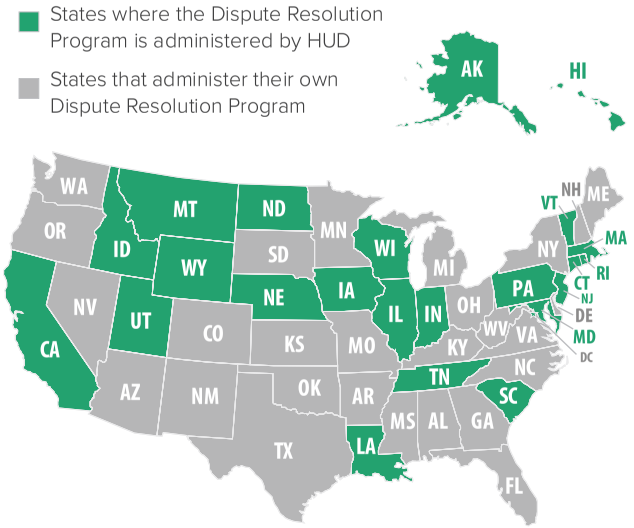
What is the HUD Manufactured Home Dispute Resolution Program (DRP)?

The HUD Manufactured Home DRP provides timely resolution of disputes between the manufacturer that built the home, the retailer who sold the home, and the installer who placed the home on its site, regarding the responsibility for correction or repair of defects reported by the homeowner or others in the one-year period after the first installation of the manufactured home.

Did you know that all states have a dispute resolution program?

There are 23 states where the manufactured home Dispute Resolution Program is administered by HUD.

If your state is not identified as a state that has a Dispute Resolution Program administered by HUD, then your state is one of 27 states that administers its own program. To find the contact information for your state's program, visit www.hud.gov/mhs and click on Dispute Resolution Program.



1 If your state has a Dispute Resolution Program administered by HUD, complete the checklist below:

- ☐ The retailer, manufacturer, installer, HUD, or the State Administrative Agency was notified of alleged defect(s) within one year after the date the home was first installed.
- ☐ Your home was not reinstalled.

2 Know the process.

First, the dispute is assigned to a neutral screener who will verify the eligibility of the dispute. Next, a mediator will attempt to mediate a resolution between parties. If mediation fails, an arbitrator will identify cause and responsibility, and develop resolution recommendations to HUD. Homeowners may observe the process, but are not participants.

3 Submit a request for dispute resolution.

There are five ways to submit your request:

Online: www.huddrp.net

By Phone: (571) 882-2928

By Fax: (888) 819-5191

By Email: info@huddrp.net

By Mail: ATTN: Manufactured Home Dispute Resolution Program
2300 Clarendon Blvd.
Suite 250
Arlington, VA 22201

Remember, whenever there is an issue with your home, always contact the retailer, manufacturer or installer first. Also, be sure to allow a reasonable amount of time for a satisfactory response to your issue from the retailer, manufacturer or installer before submitting a request.

SALE CONSIDERATIONS

Q. When can a retailer consider the sale of a home complete?

A. The sale of a manufactured home will not be considered complete until all services are complete that were agreed upon at the time the contract was entered into. For example, when a retailer is providing the installation and the installation causes safety hazards or takes the home out of compliance, and those issues are discovered during the installation of the home, the sale or lease of the home is not complete until the home is corrected. [3282.252(b)]

Q. May I sell or lease a new home that does not conform to the federal standards if I inform the manufacturer and homeowner?

A. No. A retailer or distributor cannot sell, offer for sale, lease, or offer for lease a new home that knowingly contains a failure to conform to the standards. [3282.252(a)]

Q. What is my responsibility as a retailer if I know a new home on the lot that does not conform to the federal Standards?

A. Retailers must contact the manufacturer, provide full information concerning the problem, and request appropriate action. This action may include manufacturer repair or authorization for you to repair on a reimbursable basis. [3282.414(b)] You may not offer to sell or lease the home unit it meets the federal standards.

Q. Can I sell or lease a used home that does not contain a manufacturer's certification label (red metal tag on each floor or section of a home) or a used home that contains a failure to conform to the federal standards?

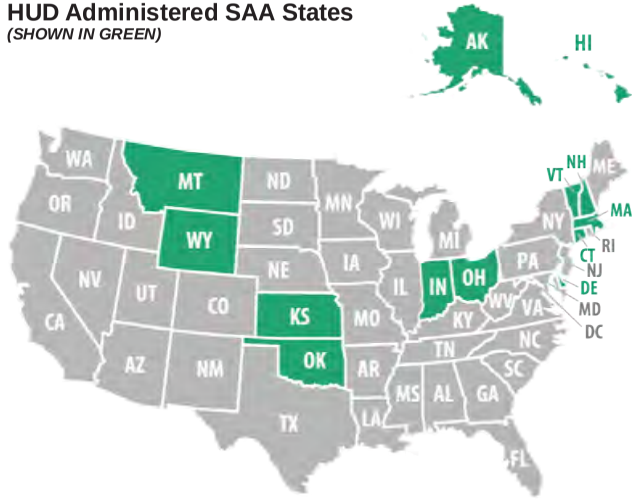
A. HUD does not prohibit the sale of used home without labels or the sale or lease of a used home that contains a failure to conform. However, state and local authorities having jurisdiction may impose terms, conditions, and requirements regarding the sale of used homes.

CONSUMER COMPLAINTS

Q. Who do I contact when I forward a complaint or a request for service to the home manufacturer and the manufacturer does not adequately respond?

A. In this situation, a retailer needs to refer the matter to the State Administrative Agency (SAA) where the home is located or to HUD if there is no SAA [3282.256(a)]. A list of SAAs with contact information is available on HUD's website at www.hud.gov/mhs.

HUD Administered SAA States
(SHOWN IN GREEN)



HUD Administered Installation Programs
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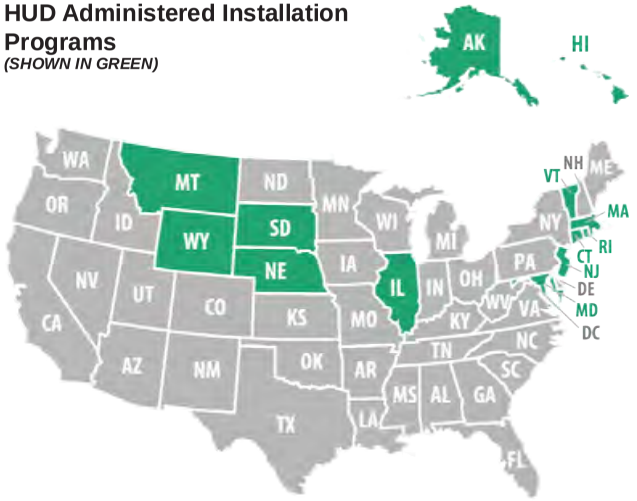

HUD Administered Dispute Resolution Program
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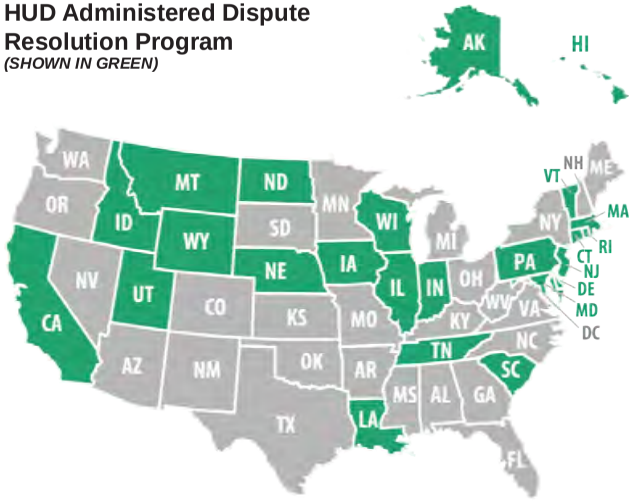


Manufactured Home Retailer Frequently Asked Questions (FAQs)

Office of Manufactured Housing Programs

U.S. DEPARTMENT OF HOUSING AND URBAN DEVELOPMENT

www.hud.gov/mhs

GENERAL QUESTIONS

Q. How do I know what my responsibilities are under the Department of Housing and Urban Development's regulations as a manufactured home retailer or distributor?

A. Retailer and distributor are integral in the supply chain for the manufactured housing industry and have a significant and integral responsibilities within the federal and state programs. Retailers and distributors need to be familiar with the entire set of program regulations with a focus on the regulatory responsibilities outlined in Subparts F and I of the Manufactured Home Procedural and Enforcement Regulations, Subparts A and G of the Manufactured Home Installation Program Regulations, and Subparts A and B of the Dispute Resolution Program Regulations. Entities should also seek guidance for responsibilities of retailers and distributors under state law and state program requirements and understand that some states administer their own qualifying installation and/or dispute resolution programs. (See brochure back)

Q. Are there penalties for not complying with the Regulations?

A. YES. Failure to comply with the Federal Regulations may result in civil and or criminal penalties, imposed by HUD or a State-based agency. Assessed penalties are $1,100 per violation up to a maximum of $1,100,000 for related violations. Furthermore, any person other than an officer or employee of the Unites States, or a person exercising inspection functions under a State Plan, who knowingly and willfully fails to report a violation of the Federal Regulations may be fined up to $1,100 or imprisoned for up to one year or both. [42 USC 5420, 3282.10]

REQUIRED INFORMATION AND DISCLOSURES

Q. What information am I required to provide to the manufacturer of the home regarding homes on a retailer or distributor lot or with respect to homes in the hands of consumers?

A. There are various pieces of information that must be forwarded or otherwise sent to home manufacturers. This information includes purchaser information, information regarding consumer complaints, and other information as may become known about the compliance and performance of manufactured homes on retailer lots.

Q. Are retailers responsible for providing Installation Instructions?

A. YES. Retailers are responsible for providing installation instructions to the purchaser and/or installer of the manufactured home. [3286.103]

The Regulations require the manufacturer to put the consumer manual in a conspicuous location in the home to ensure that only the purchaser removes it. No retailer or distributor may interfere with the distribution of the consumer manual. The retailer shall take any appropriate steps to ensure the purchaser receives a consumer manual. [3282.207(d)]

Q. Do I have to leave the formaldehyde notice displayed in the home?

A. YES. The Regulations require the manufacturer to place a notice in each home informing prospective purchasers and consumers about potential for formaldehyde emissions from the products used in the construction and assembly of the home. This notice must be placed in a conspicuous location in the home to ensure that only the consumer removes it. No retailer or distributor may interfere with the availability of the consumer to view and obtain this notice. The retailer shall take any appropriate steps to ensure the purchaser receives this health notice. [3280.309(c)]

Q. Am I required to complete the homeowner information card and forward it to the manufacturer?

A. YES. Each consumer manual should contain three postage-paid homeowner information cards. The retailer is responsible to complete one of these cards at the time of sale with appropriate owner information and return it to the home manufacturer. If the homeowner card is not available, the retailer needs to obtain the information the card requires and forward the information to the home manufacturer. [3282.255]

Q. Does a retailer have to provide any specific information to a home purchaser before I sell or lease a home?

A. Before selling a manufactured home, the retailer is required to provide certain information to the purchaser or lessee. This includes, but is not limited to providing consumer notices, a copy of a consumer disclosure statement required in 3286.7(b) and advising of specific wind, thermal and roof load zone loads, and consumer notices on dispute resolution. The information that a retailer provides varies depending on how much they know about the home's final location and aspects included in the sale of a new manufacture home.

Q. What is a Consumer Disclosure Statement?

A. Prior to execution of the sales contract to purchase or agreement to lease a manufactured home, the retailer must provide the purchaser or lessee with a consumer disclosure. This disclosure must be in a document separate from the sales or lease agreement. A sample disclosure that can be used as a model, can be found at www.manufacturedhousinginstallation.com. [3286.7(b)]

RETAILER ALTERATIONS

Q. If I alter a new home or make repairs before I sell or lease it, do I have to keep any records?

A. YES. Retailers must maintain complete records of all alterations and repairs conducted under its operations or under a service contract on new manufactured homes. [3282.414(b), 3282.254(c)]

Q. May I make corrections or alterations to a new manufactured home prior to the sale of the home?

A. YES. A retailer may correct or alter a home as long as the work does not create an imminent safety hazard or take the home out of conformance with the federal standards. [3282.254]. However, in order to avoid taking the home out of conformance, a retailer needs to receive manufacturer authorization, obtain applicable instructions, perform required testing, and maintain complete records of the work (see definition of "alteration" in 3282.7.) The manufacturer alone is responsible to correct all failures to conform and imminent safety hazards on all homes not yet sold, regardless of the severity of the issue.

Q. Is the retailer required to notify the consumer about the HUD Manufactured Home Dispute Resolution Program?

A. YES. Per 3288.5, at the time of signing a contract for sale or lease for a manufactured home, the retailer must provide the purchaser with a retailer notice. This notice may be in a separate document from the sales contract or may be incorporated clearly in a separate section on consumer dispute resolution information at the top of the sales contract. The notice must include the following language:

The U.S. Department of Housing and Urban Development (HUD) Manufactured Home Dispute Resolution Program is available to resolve disputes among manufacturers, retailers, or installers concerning defects in manufactured homes. Many states also have a consumer assistance or dispute resolution program. For additional information about these programs, see sections titled "Dispute Resolution Process" and "Additional Information—HUD Manufactured Home Dispute Resolution Program" in the Consumer Manual required to be provided to the purchaser. These programs are not warranty programs and do not replace any warranty program.

New homes, located in HUD dispute resolution states, are eligible so long as the unresolved issue was reported to the home manufacturer, retailer, installer, State Administrative Agency, or HUD during the one-year period beginning on the date of installation and a complete request for dispute resolution is received by HUD. If your home has an unresolved issue that was not reported to any party within the first year beginning on the date of installation, you should contact your state's manufactured housing program or HUD to learn about other ways the issue may be resolved. Programs may vary in each state. Documentation should be kept for all contact with disputed party(ies).

MHCC MEETING
October 25-27, 2016

APPENDIX F:
HUD-Administered Manufactured Home Installation Program

By Michael S. Henretty, SEBA Professional Services

HUD-Administered Manufactured Home Installation Program

From the

The U.S. Department of Housing and Urban Development

Presented by

SEBA Professional Services, LLC

Installation Program in HUD-Administered States

HUD-Administered Manufactured Home Installation Program

Basic Program Requirements

- All installations of new manufactured homes are supervised by a HUD Licensed Installer in accordance with 24 CFR 3286.205.
- All new manufactured homes are installed in accordance with the manufacturer's installation instruction manual. All manuals should be based on 24 CFR 3285.
- 100% inspection requirement of new manufactured homes by a qualified inspector per 24 CFR 3286.511 in all HUD-Administered states.
- Reporting requirements for installers (HUD 309).
- Reporting requirements for retailers (HUD 305, 306 and Consumer Disclosure).

HUD-Administered Manufactured Home Installation Program

Program Accomplishments

- **Approved Training Programs**: 4
- **Individuals Trained**: 470
- **HUD Licensed Installers**: 296
- **Contact Database**: 2,493
- **Kick-off Attendees**: 256
- **Monthly Conference Call Attendees**: 490

  July 2015 – September 2016

Program Monitoring and Compliance

Program Monitoring

Moving forward, HUD will focus on program monitoring and compliance. This will be achieved through:

- Installation monitoring inspections
- Review of manufactured home shipment reports
- Permits submitted from local authorities
- Reconciliation of program reporting (HUD 305, 306, 309)
- Program communications and notification from industry members

Completed Installation Monitoring Inspections

- Nebraska – May 2016
- Maryland – August 2016
- South Dakota – September 2016
- New Jersey – September 2016
- Vermont – October 2016
- Massachusetts – Upcoming, November 2016
- Connecticut – Upcoming, November 2016

Monitoring Inspection Discoveries

- Home site issues (grading, organic material under home).
- Foundation issues (piers, footings).
- Lack of reporting (HUD 305, 306 and 309 Forms).
- Lack of required Consumer Disclosure.
- Good installations, proper licensing and inspection.
- Engaged industry, willingness to participate and improve.

Noncompliance and Enforcement

- Discovered installation defects require action plans and correction.
- Failure to comply with mandated installation updates can result in suspension and/or revocation of HUD Installer License and civil and criminal penalties pursuant to 24 CFR part §3282.10.

Alternative Foundation Review

Foundation Systems: Purpose

Some foundation systems do not fully meet the requirements of SEI/ASCE 32-01. A review of Frost Free Foundation Systems (FFF) and Frost Protected Foundation Systems (FPFS) was conducted to ensure:

- Regulatory adherence to 24 CFR 3285.312(b).
- Proper use and interpretation of SEI/ASCE 32-01 with regards to foundations in freezing climates.

HUD has also found a wide-spread dedication to proper installation practices.

Requirements for Foundations in Freezing Climates

Under HUD Installation Standards in 24 CFR 3285.312, foundations in freezing climates must either be installed:

- With conventional footings below the frost line depth; or
- As a monolithic slab system in accordance with accepted engineering practice or in accordance with SEI/ASCE 32-01, 2001; or
- As an insulated foundation system to prevent the effects of frost heave or in accordance with SEI/ASCE 32-01, 2001.

HUD Office of Manufactured Housing Programs

Review Findings

- A lack of clarity of technical requirements.
- Missing or vague criteria for identification and measurement of soil frost susceptibility.
- Missing or vague guidance for determining soil moisture, sub-surface drainage conditions, and water table depth.
- Missing guidance to direct appropriate site specific adjustments of important installation details.
- Confused roles and responsibilities.

HUD Office of Manufactured Housing Programs

Determination

A need exists to clarify requirements and provide guidance for proper and compliant applications of FFF designs as an alternative to a conventional (frost depth) footing or a conventional FPSF design using insulation to protect against ground freezing per the ASCE 32 standard.

HUD Office of Manufactured Housing Programs

Recommendations for Manufacturers

- Manufacturers Installation Instructions (MII) for FFF designs need to:
  - Identify what steps need to be taken to confirm that the site is non-frost-susceptible.
  - Have at least one example of an acceptable foundation system for frost and non-frost susceptible soil conditions for use in freezing climate locations.
- Have available an updated copy of their MII in electronic format as part of the sale process.

HUD Office of Manufactured Housing Programs

Recommendations for Retailers & Park Owners

- Provide required Consumer Disclosure.
- Provide an electronic copy of the MII and foundation details at the time of the sale.
- In HUD states, notify HUD of the certification and location of each home installation (HUD 305 & 306 form).
- Ensure that each installation is inspected by an independent third party and the inspection verified (HUD 309 form).

HUD Office of Manufactured Housing Programs

Recommendations for Designers & DAPIAs

- Designs that rely exclusively on surface drainage as a means of foundation frost-protection are not acceptable. These should be recalled and revised or disapproved.
- Designs that do not specify appropriate means of assessing the frost-susceptibility of soils and their sub-surface drainage characteristics on a site-specific basis need to be disapproved.
- Designs that assign design responsibilities to local regulatory authorities are not acceptable.

HUD Office of Manufactured Housing Programs

Recommendations for Installers

- When installing a new home on a site that has conditions not covered in the MII or the engineered foundation plan, special site conditions should be brought to the attention of the engineer of record. If there is no engineer of record, a licensed engineer or licensed architect should be retained to evaluate the conditions and then design a plan to install the home.

HUD Office of Manufactured Housing Programs

Recommendations for Installers

- Manufactured homes must not be installed using FFF installation plans that rely exclusively on surface drainage as a means of frost protection.
- Verify that appropriate soil testing and site assessment for use of a FFF design has been completed prior to initiating an installation.
- Prior to installation of an engineered system, that is not included in the MII, installers need to verify that the installation plan is stamped by an engineer of record as well as approved by the manufacturer and its DAPIA.

HUD Office of Manufactured Housing Programs

Recommendations for Local Officials & Inspectors

- Reject installation plans that require them to execute a design responsibility.
- Freezing-climate installation plans that rely exclusively on surface drainage as a means of frost protection should not be approved.
- Require evidence when a site is claimed to have non-frost-susceptible soils or soils that are “well-drained”.
- Ensure that that the approved installation plans and MII are on site and available during inspections.

Contact Information

All participants can submit questions or information to SEBA through any of the following channels:

- Email: hudinfo@sebapro.com
- Website: www.manufacturedhousinginstallation.com
- Phone: 202-552-7356
- Fax: 202-379-3340
- Address: Office of Manufactured Housing Installation Programs
  C/O SEBA Professional Services, LLC
  1325 G Street, NW Suite 500
  Washington, DC 20005

MHCC MEETING
October 25-27, 2016

APPENDIX G:
An Assessment of Design and Installation Practices for Manufactured Homes in Climates with Seasonally Frozen Ground

By Jay H. Crandell, P.E.

An Assessment of Design and Installation Practices for Manufactured Homes in Climates with Seasonally Frozen Ground

Presentation to MHCC
October 26, 2016

Jay H. Crandell, P.E.

Introduction

- Welcome
- Qualifications
- Purpose
  - Assess foundation design and installation practices for cold climates (seasonally frozen ground)
  - Prepare an engineering research report for SEBA and HUD
  - TODAY: Review findings and recommendations

Outline

- Background info
- Define important terms and requirements
- Assessment of representative designs (examples)
- Other Considerations
- Conclusions
- Recommendations (solutions)

Background

- For the purpose of this presentation:
  - Frost Free Footings (FFF) are designs that rely on Section 4.2 of ASCE 32-01 standard
    - Relies on use of well-drained, non-frost susceptible soil or fill to prevent frost heave
  - Frost-Protected Shallow Foundations (FPSF) are designs that rely on all other parts of ASCE 32-01
    - Relies on use of insulation to prevent ground freezing and frost heave
- Either approach properly executed can be considered as conforming to the HUD Code (24 CFR Ch. XX, 2385.312)
- The BIG Question: *Are current designs and installation practices conforming or at least equivalent?*

Background

- In theory, frost protection can be provided by removing any one of the following three conditions necessary for frost heave:
  - Moist ground or a moisture source below the frost-front in ground
  - Freezing temperatures in the ground
  - Frost-susceptible soil or fill material
- *"In theory there is no difference between theory and practice. In practice there is."* Yogi Berra
- There are differences in the reliability achieved in practice depending on the approach chosen based on the theory of what can be done.
  - How the theory is put into practice is important.

Background

- Key requirements in ASCE 32-01, Section 4.2 for FFF designs:
  - Footings must be "placed on a layer of **well-drained** undisturbed ground or fill material", AND
  - The ground or fill material "is **not susceptible to frost**", AND
  - The non-frost-susceptible ground or fill layer must extend to the "**design frost depth**"
- To understand these requirements certain terms must be properly understood…

Terminology & Requirements

- What does "well-drained" mean?
- What does "not susceptible to frost" mean?
- What does "design frost depth" mean?
  - How do you execute these terms/requirements in an practical and enforceable manner?

Well-Drained

- Not explicitly defined in ASCE 32-01
- Must rely on engineering standard of care and accepted practice
- Generally this involves BOTH surface drainage and sub-surface drainage or moisture conditions of the site and soil profile.
- Meaning may vary based the application or context: buildings, agriculture, roads, etc.

Well-Drained (cont'd)

- Quote from McFadden and Bennet, 1991, Construction in Cold Regions: A Guide for Planners, Engineers, Contractors, and Managers, John Wiley & Sons, pp.340-342:
  - *"…it is imperative to provide the best drainage possible. In more moderate regions where frost does not penetrate as deeply, this may include careful installation of underdrains…Barriers to restrict capillary moisture flow…so that moisture cannot "wick" to the freezing front…"*
- At a minimum, the level of the water table must be considered together with surface drainage.
- Even a water table located moderately below the design frost depth can supply moisture to the freezing front which is the mechanism of ice-lense development in frost-susceptible soils.

Non-Frost Susceptible

- Varying degrees of sophistication in methods to assess frost-susceptibility of soils (Chamberlain, 1981)
- Most common methods rely on grain size distribution
- Simplest of these is a particle size limit (e.g., % of soil mass less than a certain particle size)
- ASCE 32-01:
  - "Undisturbed granular soils or fill material with less than 6% of mass passing a #200 (0.074mm) mesh sieve in accordance with ASTM D442."
  - Considered appropriate for general building foundation applications to prevent unacceptable frost-heave risk.

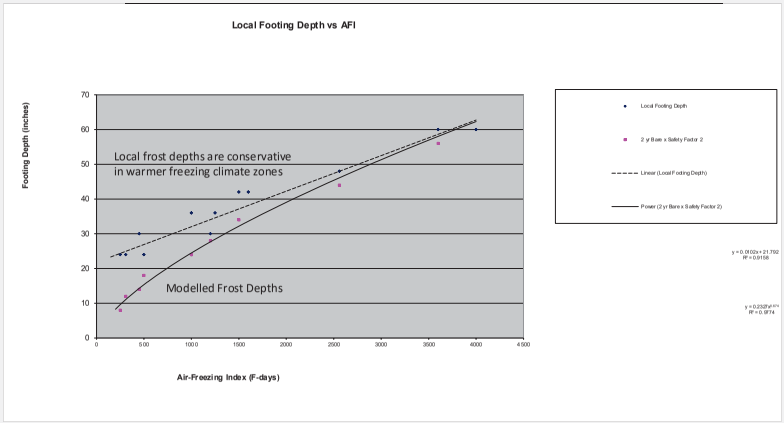
Non-Frost Susceptible (cont'd)

- Who makes this determination?
- ASCE 32-01:
  - "Classification of frost susceptibility of soil shall be determined by a soils or geotechnical engineer, unless otherwise approved."
  - While alternatives are permitted, there is still a requirement for evidence that a given soil or fill material on a given site is not susceptible to frost heave.
  - A qualified soils engineer may determine that use of a different scientific/test method to assess soil frost susceptibility may be more favorable (and at least equivalent).
  - More on this later in assessment of actual example designs.

Design Frost Depth

- Design frost depth refers to the expected depth of frost penetration into the ground for a given severity of winter and ground conditions (e.g., soil type, moisture condition, and ground cover or lack thereof).
- Generally, established by local jurisdiction in ad-hoc fashion.
- Can be somewhat inconsistent with variation in risk, but also tend to follow the right trend.
- To assess this trend and provide a more risk-consistent basis of frost depth, this has been studied and compared to risk-consistent modeling by NOAA Northeast Climate Data Center for HUD (HUD, 2001).

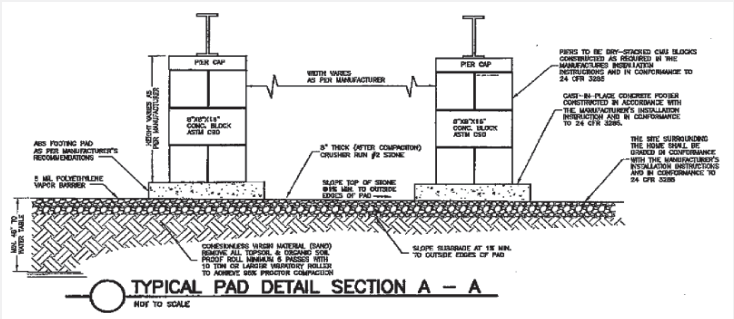
Design Frost Depth (cont'd)



Review of Existing FFF Designs & Data

- 4 representative examples of actual designs & installation instructions reviewed for FFF
- FPSF designs (insulated foundations) also reviewed, but found to have far fewer conformity concerns (though not absent)

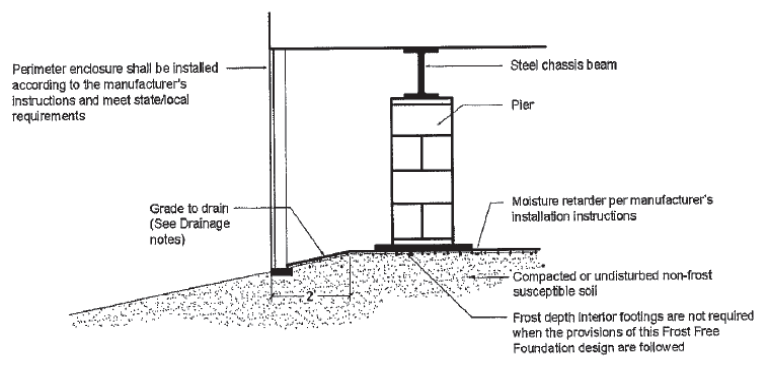
Example #1: FFF Design (footings on crushed stone pad on subgrade)



Example #1 (cont'd)

- A reasonable representation of the FFF technical requirements:
  - Appropriately defines non-frost-susceptible (NFS) material
  - Appropriately requires NFS material to be well-drained and to extend below the design frost depth
- But, "DESIGN NOTES" have confused roles and responsibilities:
  - Places a design burden on local authorities for determining NFS for each site/application.
  - At the same time, it requires engineering verification
  - See report for copy of DESIGN NOTES
- Recommendation:
  - Roles should be reversed and clarified
  - Engineering should perform the site assessment and determination of NFS
  - Local authorities should perform verification of design and installation

Example #2: FFF Design (footings directly on subgrade)



Example #2 (cont'd)

- This is a very different execution of the FFF concept as compared to Example #1
- Appears to be based on SBRA/Hayman (2010) report
  - Relies exclusively on assumption that *"the soil beneath the manufactured home stays dry thereby preventing frost heave."*
  - Claims that *"Soil type is not relevant using the Frost Free Foundation design. Soil test are not necessary."*
- For reasons that follow, this approach and these assumptions which appear to be the basis of justification for Example #2 do not conform with the intent and requirements of the HUD Code or the ASCE 32-01 standard.

Example #2 (cont'd)

- Assessment of SBRA/Hayman (2010) report:
  - Also, claims soil tests are "potentially expensive and time consuming process"
    - No evidence provided to support the claim
    - Lab tests are not necessarily expensive and can have quick turn-around
  - Quotes Unified Facilities Criteria for roadway design to justify that a manufactured housing foundation creates the necessary "special condition" to avoid use of well-drained, non-frost-susceptible soils.
  - But, the full quote of the UFC document says otherwise:
    - *"d. Special Conditions….[A different classification of frost susceptibility is permissible] if complete justification for the variation is presented."*
    - A NFS determination and classification of soil is still required and it must involve justification/data to support it on a case-by-case basis.

Example #2 (cont'd)

- The quote from UFC continues:
  - *"Such justification may take into account special conditions of subgrade moisture or soil uniformity, in addition to soil gradation and plasticity, and should include data on performance of existing pavements near those proposed to be constructed."*
  - Clearly this requires testing and data collection at the site by a qualified person.
  - It also specifies the type of data that must be collected and considered.
  - In addition to this data (not in replacement of) local experience may be considered.
- Example #2 and the SBRA/Hayman (2010 report) do not meet these expectations for accepted practice even though it claims:
  - "superior under home water control capabilities"

Example #2 (cont'd)

- The SBRA/Hayman (2010) report also references various sources of anecdotal experience without:
  - Disclosing and analyzing the important variables that would affect experience.
    - What was the variation in soil type and particle size distribution represented by the sources of experience?
    - What were the winter air-freezing indices during the time period of experience?
    - What depth of footings was represented by the experience?
    - Etc.
- This can create a number of problems related to justification and scientific method (repeatable, relevant, and verifiable data).

Example #2 (cont'd)

- A specific example for the SBRA/Hayman (2010) report:
  - One anecdotal source of experience of "no problems" was associated with a specific period of time: 1994-2004
  - However, this 11 year period is marked with below average winter freezing conditions (less severe than normal) for 8 of the 11 years. Furthermore, the 3 years that were above average in a national sense were only marginally above – certainly not representative of design conditions.
- In another case, the experience was associated with a location where 24"deep footings were required (with 12" permitted within enclosed portions).
  - Thus, this successful performance experience does not appear even relevant to the FFF design of example #2
  - Instead, it is a confirmation of use of reasonable design frost depths for conventional footings placed at frost depth.
  - More on this topic later as justification for more efficient design frost depths for conventional footings at frost depth (or placement of NFS material to frost depth).

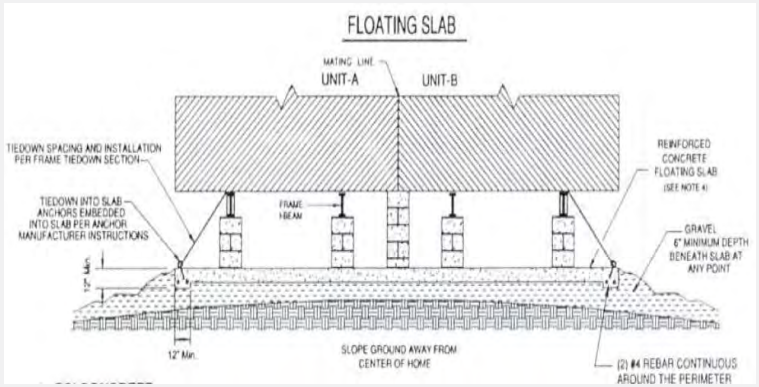
Example #2 (cont'd)

- The SBRA/Hayman (2010) report does mention that:
  - *"the possibility of ground water level overlapping the frost depth does need to be addressed…If the ground water depth is determined to be above the local frost depth, the Frost Free Foundation design cannot be used."*
- While recognizing the need to assess the water table depth, this overlooks the need to also provide non-frost-susceptible soil or compacted fill to the design frost depth.
- It also confuses roles and responsibilities by assigning the responsibility of doing site engineering/assessment work, including water table assessment, to "the local authority having jurisdiction".
- Also, merely making sure the water table depth is at frost depth is not sufficient where there are frost-susceptible soils because water below the frost depth is "wicked" to the frost front to support ice-lens growth which is the primary process of severe frost heave.

Example #2 (cont'd)

- Recommendations:
  - Meet technical requirements as better executed in FFF Example #1:
    - Determination of frost-susceptibility by testing site soils or fill materials to frost depth
    - Determination of water-table level to a level at least 2 feet below design frost depth
    - Specify under-drainage where below grade and surface water conditions warrant it
    - These are minimum requirements needed for conformity
  - Address proper assignment of roles and responsibilities (same concern as found in Example #1).

Example #3 FFF Design (floating slab)



Example #3 (cont'd)

- Certified by engineer and DAPIA-approved in one state, but is included in installation instructions used in another state.
- General NOTES on install instructions indicate use on sites with *"well drained soil with an average moisture content of less than 25% to frost depth"*.
- Is this an average over depth or over site? Vague. If a soil is saturated in one place, but dyer in the other the average may "pass" but the site will potentially experience the worst-case of differential heave or thaw weakening.
- More important, is MC to be measured by mass or volumetric?
  - 25% (vol. MC) may be near saturation
  - 25% (mass MC) is usually at saturation
- BOTH are very frost susceptible conditions (criteria is inadequate)

Example #4: FFF Design (Monolithic Slab)

- Similar to Example #3
- Similar problems to Examples #2 and #3 with confused, vague, or incomplete requirements.
- See report for details

Other Considerations

- Skirting
  - Frost protection must be considered to prevent potential jacking
  - Some designs have used insulation for this purpose, but not placed in conformance with ASCE 32-01 (e.g., see Fig. 3.38 and others in "Guide to Foundation and Support Systems for Manufactured Homes" prepared by SBRA for HUD).
  - Unvented crawlspace design must be used (or vents must be automatically closed in winter).
- Proprietary Foundation Systems
  - Generally rely on same means of frost protection as masonry piers
  - Findings and recommendations of this report are applicable.

Other Considerations (cont'd)

- Local/State Regulations
  - Example: New Hampshire, installation standards (Section 603.08)

    (b) Every pier shall be supported by a footing of the following type:

    (1) A pad which shall be a monolithic concrete slab…and complies with the following:

    a. Fill shall extend a minimum of 3 inches up the side of the slab;

    b. Top soil and all organic soils shall be removed under the slab area;

    c. A minimum of 12 to 14 inches of sand or gravel compacted; and

    d. Shall be at minimum as set forth in Figure 600-3; or

    (2) Below frost footing, which shall be designed by a New Hampshire licensed professional engineer.
  - (b)(1) = FFF and (b)(2) = conventional footing at frost depth
  - FFF can be built with no consideration of soil frost-susceptibility or drainage condition and requires no engineering
  - Oddly, use of a traditional conventional "below frost footing" requires the design of a licensed professional engineer
  - The state regulation is incomplete and totally misguided regarding when engineering should be required.
  - How are other states addressing this? Review of state regs is advisable.

Conclusions

- Except as found in Example #1, there is a consistent lack of enforceable or clearly actionable criteria related to important design factors affecting consistency, suitability and conformity of FFF designs.
- Commonly confused roles and responsibilities (e.g., regulators assigned design responsibilities, etc.).
- Installation details for FFF designs often lack criteria for assessing the frost-susceptibility of soils.
- Requirements for assessing site moisture conditions lacking or unenforceable; "well drained" needs clarity
- Other considerations (protection of skirting, applicability to proprietary systems, appropriate local/state regulations)

Practice Recommendations (Solutions)

- See full report by SEBA to HUD
- OPTION #1 – Conventional footings to frost depth
  - Always appropriate where FFF designs or FPSF design prove unsuitable
  - Provides a checklist and a very simple means to determine more risk-consistent (and often more economical) footing depths (see next slides)
- OPTION #2 – FFF Foundations
  - Provides checklist with guidance addressing all of the issues found in the assessment of current practice (conformity with HUD Code and ASCE 32-01)
  - Guidance for assessment of "frost susceptible" and "well drained"
- OPTION #3 – FPSF Foundations
  - Provides checklist for conformity with HUD Code and ASCE 32-01
  - Focuses on proper specification and placement of insulation to prevent frost heave.

Risk-consistent and more cost-effective design frost depths

- Generally defined by local jurisdictions, but there is a better way
- Can be used to determine depth of footings or non-frost susceptible fill
- STEP 1: Determine local Air-Freezing Index (AFI)
  - AFI is directly related to frost penetration into ground
  - See Map that follows
- STEP 2: Determine Design Frost Depth Based on AFI
  - See Table that follows
- STEP 3: Adjust Design Frost Depth
  - If footing located under building in enclosed foundation area, then design frost depth can be halved
  - See footnote to Table that follows

AFI Maps for U.S.

Design Frost Depths vs. AFI

TABLE 1. DESIGN FROST DEPTH FOR FOOTINGS[a]

AIR-FREEZING INDEX [See Figure 4]	MINIMUM DEPTH[b] (inches)
≤ 50	3
250	9
350	12
500	16
1000	24
1500	32
2000	40
2500	45
3000	52
3500	57
4000	62
4250	65

a. These design frost depths are intended to be used for protection of building foundations against frost heave and are not applicable to site or street utilities or other non-building applications.
b. These design frost depths for footings shall be permitted to be halved for footings interior to the building perimeter and located within an enclosed space. Where skirting is used to enclose the space, the skirting shall be insulated to a minimum R-5 (1000 to 2500 AFI) or R-10 (>2500 AFI) and vents shall be capable of automatically closing at outdoor temperatures below 40 deg F (which necessitates use of a ground vapor barrier).

MHCC MEETING
October 25-27, 2016

APPENDIX H:
Manufactured Home Foundations in Freezing Climates, An Assessment of Design Installation Practices for Manufactured Homes with Seasonally Frozen Ground

By SEBA Professional Services

SEBA Professional Services, LLC
Management Consultants and Financial Advisors

Manufactured Home Foundations in Freezing Climates

An Assessment of Design and Installation Practices For Manufactured Homes in Climates with Seasonally Frozen Ground

Prepared by: SEBA Professional Services, LLC

For

The U.S. Department of Housing and Urban Development,
Office of Manufactured Housing Programs
Under Contract #DUI00H-14 -C-04

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EXECUTIVE SUMMARY

The primary purpose of this report is to provide guidance on the installation of "frost-protected shallow foundations" (FPSF) and "frost-free foundations" (FFF) for new manufactured homes in frost-susceptible climates. There are important issues with current frost-protected foundation designs that must be considered and addressed when installing a new manufactured home within any state where soil is susceptible to frost heave. The detailed findings on reviewed designs are provided in the Engineering Assessment Report located in Appendix A.

The primary requirements for consideration in any frost-protected foundation, include:

- clarity of technical requirements,
- definite criteria for determining soil frost susceptibility and soil moisture sub-surface drainage conditions, and
- guidance on water table depth to determine if the site is suitably well drained.

Additionally, it is necessary to provide guidance on appropriate site-specific adjustments of details such as depth of non-frost-susceptible soil, fill layers and the layout of sub-surface drainage. Clarification and accuracy of roles during the site testing and installation process also plays an important part in ensuring that frost-protected foundation designs are acceptable. Most reviewed designs failed one or more of these requirements.

Per these requirements, each organization involved in the process of foundation design, approval, and installation has responsibilities that must be met. These responsibilities are described in more detail later in the report.

- For manufacturers, this includes ensuring designs comply fully with 24 Code of Federal Regulations (CFR) 3285, Model Manufactured Home Installation Standards (HUD Code) and applicable provisions of SEI/ASCE 32-01 (ASCE 32). Installation instructions that rely exclusively on surface drainage must be terminated or immediately revised and all instructions should inform installers that prior to beginning the installation, a site-specific soil test is required to determine soil frost susceptibility.

- Retailers must provide consumers with a copy of the consumer disclosure and verify that the installations are performed only by licensed installers. Additionally, retailers must notify HUD of any new manufactured home sales within or into a HUD-administered state.

- Design professionals and Design Approval Primary Inspection Agencies (DAPIAs) must comply with all aspects of the HUD Code as provided in 24 CFR 3285 as well as the ACSE 32 standard. Designs that rely on surface drainage exclusively or do not specify the means of assessing frost susceptibility of soils and their sub-surface drainage characteristics must be disapproved. Additionally, design and installation responsibilities may not be delegated to local regulatory authorities.

- Installers, if installing a new home on a site that has conditions not covered in the manufacturer's installation instructions or the engineered foundation plan, should bring the site conditions to the engineer of record or any licensed architect or engineer. Once the plan is updated to address site conditions and sealed, it should be sent to the manufacturer and its DAPIA for approval as well as the Local Authority Having Jurisdiction (LAHJ). Installers should not use any design that has them take on the responsibility of assessing frost susceptibility and sub-surface drainage conditions without proper soil analysis.

- Regulatory officials and inspectors should categorically reject installation plans that require them to take on any aspect of design responsibility. If a site is claimed to have soil that is not frost susceptible or soil that is well-drained, evidence must be provided. Installation plans should be available on-site during inspections. If these plans are not available, the home cannot pass inspection. In areas where no set local frost depth is determined, the depths corresponding with the Air Freezing Index (Figure 1) should be used. Installation rules in both states and local municipalities should be compared to the ASCE 32 standard and HUD Code to ensure conformity.

INTRODUCTION

Engineered Foundations Designs (EFD) including frost-protected shallow foundations (FPSF) and "frost-free foundation" (FFF) variant as implemented for some manufactured housing installations, have great appeal and potential in freezing climates as a cost-effective means of installing manufactured homes on seasonally-frozen ground. Understandably, their use has been promoted and increased in recent years as a means for reducing manufactured housing installation costs when compared to using conventional or proprietary foundation support systems in freezing climates. However, some key factors important to their long-term and consistent success require special considerations that are often neglected, particularly for FFF designs and installations. These factors include appropriately engineered installation details, site investigation practices, and verification procedures to ensure that important design conditions are actually being achieved in practice.

PURPOSE

Given the concern described above, this report was developed for the purpose of clarifying requirements and providing practical guidance for the manufactured housing industry when designing or setting foundations for a manufactured home in locations with freezing climates with seasonal ground freezing. This guidance is intended for first-time installations, not replacement installs when current foundations exist on site.

FINDINGS

In support of this report's purpose, a selection of representative FFF designs in current use were reviewed for consistency with the HUD code, the SEI/ASCE 32-01 (ASCE 32) standard titled *Design and*

Construction of Frost Protected Shallow Foundations, and generally accepted engineering practice. These reviews and additional technical information (including terminology and technical references) are included in an engineering assessment report located in Appendix A. Thus, Appendix A provides the technical basis for the guidance and recommendations included herein. FPSF designs were also reviewed, however, fewer issues were identified than were found with the FFF variants.

A summary of key findings from the engineering assessment in Appendix A is as follows:

- One reviewed FFF design demonstrated an appropriate application of the HUD code and ASCE 32 standard's technical requirements for frost protection of foundations. Thus, it is possible to develop a compliant FFF design.
- All other reviewed FFF designs contained a number of flaws or non-conformances, including:
    - A lack of clarity of technical requirements in manufacturer installation instructions, details, and notes
    - Missing or vague criteria for identification and measurement of soil frost susceptibility
    - Missing or vague guidance for determining soil moisture, sub-surface drainage conditions, and water table depth in relation to determining if the site is "well drained" and suitable for an FFF installation.
    - Missing guidance to direct appropriate site specific adjustments of important installation details (e.g., depth of non-frost-susceptible soil or fill layers and lay-out of sub-surface drainage when required).
- All of the FFF installation designs reviewed showed a pattern of confused roles and responsibilities, often assigning design decisions and site engineering evaluations to local regulatory officials who are typically neither qualified nor trained in foundation engineering or soil mechanics and engineering. Furthermore, they are not charged for such responsibilities because it may pose a conflict of interest (i.e., enforcers making design and construction decisions or judgments on matters they will be enforcing) and a potential conflict with state engineering practice laws (i.e., conducting engineering or design activities for which they are not licensed). Consequently, this practice can lead to an incorrect selection of the proper foundation and drainage system for the site.

Consequently, most of the reviewed FFF designs were found to be not in conformance with the HUD Code and the ASCE 32 reference standard for frost-protection of shallow foundations. In addition, one state's installation rules were reviewed and provisions related to FFF design and installations were found to be similarly non-compliant. Thus, a need exists to clarify requirements and provide guidance for proper and compliant applications of FFF designs as an alternative to a conventional (frost depth) footing or a conventional FPSF design using insulation to protect against ground freezing per the ASCE 32 standard.

RECOMMENDATIONS

Recommendations to resolve the problems with FFF designs all relate to technical and procedural conformance issues identified in the previous section. These issues necessarily involve designers, DAPIAs, manufacturers, installers, and regulatory authorities. The most important factor in reducing problems is a properly designed installation instruction giving appropriate direction and details for

installers to implement and regulatory officials to verify and inspect. Because this over-arching concern is applicable to all methods of installation related to foundation frost-protection, specific recommendations and guidance for various design and installation options are provided in the next section.

Recommendations for Manufacturers

Manufacturers should require that design professionals who submit plans to them for approval, as required by 24 CFR Part 3285.2 (c) (1) (ii), develop foundation frost-protection installation methods that comply with applicable provisions of the HUD Code and ASCE 32. To ensure consistent and effective conformance, options with detailed guidance for compliant designs are provided in the next section and should be followed. These directions should also be incorporated into their Manufacturer Installation Instruction manual as required by 24 CFR Part 3285.2 (c)(2).

- Current FFF installation instructions that rely exclusively on surface drainage as a means of foundation frost-protection should be terminated or immediately revised in accordance with the previous recommendation.

- Manufacturer installation instructions for FFF designs need to indicate that, prior to commencement of installation, a site-specific soil test is required in order to determine if the site soil is non-frost-susceptible and that the soil is “well-drained” with a water table depth consistently and sufficiently below the frost line. Specific requirements are presented in the installation practices section of this paper.

- Manufacturer installation instructions should indicate that a ground water assessment needs to be done prior to commencement of installation. If there appears to be a situation where the ground water is within 2 feet of the bottom of the foundation then an engineered design must be used.

- Manufacturer’s installation instructions need to identify what steps need to be taken to confirm that the site is non-frost-susceptible. If a soil test is not done to prove that the soil is non-frost susceptible, then the site must be assumed to be frost susceptible and must be developed accordingly, as such tests must be done prior to commencement of installation.

To facilitate installations in locations subject to freezing, manufacturer instructions should have at least one example of an acceptable foundation system for frost and non-frost susceptible soil conditions for use in freezing climate locations. These designs must have a design professional’s seal, and if not previously part of the manufacturer’s instructions, be approved by the manufacturer and its Design Approval Primary Inspection Agency (DAPIA). These plans can be a supplement to the manual and should also be available as an electronic PDF.

It is recommended that manufacturers make an updated copy of their manufactures installation instructions with the supplements available in electronic format as part of the sale process. This will

greatly decrease mistakes made in installing the foundations before the owners and installers have a copy of the manufactures instruction manual.

Retailers-and Park Owners

Retailers and park owners operating as retailers must provide buyers with a copy of the required consumer disclosure which indicates that new manufactured homes must be installed by licensed installers and must verify and employ only installers that have the proper licenses and training to install manufactured homes within the state of each home's installation.

It is also recommended that an electronic copy of the manufacturer's instruction manual and foundation details be available at the time of the sale to purchasers to evaluate any foundation options before the home is delivered and before installation begins.

In HUD Administered Installation States, retailers and park owners acting as retailers must notify HUD of the certification and location of each home installation (HUD 306 form) and each installation must be inspected by a qualified inspector (see 24 CFR § 3286.511(a)) and the acceptability of the inspection verified on a HUD approved inspection form (HUD 309 form).

Recommendations for Design Professionals and DAPIAs

Foundation frost-protection methods used for installation designs must comply with the HUD Code and the ASCE 32 standard. To ensure consistent and effective conformance, options with detailed guidance for development of compliant designs and for DAPIA review and approval are provided in the next section, Conformance Options for New Designs and Future Installation Practices.

FFF installation designs that rely exclusively on surface drainage as a means of foundation frost-protection are not acceptable. Any existing installation designs of this type should be removed for use and revised by the engineer of record and DAPIA approval withdrawn.

FFF installation designs that do not specify appropriate means of assessing the frost-susceptibility of soils and their sub-surface drainage characteristics on a site-specific basis need to be removed from use and DAPIA approval withdrawn.

FFF installation designs that assign design responsibilities to local regulatory authorities, such as assessing site drainage, water table depth, or soil frost-susceptibility are also not acceptable and need to be disapproved.

Recommendations for Installers

When installing a new home on a site that has conditions not covered in the manufacturer's instruction manual provided by the manufacturer, or the engineered foundation plan, the special site conditions should be brought to the attention of the engineer of record. If there is no engineer of record, a licensed engineer or licensed architect should be retained to evaluate the conditions and then design a plan to

install the home. Once this plan is finalized and sealed, it must be sent to the manufacturer and its DAPIA for approval per 24 CFR Part 3285.2(c)(1)(ii). The plan should also be submitted to the Local Authority Having Jurisdiction (LAHJ) for approval if applicable. Refer to the next section for guidance on compliant installation instructions and installation practices.

Manufactured homes must not be installed using FFF installation plans that rely exclusively on surface drainage as a means of frost protection.

Installers should never initiate a FFF installation where the instructions requires them to take on design responsibility of assessing soil frost-susceptibility and sub-surface drainage conditions without proper soil testing and analysis. Instead, installers should verify that appropriate soil testing and site assessment for use of a FFF design has been completed prior to initiating an installation. Refer to the next section for guidance.

Prior to installation of an engineered system that is not included in the manufacturer's installation instructions, installers need to verify that the installation plan is stamped by an engineer of record as well as approved by the manufacturer and its DAPIA. A LAHJ may require that the plans be reviewed and sealed by an engineer or architect that is licensed in the state where the installation is occurring.

Recommendations for Local Regulatory Officials and Inspectors

Regulatory officials and inspectors should reject installation plans that require them to execute a design responsibility such as assessing the subsurface drainage, water table depth, or frost-susceptibility of soils on a given site. Freezing-climate installation plans that rely exclusively on surface drainage as a means of frost protection should not be approved by local regulatory officials.

Where a site is claimed to have non-frost-susceptible soils or soils that are "well-drained" as a basis for setting foundation pads or footings above the design frost depth, evidence should be required including soils tests and site sub-surface drainage and groundwater investigation by a qualified laboratory or professional. Single site soil samples can be taken by a HUD Licensed Manufactured Home Installer in HUD administered states with the soil tests done by an accredited lab.

Regulatory officials should assure that the approved installation plans and the manufacturer installation instructions are on site and available during inspections. If approved installation plans are not available and on site during inspections, the home cannot pass inspection.

Local regulatory officials should consider permitting design frost depths to be determined in accordance with Option #1 in the next section. In areas where no set local frost depth is determined, the frost depths from the Air Freezing index (see Figure 1 and Table 1) should be used.

State and local installation rules should be reviewed and corrected as necessary to ensure conformity with the ASCE 32 standard and the HUD code 24 CFR, Part 3285.312(b).

OPTIONS FOR NEW DESIGNS AND FUTURE INSTALLATION PRACTICES

OPTION #1: Checklist for Conventional Footings in Freezing Climates
HUD Code, 24 CFR Part 3285.312(b)(1)

- Obtain the local-design frost depth for footings from one of the following:
  - The local authority having jurisdiction (LAHJ),
  - Use Table 1 with the site's Air-Freezing Index (AFI) from Figure 1[1], or
  - Consult with a registered professional engineer, registered architect, or registered geologist.

- When using Table 1 and Figure 1 to determine frost depth for footings, the depth of interior pier footings complying with footnote (b) of Table 1 may be taken as one-half the depth required in Table 1 with approval of the LAHJ.

- Based on the required frost depth for footings, dig the footing to the frost depth.

- Check the soil bearing at depth of the footing with a torque probe, pocket penetrometer or other suitable testing device.

- Based on the tested soil bearing value, properly size the footing according to the manufacturer's installation instructions or use Table to 24 CFR Part 3285.312 in the HUD Code.

- Place footing pads and construct piers or supports at locations specified in accordance with the manufacturer's installation instructions.

- Backfill as needed and grade the site as required for drainage:
  - Crown the finish grade at the centerline of the foundation
  - Slope grade a minimum of ½-inch per foot for a minimum distance of 10 feet away from the home perimeter.

[1] A list of AFI values for various states and counties can be found in the 2015 International Residential Code (IRC), Table R403.3(2), published by the International Code Council, Inc., and used as the model building code for most states.

TABLE 1. DESIGN FROST DEPTH FOR FOOTINGS[a]

AIR-FREEZING INDEX [See Figure 4]	MINIMUM DEPTH[b] (inches)
≤ 50	3
250	9
350	12
500	16
1000	24
1500	32
2000	40
2500	45
3000	52
3500	57
4000	62
4250	65

a. These design frost depths are intended to be used for protection of building foundations against frost heave and are not applicable to site or street utilities or other non-building applications.

b. These design frost depths for footings shall be permitted to be halved for footings interior to the building perimeter and located within an enclosed space. Where skirting is used to enclose the space, the skirting shall be insulated to a minimum R-5 (1000 to 2500 AFI) or R-10 (>2500 AFI) and vents shall be capable of automatically closing at outdoor temperatures below 40 deg F (which necessitates use of a ground vapor barrier).

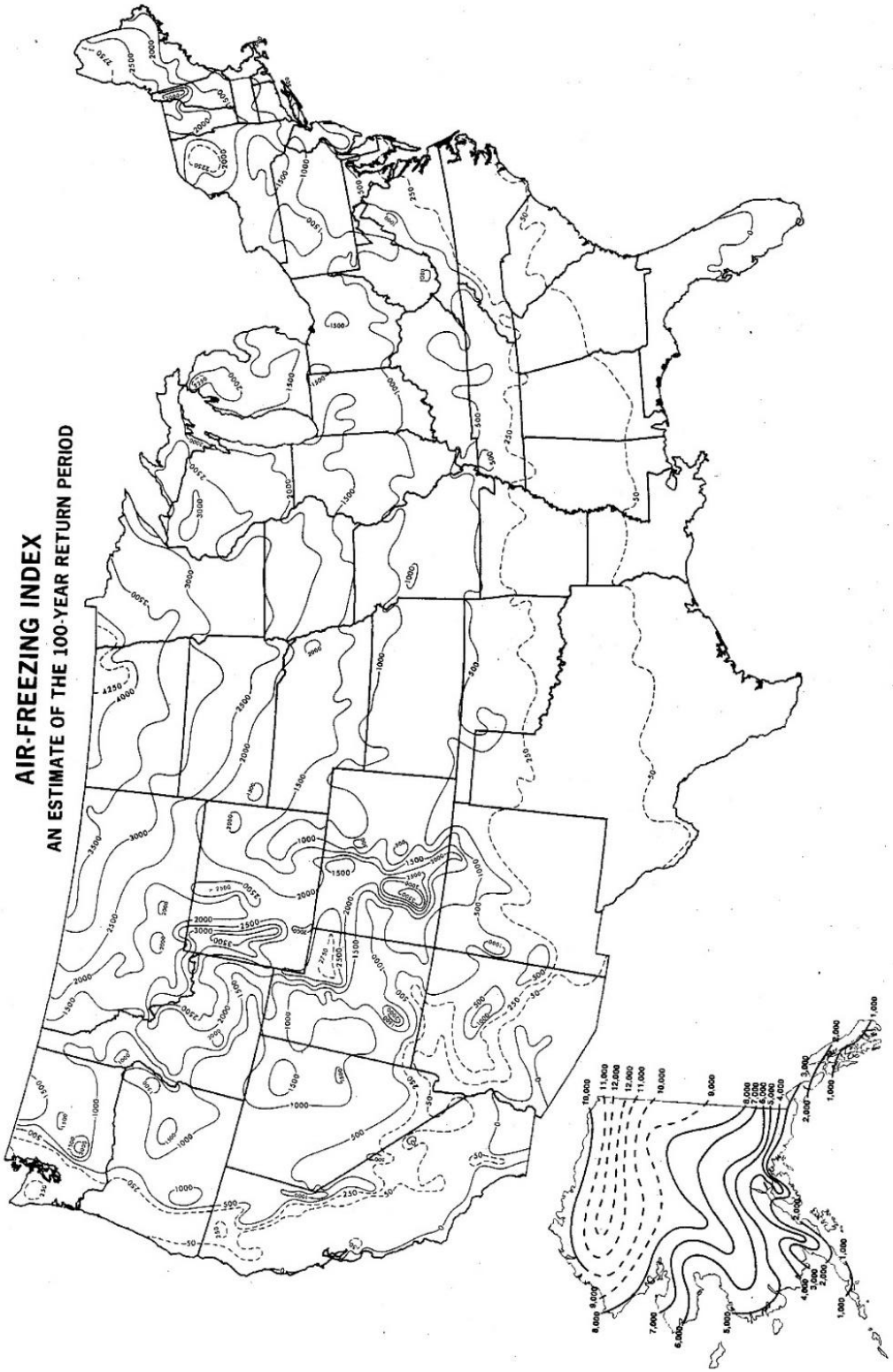

Figure 1. U.S. Air Freezing Index Map (based on Steurer, 1989 and Steurer and Crandell, 1995)

OPTION #2: Checklist for Monolithic Slab Systems in Freezing Climates ("Frost Free Footing")
HUD Code, 24CFR Part 3285.312(b)(2)

Pre-Installation Preparations:

- Before initiating installation, verify that the installation instructions are designed (sealed) by a registered professional engineer or registered architect, approved by the manufacturer and its DAPIA. The LAHJ can require that the plans also be reviewed and sealed by an engineer or architect in the state where the installation is to occur.

- Verify that the LAHJ has accepted and approved the foundation and installation plan and all applicable permits are obtained. An approved installation design needs to comply with one of the following conformance options for the proposed installation design as permitted in the HUD Code:

    - Complies with SEI/ASCE 32 standard by use of non-frost-susceptible fills or existing soils (adequately tested and verified as such as defined in SEI/ASCE 32) and that such fills or soils extend to the local frost depth with provision for adequate surface drainage and, in addition, subgrade drainage where underlying soils are poorly drained and/or the water table is within two feet of the design frost depth.

    - Complies with accepted engineering practice to prevent the effects of frost heave in a manner equivalent to the SEI/ASCE 32 standard. Equivalent alternative accepted engineering practices include: (1) the specification of an alternative criteria for testing the frost susceptibility of soils (e.g., different fines content allowances based on substantiating data), and (2) different frost depth determination based on thermal modeling of the climatic, soil, and foundation conditions.

    NOTE: Reliance solely on surface drainage to prevent frost heave without verification of non-frost-susceptible fill materials or existing non-frost susceptible soils to frost depth does not comply with the SEI/ASCE 32 standard or HUD Code's allowance for "acceptable engineering practice to prevent the effects of frost heave."

- For designs that rely on well-drained sites and use of existing soils to frost depth that are non-frost susceptible, verify the following before initiating installation:

    - The non-frost-susceptible condition of existing soils above the frost depth (and below the base of the proposed slab) have been tested in accordance with ASTM D442 and determined to have a fines mass content of less than 6% passing a #200 sieve for the specific installation site or the development as a whole. A soils report should be provided by the engineer or soil lab of record for verification.

- Alternatively, conduct or contract such testing as follows:
    - Obtain a minimum of two soil samples per installation site (one at each end of the foundation area) and from any borrow materials on site used as fill. A materials report from a quarry may be used when material is supplied from a licensed quarry.
    - When conducting borings for soil samples, take a minimum of one pint (plastic bag full) of soil from depths of one foot and at the locally prescribed frost depth or as determined from Table 1, Design Frost Depth for Footings. Continue each boring to two feet below the locally-prescribed frost depth (as measured from the proposed finish grade) to determine if the water table is present.
    - Deliver or send the soil samples to a soils lab for particle size testing per ASTM D442.
    - If the soils lab report indicates greater than 6% fines by mass passing a #200 sieve then the soil at the site is frost susceptible and either footing to frost depth or one of the alternative foundation options (see Appendix C) for frost susceptible soil conditions must be used.
- The water table condition of the site has been assessed by the engineer of record and documentation provided of the water table being at least two feet below the local frost depth. Alternatively, make this determination using soil borings as described above.
- If the water table is higher than two feet below the local frost depth, a network of drainage pipes sloped to drain to daylight must be placed at the base of non-frost-susceptible fill (e.g., clean gravel or crush rock) placed to a depth equal to the local frost depth.
- Alternatively, a site specific foundation design can be prepared and sealed by a professional engineer or registered architect and approved the manufacturer and it's DAPIA.
- Save documentation of all of the above and provide to the LAHJ for verification.

- For designs that rely on well-drained sites and use of fill materials to frost depth that are non-frost susceptible, verify the following before initiating installation:
    - The slab base and foundation fill materials are specified by the engineer of record as non-frost susceptible such as clean gravel or crushed rock or other suitable material with no more than 6% fines by mass passing a #200 sieve per ASTM D442 test method. Order subgrade materials accordingly and in an amount required to fill from the frost depth to the slab base for the entire extent of the slab plus any over dig.

- The water table condition of the site has been assessed by the engineer of record and documentation provided of the water table being at least two feet below the local frost depth. Alternatively, make this determination using soil borings as described above.

    - If the water table is higher than two feet below the local frost depth, a network of drainage pipe sloped to drain to daylight must be placed at the base of non-frost-susceptible fill (e.g., clean gravel or crush rock) placed to a depth equal to the local frost depth.

- Save documentation of all of the above and provide to the LAHJ for verification.

Installation Phase:

- Excavate slab area to frost depth or only to the bottom of the slab's non-frost-susceptible base layer if existing soils have been determined to be non-frost susceptible down to frost depth during the pre-installation preparation phase (see above).

- Place foundation drains sloped to drain to daylight at the bottom of the non-frost-susceptible base or fill material layer.

- Place the non-frost-susceptible fill and base materials, compacting as required by the manufacturer's installation instructions and the engineer of record. Do not initiate fill placement where compaction requirements and methods are not specified. Obtain compaction requirements, as needed, from the engineer of record. The minimum requirement is 90% compaction per 24 CFR Part 3285.201 although an engineer or LAHJ may require a higher number based on the fill material used.

- Construct the reinforced monolithic slab in accordance with the manufacturer's installation instructions or according to the manufacturer and DAPIA approved plans.

- Backfill as needed and grade the site as required for drainage:
    - Slope grade a minimum of ½-inch per foot for a minimum distance of 10 feet away from the home perimeter.

NOTE: The above procedures also apply to designs where a monolithic slab is not used and pier footing pads are placed directly on non-frost-susceptible fill materials (e.g., clean gravel or crushed rock).

OPTION #3: Checklist for Insulated Foundations (Frost-Protected Shallow Foundation)
HUD Code, 24 CFR Part 3285.312(b)(3)

Pre-Installation Preparations:

- Before initiating installation, verify that the installation instructions are designed (sealed) by a registered professional engineer or registered architect, approved by the manufacturer and its DAPIA. A LAHJ may also require the plans to be reviewed and sealed by a licensed engineer or architect in the state where the installation is to occur.

- Also, verify that the plans have approved the installation design as complying with one of the following basis for the proposed installation design as permitted in the HUD Code:

    - Complies with SEI/ASCE 32 standard by use of properly-specified insulation materials and sized in accordance with the local climate and located around the perimeter of the foundation (including insulated skirting with vents capable of closing at temperatures below 40 degrees) or the entire foundation pad is

insulated where there is no skirting or the skirting is un-insulated or the skirting has non-closing vents. Non-frost-susceptible base materials are used at a minimum thickness required by SEI/ASCE 32, and insulation materials are protected against damage in accordance with SEI/ASCE 32.

- Complies with accepted engineering practice to prevent the effects of frost heave in a manner equivalent to the insulation provisions in the SEI/ASCE 32 standard. Equivalent alternative accepted engineering practices include: (1) the specification of an alternative insulation amounts based on dynamic thermal modeling of the climatic, soil, and foundation conditions specific to the site, and (2) alternative insulation materials or types with data substantiating long-term R-values in below-grade applications.

- NOTE: Designs which place insulation materials in a discontinuous fashion, such that exposed slab edges or other types of thermal bridging occurs, do not meet the requirements of the SEI/ASCE 32 standard or the HUD Code provisions that allow the use of "acceptable engineering practice to prevent the effects of frost heave."

- Order foundation insulation materials as specified in the installation instruction and verify the correct type is received. Commonly accepted insulation materials include Extruded Polystyrene (XPS) and Expanded Polystyrene (EPS) of various "types" in accordance with ASTM C578.

- Insulation material conformance with the specified type should be verified by product labels or a certification from the insulation manufacturer. Materials commonly stocked in supply stores may not be the correct "type" even though it may be the correct "kind" (e.g., XPS or EPS).

  NOTE: There is no need to determine the frost susceptibility of underlying soils to frost depth in the insulated foundation design approach when the provisions of SEI/ASCE 32 are satisfied.

<u>Installation Phase:</u>

- Excavate the foundation area to the correct shallow foundation depth as indicated in the manufacturer's installation instructions or by the engineer of record (generally the foundation depth need not exceed 12" to 16" below finish grade).

- Place specified non-frost-susceptible base material and provide drainage pipes around the perimeter, at a minimum of 4 inches (within the base material layer) as required by the installation instructions. Pipes need to be day-lighted or have a mechanical means of draining the water (see detail in Appendix C).

- Sequence the foundation slab or pad construction and insulation placement in accordance with the design approach indicated on the manufacturer's installation instructions. Where sub-slab insulation is required this will need to be placed before slab construction. Perimeter insulation may be placed after slab construction (see detail in Appendix C).

- After construction of the slab and supports and placement of the home, construct the insulated skirting with automatically closing vents as required by the manufacturer's installation instructions. Where the foundation slab is entirely insulated with horizontal below ground insulation (the design does not rely on perimeter insulation only), no skirting is required. (See detail in Appendix C).

- Place wing insulation (extending outward horizontally underground from the perimeter of the foundation) as required by the installation instructions. Depending on the design approach and climate severity, wing insulation may or may not be required.

- Provide protection of any exposed exterior insulation or within 10 inches of the finish grade surface. (see detail in Appendix C)

- Backfill as needed and grade the site as required for drainage:
    - Slope grade a minimum of ½-inch per foot for a minimum distance of 10 feet away from the home perimeter.

CONCLUSION

A detailed review of several systems outlined in the report below indicate that many FFF designs and practices are not conforming to the requirements outlined in 24 CFR part 3285.312 and SEI/ASCE 32.01. This non-conformance is largely due to lack of consistency in design approaches, insufficient or nonexistent instructions in Manufacturers Installation Instructions related to FFF designs, the lack of understanding of best practices for installation site analysis and foundation installation, and an overreliance on localities that often do not possess officials with specialized knowledge of FFF designs and requirements. These shortcomings can be improved by establishing consistent, well-documented best practices and supplemental guidelines for the use of FFF designs.

APPENDIX A – ENGINEERING ASSESSMENT REPORT

Foundation Design for Manufactured Homes in Freezing Climates

An Assessment of Design and Installation Practices For Manufactured Homes in Climates with Seasonally Frozen Ground

FINAL REPORT

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INTRODUCTION

Foundation systems that do not require standard footings to below the frost line have great appeal and potential in colder climates as a cost-effective means of installing manufactured homes on seasonally-frozen ground. Understandably, their use has been promoted and increased in recent years as a means for manufactured housing installation using conventional or proprietary foundation support systems in colder-climates. However, key factors important to their long-term success require special consideration. These factors include appropriately engineered installation details, site investigation practices, and verification procedures to ensure that important design conditions are actually being achieved in practice.

For the purpose of this report, frost-free foundations (FFF) are distinguished in practice from a frost-protected shallow foundation (FPSF) even though both methods are based on the same design and construction standard, ASCE 32-01, *Design and Construction of Frost-Protected Shallow Foundations* (ASCE 32). The FFF relies exclusively on the presence of non-frost-susceptible subgrade materials (soil or fill) on a well-drained site. The FPSF relies exclusively on the use of foundation and below-ground insulation to protect the soil under the foundation (assumed frost-susceptible) from freezing, although a nominal amount of drainage is still required as a matter of good practice to provide a suitable environment for acceptable below-grade insulation materials and to also satisfy building code or HUD code requirements for foundation and site surface drainage.

Theoretically, frost protection can be achieved by removing any one of the three conditions required to support the occurrence of frost heave: (1) moist ground or a moisture source at depth below ground, (2) freezing temperatures within the ground, and (3) presence of fine-grained, frost-susceptible soils or fill materials. However, this should not be taken to imply that by simply removing any one of these factors an equally reliable design is achieved or that there are not important differences in execution to ensure an equivalent and consistent performance outcome. In short, differences in the proper execution of the different methods of frost protection affect the level of reliability achieved in practice.

For example, using the FPSF method, attention must be paid to proper specification and installation of foundation insulation in accordance with ASCE 32-01. Similarly, using the FFF method, care must be

taken to properly specify and confirm the non-frost-susceptibility of foundation sub-grade soils or fill materials. In both cases, but for different purposes and reasons or consequences, adequate drainage is required. In particular, the ASCE 32 standard requires in Section 4.2 that FFF designs, which rely primarily on subgrade non-frost-susceptibility rather than protection against freezing temperatures, must address the following criteria:

(1) "placed on a layer of well-drained undisturbed ground or fill material",
(2) the ground or fill material "is not susceptible to frost", and
(3) the non-frost-susceptible ground or fill layer must extend to the "design frost depth".

The proper execution of the above criteria require a proper understanding of:

1) The meaning of "well-drained" and how to confirm and provide this characteristic
2) The meaning of "not susceptible to frost" and how to confirm the presence of or provide this characteristic in relation to site soils or fill materials
3) The meaning of "design frost depth" and, again, how to confirm or characterize it for a given site.

The above items define important design considerations in ASCE 32 and also establish a standard of care that other alternative methods must meet with at least an equivalent level of performance and reliability. These same design concepts and principles apply to FFF designs as currently used in the manufactured housing industry. Thus, this report has involved the review of a number of contemporary FFF designs and installation practices. Consequently, a number of inconsistencies and problems have been identified in the execution of the above concepts for conformance with the HUD Code and, specifically, its reference to the ASCE 32-01 standard. To assist in resolving these problems, this report examines the meaning and intentions of the above terms and criteria. Finally, recommendations are made where considered necessary and meaningful to ensure the proper and cost-effective execution of FFF designs for installation of manufactured housing units in cold climates with seasonal ground freezing.

IMPORTANT TERMS AND THEIR MEANING

Well-drained

The term "well-drained" in reference to FFF designs is not defined in the ASCE 32-01 standard. Therefore, its application in regard to frost-heave mitigation or prevention must rely on accepted engineering practice. Well-drained encompasses both surface drainage and sub-surface moisture conditions of a soil which are affected by site topography and also local climate among other factors such as sub-surface water flows. Merely, assessing site surface drainage without assessing ground water conditions at depth or vice-versa is inadequate. In addition, assessing these conditions at a point in time (without considering climate factors and soil moisture conditions that vary seasonally and over longer periods of time) also can lead to an inadequate or incomplete assessment. The term "well-drained" must also align with the intended application. For example, a common agricultural definition of a "well-drained soil" is as follows (http://agebb.missouri.edu/agforest/archives/v10n2/gh14.htm):

> "Well-drained soil is that which allows water to percolate through it reasonably quickly and not pool…
>
> Deep, loamy soil and sloping sites tend to be well drained. Soil high in clay content, depressions, or sites with high water tables, underlying rock or 'hard pans' (a layer of soil impervious to water) tend to not be well drained. A test that is often recommended is to dig a hole 12 by 12 inches square and about 12 to 18 inches deep. Fill it with water and let it drain. Then do it again, but this time clock how long it takes to drain. In well-drained soil the water level will go down at a rate of about 1 inch an hour. A faster rate, such as in sandy soil, may signal potentially dry site conditions; a slower rate is a caution that you either need to provide drainage …"

However, the above definition is inadequate and incomplete for an engineering application related to protection of building foundations from frost heave risk. For example, should the soil infiltration rate be measured at the design frost depth? Can an installer reliably conduct a soil boring to identify the water table (or absence thereof) when the water table may vary seasonally or annually? At what infiltration rate should use of subsoil drainage be triggered to prevent accumulation of water in non-frost-susceptible soil or fill layers placed above the frost line. Clearly, more information is needed to properly differentiate between "well-drained conditions" and those that are not so "well-drained" from the perspective of mitigating risk of frost heave or thaw-weakening of soils supporting building foundations. Furthermore, the "well-drained" criteria may need to be more stringent for conditions where existing soils are marginally frost susceptible (or worse) as oppose to conditions where a clearly non-frost-susceptible fill material is used to frost depth (e.g., less than 6% by mass passing a #200 sieve as determined by site samples or certification from the quarry/supplier). The vulnerability of a building foundation to and consequences of foundation differential movement due to a given level of frost-heave or thaw weakening hazard should also be considered, although common practice is aimed at minimizing the hazard to avoid uncertain long-term damage and serviceability problems.

Where soils are potentially frost-susceptible (and must be used for bearing within the frost depth or "active freezing zone" layer of the soil because there are no alternatives such as use of a deeper foundation or non-frost-susceptible fill material), the following description represents an accepted engineering practice for creating a "well-drained" condition intended to protect against excessive frost heave (e.g., control it, but not necessarily eliminate it):

> "…it is imperative to provide the best drainage possible. In more moderate regions where frost does not penetrate as deeply, this may include the careful installation of underdrains to allow water…to escape. Barriers to restrict capillary moisture flow…from below [the frost depth] may also be considered. These may be layers of course grained material or geotextile layers. The purpose is to break the capillary action of fine grained soil…so that moisture [below the frost depth] cannot "wick" to the freezing front…." (McFadden and Bennett, 1991, pp.340-342).

For natural soils, the above practice requires a means of establishing the absence of a water table in close proximity to the design frost depth and that the soil materials within the frost depth are adequately drained, using sub-drainage or ensuring the ability for infiltration below the frost depth. The accepted foundation engineering practice for protection against frost-heave does not merely rely on surface drainage when structures are supported on the "active freezing zone" of a frost-susceptible soil or fill.

Non-Frost-Susceptible

In reference to soil or fill materials, the phrase "not susceptible to frost" or "non-frost-susceptible" is usually taken to mean the soil is granular (e.g., coarse grained) and lacks a sufficient amount of fines (e.g., very fine sand, silt, and clay) to support development of ice lenses in the soil which results in varying degrees of frost heave or thaw-weakening potential depending on a number of factors. Very clayey soils, however, can suppress frost heave potential due to the inability of tightly held soil moisture to migrate by capillary action to the freezing front in the soil to form ice lenses. But, these soils are still considered frost susceptible from the standpoint of thaw-weakening effects.

While varying degrees of sophistication are available to assess the frost-susceptibility of soil (Chamberlain, 1981), methods commonly used rely on an assessment of the grain size distribution of the soil. The most simple of these methods provides a limit on the percentage of a soil mass below a certain particle size, although the percentage may vary from 3% to more than 10% (Chamberlain, 1981). In the ASCE 32 standard (Section 4.2), a non-frost-susceptible soil is defined as follows:

> "Undisturbed granular soils or fill material with less than 6% of mass passing a #200 (0.074 mm) mesh sieve in accordance with ASTM D442."

Other approved materials also are permitted, but with the understanding that the approval is based on geotechnical evidence and analysis as is generally required for alternative means and methods of design and construction. For example, foundation applications that are more sensitive to differential soil movement (due to heave or thaw-weakening) may require a more stringent criteria whereas those that are less sensitive may justify use of a less stringent criteria. But, in both cases, a criteria is applied based on engineering analysis and evidence. The above "6% by mass" criteria is considered appropriate for general foundation applications and is the referenced basis for judging frost-susceptibility of soils in the HUD Code for manufactured housing foundations.

Finally, the ASCE 32 standard requires that "Classification of frost susceptibility of soil shall be determined by a soils or geotechnical engineer, unless otherwise approved." Again, it is clear that, while alternatives are permitted, there is a requirement for evidence that a given soil or fill material on a given site is not susceptible to frost. For example, a contractor or technician may sample materials, have them assessed by a soils lab per ASTM D442 as required by ASCE 32. The soils lab report serves as a basis for approval (i.e., evidence consistent with the requirements and intent of ASCE 32 when an FFF design is pursued). Also, a qualified geotechnical engineer may determine that use of a different method to assess soil frost susceptibility is more favorable (and at least equivalent), again based on evidence.

Design Frost Depth

The term "design frost depth" refers to a depth into ground that frost is expected to reach under a given severity of winter freezing conditions and other factors (such as soil type and ground cover or lack thereof). Generally, design frost depths have been established in an ad-hoc fashion from locality to locality. Consequently, requirements may vary based on different perspectives or experiences that are not always consistent with the physics of frost penetration into ground. For example, some localities in warmer climates may require greater frost depths than those in colder climates. In general, there is no

consistent consideration of the soil type or ground cover. But, experience represented in local building codes is the common source relied upon in the building industry for locally-prescribed frost depths.

To address variation in local design frost depth requirements (where they are available) and provide a more uniform and risk-consistent basis for design frost depth determinations, an alternative procedure for determining the local design frost depth is provided later in the recommendations section of this report. The approach has been prepared as a proposal for future consideration by the ASCE 32 committee. It is based on research and modeling conducted by the NOAA Northeast Climate Data Center (Cornell University) for the U.S. Department of Housing and Urban Development (HUD, 2001). The following chart (Figure 1) provides the basis of the procedure and demonstrates its relationship to variations in locally prescribed (presumptive) frost depths and modeled frost depths. The design frost depths determined by the modeled approach (noted in Figure 1 as "2yr Bare x Safety Factor 2") are calibrated to agree with local design frost depths used in more severe climates where experience with frost damage and freezing conditions are more consequential and experience may be considered more robust. It is notable that in warmer climate zones there is a clear tendency for locally-defined frost depths to overstate actual design frost depths which signals a lack of risk-consistency in locally-defined frost depths. Thus, use of risk-consistent frost depths will tend to economize foundation construction in moderately cold climates with seasonal ground freezing.

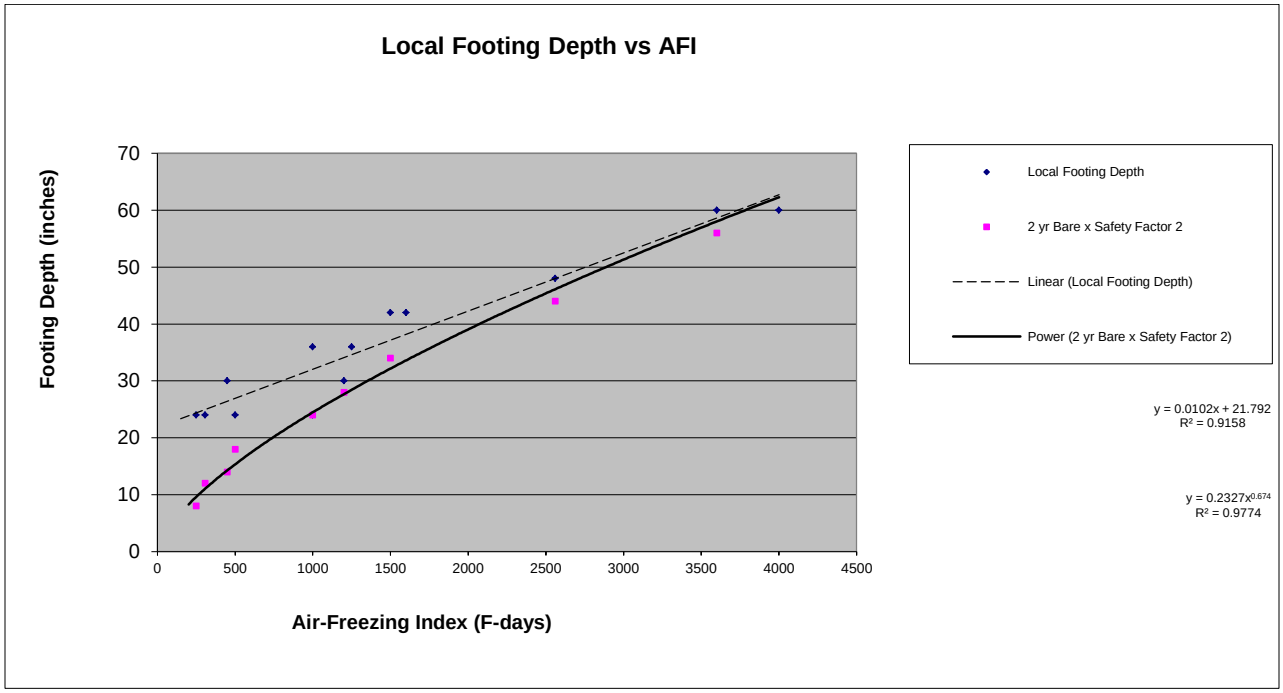

Figure 1. Comparison of Modeled and Locally-Defined Frost Depths for Building Foundations

REVIEW OF EXISTING FFF DESIGNS & DATA

As mentioned, several FFF designs currently used in several US states were provided for review and assessment. From those designs, four representative examples were selected for assessment in this report.

Example #1: FFF Design A (crushed stone pad on subgrade)

Figure 2 illustrates this FFF design as implemented by a DAPIA-approved engineered detail included in the manufacturer's installation manual.

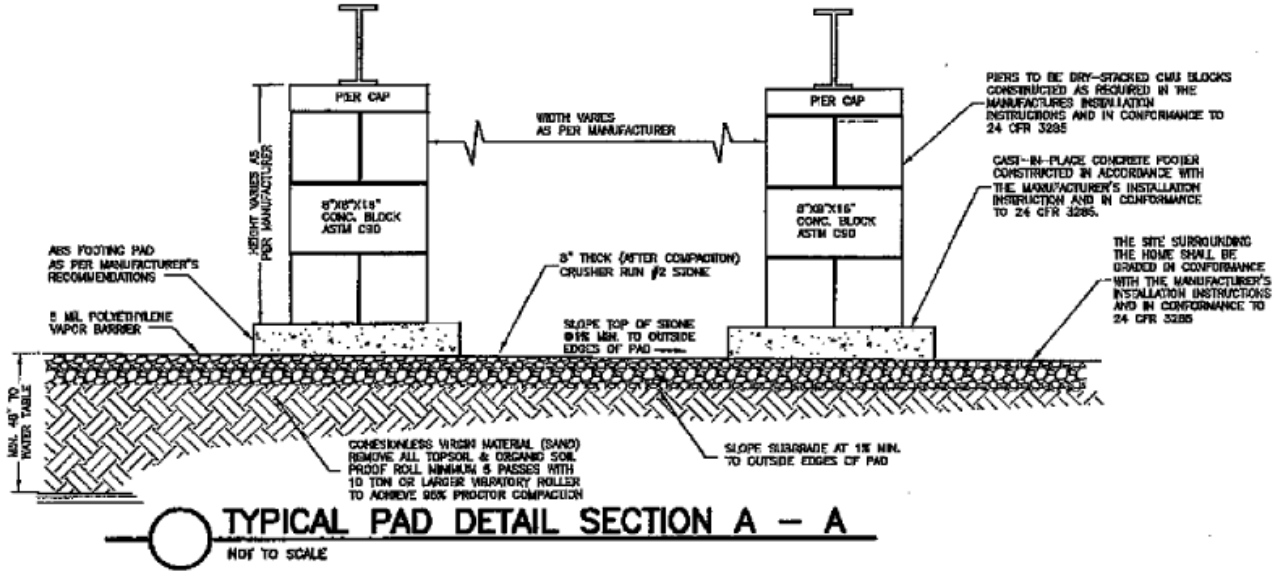

Figure 2. Installation detail for Example#1 (FFF using crushed stone pad on subgrade)

This design represents a reasonable application of the FFF technical requirements in accordance with Section 4.2 of the ASCE 32 standard. For example, it appropriately defines non-frost-susceptible material and requires it to be well-drained and to extend below the required frost depth. However, it places the burden on the local authorities for determining frost-susceptibility for each site application of the design, while at the same time requiring engineering verification (see "DESIGN NOTES" below). The reverse process is more appropriate (i.e., the engineer determines and the authority verifies). This may cause some unintended confusion as to roles and responsibilities which may be entirely missed by installers and those responsible for enforcement. Local authorities have an inspection and verification role, not a construction management or design decision-making role. To do otherwise creates a conflict of interest due to a lack of appropriate separation of roles and responsibilities.

Thus, it may be unlikely that the design is being implemented and enforced consistently in conformance with the technical requirements otherwise reasonably indicated on the installation documents (unless the engineer of record is actually contracted to visit each site or development to conduct the required determinations). Further, the requirement for testing is found in notes within the manufacturer

installation instructions as being at the discretion of the local code official, when the ASCE 32 standard clearly requires testing or an equivalent means of determination. Such judgments should originate with and be the responsibility of the design professional not a local authority or installers. The notes also do not specify a means of determining water table depth. It also does not specify any action other than notifying the engineer before continuing work when groundwater is encountered (thus implying that a ground water assessment is the responsibility of the installer, not the engineer of record and that construction can proceed after the engineer is simply notified). But, this too conflicts with other notes regarding roles and responsibilities.

To exemplify these concerns (i.e., confused or conflicted roles and responsibilities as noted above), the following notes are excerpted verbatim from the reviewed installation plan:

> "DESIGN NOTES:
> The gravel slab foundation design applies only to sites that contain all of the following soil conditions:
> 1. Well drained granular soils that are not susceptible to frost heave.
> 2. No groundwater to a depth of at least 4 feet below the bottom of the proposed slab.
> 3. Soils with a safe bearing capacity of 2,000 psf or greater.
> 4. Soil conditions at each lot shall be verified by design engineer prior to construction.
>
> …
> The slab design does not incorporate insulation around and/or under the proposed slab. The foundation shall be enclosed with skirting in accordance with manufacturer's installation instructions and in conformance to 24 CFR 3285.
> …
> Foundation shall be placed on non-frost susceptible layers of well-drained, undisturbed ground or fill materials that extend below the required frost depth. The non-frost susceptible material shall be approved by the local authority having jurisdiction. When required by the local authority having jurisdiction, the material shall be tested in accordance with ASTM D422 and found to have less than 6% of mass passing #200 mesh sieve to be considered non-frost susceptible. Soil conditions shall be verified by a soils or geotechnical engineer to verify the soil conditions are not susceptible to frost heave.
> …
> During construction if soil conditions other than well drained soils or groundwater is encountered at a depth of less than 4 feet, the contractor shall notify the design engineer prior to continuing construction. "

This FFF design also includes a detail (Figure 2) which requires the subgrade to be cohesion less (sand) extending to a minimum depth of 48 inches and compacted with a 10 ton or larger vibratory roller. The water table is required to be at least 48 inches below finish grade together with surface grading required to meet the HUD code. Thus, the detail seems reasonably consistent with the technical intent of the design notes, despite confusion regarding important installation process considerations related to roles and responsibilities as mentioned above. However, the indicated "cohesion less (sand)" subgrade material could be moderately frost susceptible if it is a very fine sand (e.g., approaching silt-size particles). Thus, the Design Notes and plan detail should be clarified that the "6% of mass passing #200 sieve" also applies to the vaguely described cohesion-less sand material in the installation detail.

It should be noted that the 8"thick crusher run #2 stone course above the non-frost-susceptible layer may include more than 6% fines and according to ASCE 32 could be considered to be frost-susceptible. However, for materials with large aggregate, the amount of fines can be increased somewhat and still

provide adequate protection against frost action. Furthermore, the 8" layer is located above what is intended to be a well-drained, non-frost-susceptible subgrade. In such a case, this sub-drainage will keep the 8" layer reasonably dry, particularly where located below the manufactured housing unit and protected from rainfall and runoff. Thus, the critical component of this design is assuring that the subgrade is indeed non-frost-susceptible and well-drained as called out on the plans consistent with the ASCE 32 standard.

Example #2: FFF Design B (directly on soil)

This FFF design appears to be based in large part on a report for the Systems Building Research Alliance (SBRA/Hayman, 2010). A typical installation detail is shown in Figure 3.

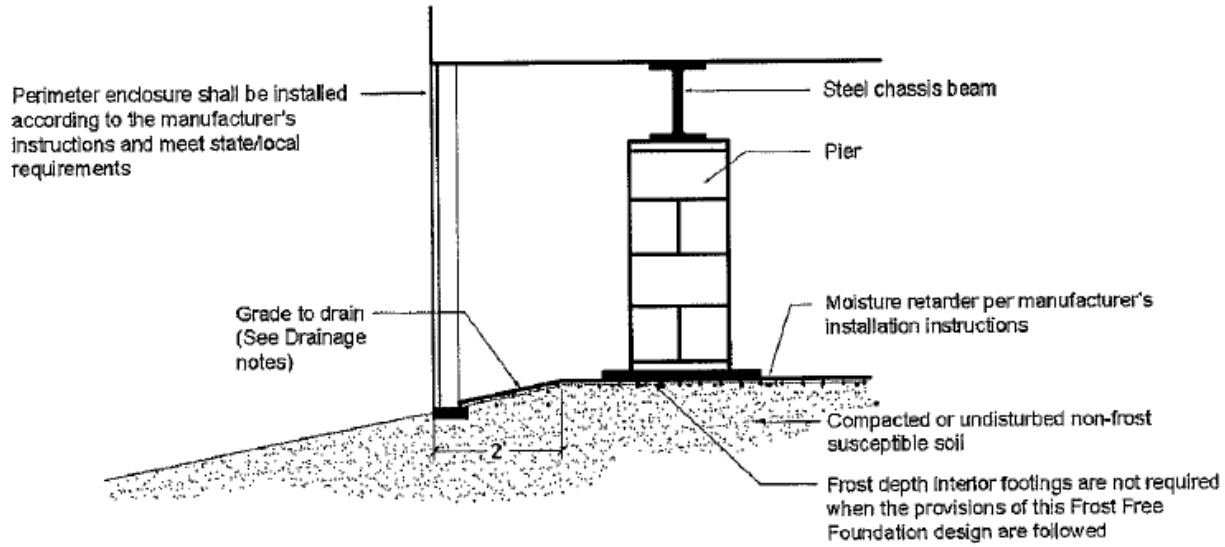

Figure 3. FFF installation detail for Example #2 (FFF with piers directly on soil) based on SBRA/Hayman (2010) report.

This design has a distinct difference from Example #1 and the ASCE 32 provisions: it relies exclusively on ensuring that "the soil beneath the manufactured home stays dry thereby preventing frost heave." The report by SBRA/Hayman (2010) mistakenly claims that "Soil type is not relevant using the Frost Free Foundation design. Soil tests are not necessary." For reasons discussed below, it is the opinion of this author, having served on the ASCE 32 committee and its task group on development of the non-frost-susceptible soil criteria, that these statements are not representative of the intent of the ASCE 32 standard or equivalent alternative procedures for ensuring the intent is met. (Refer to the earlier discussion on the meaning of key terms and clauses in the ASCE 32 standard.)

The SBRA/Hayman report claims that soil tests are a "potentially expensive and time consuming process" without providing documentation. In addition, undocumented quotes and other undocumented sources or anecdotal forms of experience (that are not repeatable or verifiable or fully

explained) are mentioned in the report. For example, a partial quote on page 6-7 of the report is extracted from the Unified Facilities Criteria (UFC, 2004) for roadway design and is apparently mistaken to mean that no soils analysis or other consideration is required under "special conditions". It is then asserted that manufactured homes create these special conditions.

To the contrary, the cited UFC document states elsewhere that only four material groups (gravel, crush stone, crush rock, and sand) can be considered as "generally suitable for base course and sub-base course materials" with respect to frost heave or thaw-weakening potential. The quote as contained and edited in the SBRA/Hayman (2010) report also leaves out important caveats related to the required justification for re-classifying the frost-susceptibility status of a material under "special conditions". The complete discussion in the Unified Facilities Criteria document is as follows:

> *d. Special conditions.* Under special conditions the frost group classification adopted for design may be permitted to differ from that obtained by application of the above frost group definitions. This will, however, he subject to the specific approval of HQUSACE (CEMP-ET) or the appropriate Air Force Major Command if the difference is not greater than one frost group number and if complete justification for the variation is presented. Such justification may take into account special conditions of subgrade moisture or soil uniformity, in addition to soil gradation and plasticity, and should include data on performance of existing pavements near those proposed to be constructed.

Clearly, there is substantial evidence and justification required on a case-by-case basis as well as approval by authorities familiar with the subject matter. The requirements also indicate the form of evidence required, including data to demonstrate soil gradation and plasticity, subgrade moisture conditions, and soil uniformity. It also includes supplemental data on performance of existing pavements near those proposed to be constructed. Thus, a complete analysis of the site conditions as well as consideration of neighboring conditions (experience) is required. The SBRA/Hayman report and design does not contain such procedural requirements or data requirements for a given site. It does not indicate how to ascertain moisture conditions below grade, the need to test for soil gradation and plasticity, or other equivalent technical or procedural matters mentioned in the full quote above.

Simply protecting the soil from direct rainfall over the small footprint of a manufactured home may do little to address moisture conditions at depth below the ground surface or the degree of frost-susceptibility of the subgrade should moisture be present at depth. Despite these omissions, the SBRA/Hayman (2010) report concludes that the FFF provides "superior under home water control capabilities". Also, important differences from road design are not address such as roads being designed for a much lesser life expectancy than buildings (i.e., design return periods for frost heave or freezing events are typically less than 30 years as commonly represented by using the average of the three worst years in a period of thirty years or the worst year in a short period of 10 years).

In addition, the SBRA/Hayman (2010) report references various sources of experience, mostly from the standpoint of attempting to prove a negative by making the assumption that an absence of complaints

means an absence of problems. While this is relevant information, it is very weak data unless properly evaluated and interpreted in context. For example, what are the variations in soil type and particle size at the sites represented by the generalized experience claim. What were the winter Air-Freezing indices observed during the period of record associated with the experience statement as needed to ascertain potential "sampling error" problems? For example, a cursory review of national average heating degree day data for years 1994-2004 (the same period of record for one quoted source of anecdotal evidence) indicates below average national winter conditions in 8 of the 11 years (with 3 of the years exceeding the average by a relatively small amount – certainly not reflective of design conditions). A more detailed association of climate data in relation to the ad-hoc experience reported is needed to make a reasoned scientific analysis and engineering interpretation of the claimed experience and its relevance to design conditions. This must also be weighed against the common foundation construction practice represented by the generalized experience claim (e.g., what depth or variation of depth were the footings actually placed at?). In other words, is the reported experience actually relevant to the FFF design as presented in the SBRA/Hayman (2010) report?

Reference is also made to reduced frost depths for footings located underneath and within an enclosed area beneath the manufactured home foundation. However, this allowance may be more appropriately associated with prevention of or suppression of freezing temperatures, not the supposed absence of sufficient soil moisture to prevent frost heave. A similar practice has been recognized and used for many years in Anchorage, AK for site built construction by differentiating between "cold" and "warm" footings (with different footing frost depths used for each condition). Thus, the stated experience in the SBRA/Hayman (2010) report, while valid when understood in context, is not justification for reliance on merely keeping the ground surface dry in the immediate vicinity of a footing as an appropriate or complete means to prevent frost heave and broadly avoid adequate frost protection measures or footing depths in general for all climates and conditions that may be experienced.

This experience also is not based on the use of FFF foundation designs and could be considered as irrelevant on that basis alone. The experience suggested in at least one place (i.e., Kentucky) was associated with footings at a frost depth of 24 inches at the perimeter and 12 inches within the enclosed portions of the foundation. Similar experience was noted in West Virginia. It is no surprise that this has worked well as demonstrated in Table 1 and Figure 4 presented later in this report. But, it is not directly relevant to the FFF design presented in the SBRA/Hayman (2010) report. Instead, it is more appropriately taken as support for the adequacy of conventional methods of foundation installation (e.g., placing footings at frost depth, including reduced frost depths in enclosed areas underneath the building).

The SBRA/Hayman (2010) report does appropriately recognize that "the possibility of ground water level overlapping the frost depth does need to be addressed…If the ground water depth is determined to be above the local frost depth, the Frost Free Foundation design cannot be used." (ibid. p.8). However, the means of establishing that the ground water table is below the frost depth during the winter season and is misappropriated to "the local authority having jurisdiction". As stated in the review of Example #1, this determination is a matter of design or construction management for individual sites; local authorities are supposed to have the role of only inspection and verification, not making decisions about and executing the practice of design. This confusion of roles and responsibilities presents a conflict of interest among regulators and perhaps also infringes on state laws regarding the practice of engineering. In addition, merely keeping the water table depth at the local frost depth does not control

frost-susceptibility in soils that are particularly frost-susceptible because water is "wicked" from the ground water source up to the freezing front in the soil. This is the mechanism by which frost heave occurs. Thus, for some soil conditions, the water table depth may need to be well below the local design frost depth to prevent frost heave.

Finally the proposed SBRA/Hayman (2010) FFF design focuses only on the following two criteria related to risk of frost heave or thaw weakening (ibid., p.9):

- Site – the design only requires that surface drainage minimally comply with HUD Code, 24 CFR Part 3285.203.
- Footings – frost depth footings are not required (can essentially locate footings at finish grade with no depth)

The first item neglects any means of establishing depth of ground water. It also fails to determine if the soil profile (at least to frost depth) is well drained. It also neglects the requirement that non-frost-susceptible soils be used in accordance with the HUD Code (24 CFR Part 3285.312(b)) and the ASCE 32 Standard. Reliance on surface drainage alone without site-specific soil drainage or water table analysis and soil particle size analysis is not consistent with accepted engineering practice for building foundations and also does not provide an equivalently reliable alternative to the methods and requirements specified in the ASCE 32 standard or the HUD Code.

The second item is not really a criteria for frost-protection, but is actually and exemption from frost protection based on the first item. Placing the footings with 0 (zero) frost depth presumes perfection in the control of frost heave risk merely by keeping the ground surface in the immediate vicinity of the footing free from direct rainfall (i.e., located underneath the housing unit) and providing for surface drainage. This is an unrealistic and unconventional presumption and, at best, may result in highly uncertain and unreliable performance. Therefore, the HUD/CODE CONFORMANCE section of the SBRA/Hayman (2010) report significantly overstates the degree of conformance or equivalency of the proposed FFF design. If a dry soil criteria is used alone for frost protection, then the level of protection against a wetted soil condition (at least to frost depth) must far exceed the level of criteria and verification specified in the FFF design by SBRA/Hayman (2010). Consequently the design criteria presented in the SBRA/Hayman (2010) report and the associated model installation plan are largely incomplete or inadequate.

For example, the installation detail based on the SBRA/Hayman (2010) report reveals the following (see Figure 3):

1. It leaves discretion for the means and methods of establishing the water table depth to the local authority. This is a design decision going beyond the role of regulatory authorities, creating a conflict of interest in their role and the practice of design and installation. The plans should specify a means of determining water table depth following accepted engineering practice and require that it be at or well below the frost depth if merely a "point-in-time" investigation is done by others than a geotechnical engineer or experienced professional.
2. It provides no means of determining or verifying the use of non-frost susceptible soil as required in the detail (but which is indicated as being unimportant in SBRA/Hayman (2010)). Such a practice is important and such inconsistencies unnecessarily confuse the issue. Specifications

and a means of determining and verifying important design criteria should be provided on installation details (see also the discussion on Example #1 which included appropriate specifications but misappropriated or confused roles and responsibilities related to design, installation, and enforcement).

3. The design does not require the use of a below foundation drainage system and gives no indication under what sub-grade conditions one may be required to maintain a "well-drained" condition.

Example #3 – FFF Design C ("Floating Slab")

Example #3 is a variant of the FFF design approach that utilizes a "floating slab" concept as shown in Figure 4 (other similar FFF variants include a "floating strip footing" approach). Interestingly, this "floating slab" installation detail was certified by an engineer and DAPIA-approved in one state, but is included in the manufacturer's installation manual for another state.

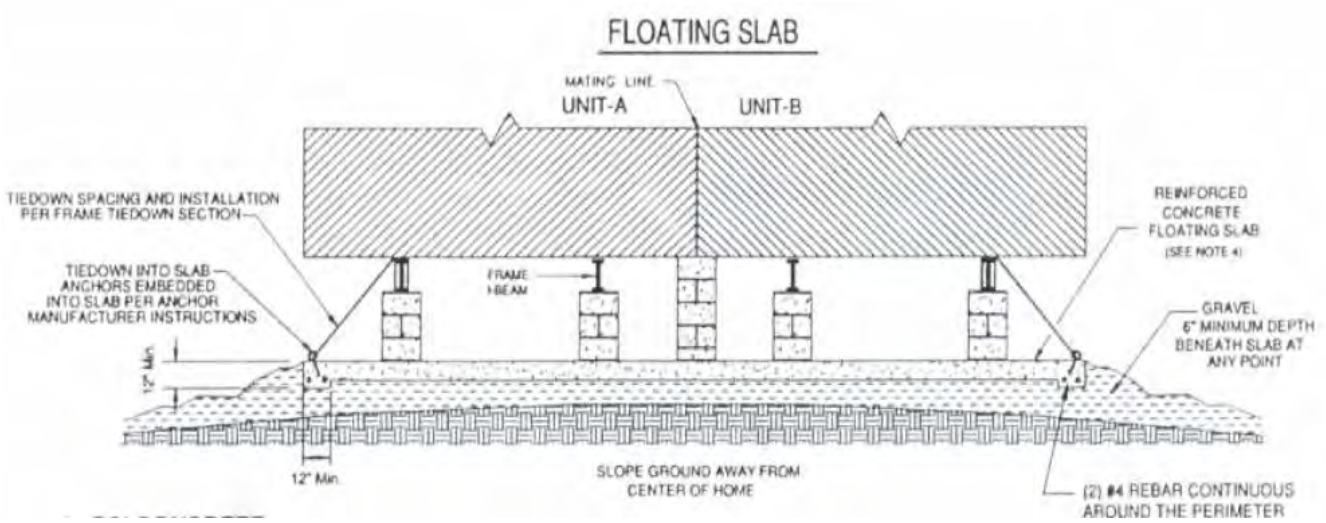

Figure 4. Installation detail for Example #3 ("Floating Slab" FFF)

Relevant notes accompanying the installation detail shown in Figure 4 are as follows:

NOTES:

1. SITE ONLY ON WELL DRAINED SOIL WITH AVERAGE MOISTURE CONTENT LESS THAN 25% TO FROST DEPTH.
2. THESE SOIL PREPARATION CONDITIONS ARE ADEQUATE FOR FOOTINGS INSTALLED ABOVE FROST LINE AND FOR FLOATING SLAB SYSTEMS WHEN INSTALLED WITH GRAVEL BACKFILL PROVIDED THE SOIL BENEATH THE GRAVEL IS WELL DRAINED WITH MINIMAL MOISTURE CONTENT.
3. FINAL DETERMINATION OF THE APPROPRIATE APPLICATION OF THE FOOTING ABOVE THE FROST LINE OR FLOATING SLAB, IS BY THE LOCAL AUTHORITY HAVING JURISDICTION FAMILIAR WITH ACTUAL SOIL CONDITIONS. BASED UPON ACTUAL SOIL CONDITIONS, DETERMINATION OF THE PROPER FOOTING DESIGN ILLUSTRATED ABOVE CAN BE MADE.

The following observations relate to concerns with the above-described "floating slab" FFF design:

1. Note #1 requires use on sites with "well drained soil with an average moisture content less than 25% to frost depth". The means of determining the average moisture content to frost depth is not specified. Is this an average at a given point in time or an average including seasonal variation? Is the moisture content volumetric or by mass? Does 25% average moisture content provide adequate frost protection for all frost-susceptible soil types? For example, soil may approach saturation at a volumetric moisture content of 25% or be saturated at a gravimetric moisture content of 20%. Furthermore, if soil moisture content is measured to a frost depth of say 4 feet, the top two feet may be relatively dry, but the bottom two feet wet; yet the average moisture content may meet the stated criteria (even though the overall moisture condition of the soil would promote frost heave in a frost susceptible soil – a risky soil condition which is not prohibited by this design). Clearly, the specification is incomplete and vague. Yet, this criteria is presented as the main "pass/fail" criteria for acceptance of a site for use of the "floating slab" FFF design.
2. Note #2 is significantly more vague and unenforceable referring to a requirement that "soil beneath the gravel is well drained with minimal moisture content". How is well drained determined in relation to frost-heave potential? What is a "minimal" moisture content?
3. Note #3 presents what is a common and inappropriate deferral of design decisions and site evaluation requirements to the "local authority having jurisdiction", thus, relying on the local enforcement authority to execute the practice of design to produce the evidence needed for enforcement (presenting a conflict of interest). It also requires the local authority to be "familiar with actual soil conditions". What are these soil conditions? Is the local authority supposed to measure moisture contents to confirm conformance with Note #1? Are there other conditions that need to be assessed?

Even if the above noted problems were resolved, the design still relies exclusively on keeping a potentially frost-susceptible soil adequately dry to the frost depth as the sole means of frost-protection. As mentioned in other reviewed examples of FFF designs, this design approach is not compliant with the provisions of the ASCE 32 standard or the HUD code. These standards require the use of non-frost-susceptible fill materials to frost depth and the provision of adequate drainage. With the above incomplete and vague design controls and confused roles and responsibilities as to the execution of design and verification of site conditions, this approach should not be considered as an equivalently reliable alternative means of frost protection.

Example #4 – FFF Design D (Monolithic Slab)

This FFF design is similar to that addressed in Examples #2 and #3. While purported to be used in a northeastern state, the design is certified by a registered engineer in a central mid-western state and was DAPIA approved. An example installation detail for this design is shown in Figure 5.

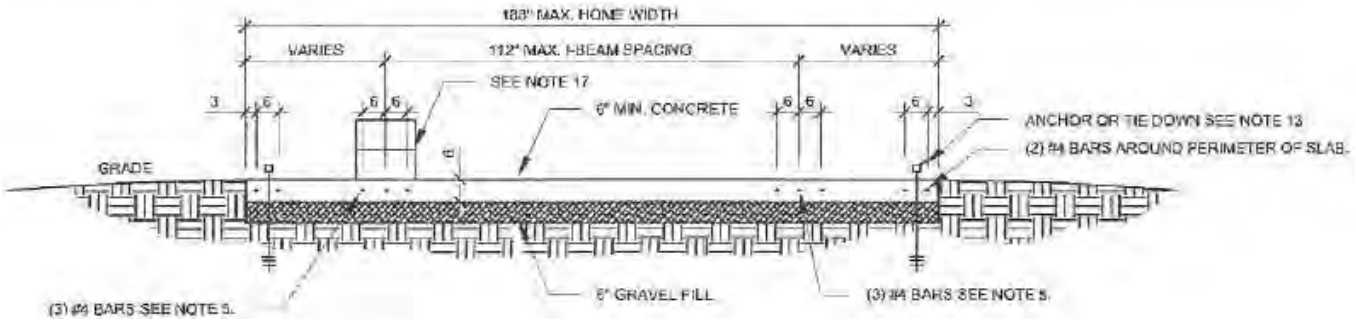

Figure 5. FFF installation detail for Example #4 (Monolithic Slab FFF)

Relevant "GENERAL NOTES" associated with the above installation detail are as follows:

7. THE SLAB FOUNDATION DESIGN IS SUSCEPTIBLE TO FROST HEAVE AND SHOULD NOT BE PLACED ON EXPANSIVE SOILS. CONSULT LOCAL JURISDICTION.
8. SLAB DEPTH NOTED SERVES ONLY AS A MINIMUM. THE BASE OF THE SLAB AND ITS GRAVEL FILL BASE MUST BE BELOW THE FROST LINE. CONSULT LOCAL JURISDICTION FOR THE FROST LINE DEPTH.
9. ADEQUATE DRAINAGE MUST BE PROVIDED UNDER THE SLAB TO THE PERIMETER OF THE SLAB. CONSULT LOCAL BUILDING CODE FOR REQUIREMENTS.

The above-described design raises concerns similar to those addressed in Examples #2 and #3. First, general note #7 does seem to admit that the design is susceptible to frost heave. However, it states that it should not be placed on expansive soils. While it is true it should not be placed on expansive clay soils, this is a different design matter than frost heave. Instead, the note should state that it should not be placed on frost-susceptible soils. Even so, the necessary criteria for evaluation of the frost-susceptibility of soils is not provided. Yet, this is presented as the critical "pass/fail" criteria for use of the design on a given site.

Second, general note #8 does seem to clarify that a gravel base must be below the frost line. Yet, the gravel base is not specified as to the amount of fines that can be tolerated. Is the intention to use clean (washed) gravel or bank run? Furthermore, the detail implies a shallow depth is intended (or may be interpreted) since the frost-depth is not shown to coincide with the depth of the gravel fill. Without careful installation and enforcement, the design intention may be overlooked or not be properly executed in the field.

Finally, note #9 indicates that drainage must be provided under the slab, but the drainage design is not defined or indicated on the detail other than to say that water is to be drained "to the perimeter of the slab". This may actually cause water to be concentrated at the edges of the slab where differential frost heave would be promoted. It also does not clarify where the drainage system is to be placed (e.g., at the bottom of the gravel layer) and that drainage water should be discharged to daylight well away from the perimeter of the slab foundation. The building code is referenced for detailed requirements, but building code foundation drainage requirements generally are not intended to address this application (e.g., drainage of fills and subgrades to prevent frost heave). The design should show a drainage plan for cases where the sub-grade is not well-drained (e.g. water table not below the frost depth or a soil layer at depth with a low infiltration rate).

<u>Other Considerations</u>

Skirting – Other considerations include installation of skirting. Where founded at a shallow depth, significant frost-heave may raise the skirting by as much as several inches, causing the building to be jacked and distorted since frost heave rarely occurs uniformly. Thus, provisions for skirting frost protection must also be considered (e.g., drainage and depth of non-frost-susceptible fill, use of a footing to frost depth as common to permanent wood foundations, or use of insulation to protect the ground against freezing). Some designs have used insulation for this purpose, but have not placed it in accordance with the ASCE 32 standard – leaving significant thermal bridges that may negate or diminish the function of the insulation. For example, see Figure 3.38 and others in the "Guide to Foundation and Support Systems for Manufactured Homes" prepared by SBRA for HUD.[2] In addition, for an FPSF design using a raised foundation (i.e., crawlspace) the enclosed area must be unvented (at least during winter months) and insulated around the perimeter (skirting) to prevent the potential for increased frost depth in the shaded ground underlying a raised foundation (PHRC, 2014).

Proprietary Foundations – Various proprietary foundation systems are commonly used to support and anchor manufactured housing units. These systems in general rely on the same means for frost protection as conventional foundations or piers. Thus, the findings and recommendations of this report apply equally to proprietary types of foundation supports that may use shallow footings or footing pads. Frost-heave does not distinguish between foundation types. If any shallow, uninsulated footing is on frost-susceptible soil with an adequate source of moisture from the surface or ground moisture from below (even if the surface appears dry) and experiences freezing temperatures within the ground, it will experience frost heave and/or thaw-weakening.

Local Regulations – One state's installation standards were provided for review in relation to the topic of this report. In New Hampshire's installation standards for manufactured housing (Chapter 600, Section 603.08), the following requirements are stated in regard to footings:

> (b) Every pier shall be supported by a footing of the following type:
>
> (1) A pad which shall be a monolithic concrete slab…and complies with the following:
>
> a. Fill shall extend a minimum of 3 inches up the side of the slab;
>
> b. Top soil and all organic soils shall be removed under the slab area;
>
> c. A minimum of 12 to 14 inches of sand or gravel compacted; and
>
> d. Shall be at minimum as set forth in Figure 600-3; or
>
> (2) Below frost footing, which shall be designed by a New Hampshire licensed professional engineer.

The above-mentioned "Figure 600-3" below is a detail of a FFF foundation slab similar to the "floating slab" design evaluated in Example #3 (and also similar to examples #2 and #4). There is no provision to ensure that the sub-grade is well drained or that non-frost-susceptible soils or fill are used to the frost depth. Also, it is extremely odd that the above provision allows the FFF approach (Item (1)) to be used with no engineering or site verification, yet a conventional footing design to frost depth (Item (2)) is required to be designed by a New Hampshire licensed professional engineer. The regulation appears to

[2] It should be noted that this guide, while containing much practical information, also contains many cases of incomplete information or questionable advice that can lead to poor practices for frost protection. HUD should consider withdrawing this document until such a time that the deficiencies can be remedied. The copy reviewed was noted as a Draft dated March 27, 2002.

be significantly misguided in regard to which foundation approach should require an engineering design and site investigation. Other state installation rules should be investigated for similar technical irregularities and corrected as needed to bring them into conformity with the HUD code (24 CFR Part 3285.312(b)).

CONCLUSIONS

The following conclusions summarize the key findings of this report:

1. Several problems with execution of the FFF design approach were identified in reviewed installation details. These problems include:
    a. Lack of enforceable or consistently actionable criteria related to important design factors governing the applicability of the FFF design and installation method for a particular site or development.
    b. Commonly confused assignments of roles and responsibilities for determining site conditions and suitability of a FFF design for a given site. In particular, matters of design in determining the suitability of a site are often deferred to local authorities which are not charged with a responsibility to practice design. Their role should be limited to enforcement and verification of evidence demonstrating conformance.
    c. Installation details for FFF designs often lack criteria for measuring the frost-susceptibility of soils or fill materials which is a critical aspect of the design and an important source of data for verification by local authorities.
    d. Requirements for determining soil moisture criteria and/or minimum water table depth are often vague and unenforceable.
    e. Similarly, means of measuring and confirming a “well-drained” soil condition generally are not defined or adequately specified. Suitable sub-drainage strategies for conditions that are not well-drained are generally not specified such that installers and inspectors can perform their duties consistently and in accordance with the design intent.
2. Because of the above problems, most of the reviewed FFF designs should not be considered compliant with the ASCE 32 standard or provisions in the HUD Code related to frost-protection of manufactured home foundations, including conventional and proprietary foundation systems that are placed at shallow depth (above the frost line) using the FFF concept.
3. It appears that at least some state installation rules also may be contributing to or propagating the above problems with FFF designs. The one example reviewed in this study was for New Hampshire. Therefore, state and local installation rules should be reviewed and corrected as necessary to ensure conformity with the ASCE 32 standard and the HUD code (24 CFR Part 3285.312(b)).
4. In at least one reviewed case (Example #1), a reasonably compliant implementation of an FFF design was achieved with only the exception of proper definition and assignment of roles and responsibilities in the assessment of site conditions (see 1.b. above). This demonstrates that the FFF design approach (and similarly FPSF designs) are capable of being executed properly, despite several examples where they are not. Consistency and conformance can be improved with supplemental guidelines for development and execution of FFF and FPSF foundation designs

including minimum design requirements, installation practices, and enforcement procedures. Recommendations toward this end are provided in the next section of this report.

RECOMMENDATIONS FOR DESIGN AND INSTALLATION

Refer to the section titled “CONFORMANCE OPTIONS FOR NEW DESIGNS AND FUTURE INSTALLATION PRACTICES” on page 7 of the main body of the report.

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APPENDIX B – GLOSSARY

Term	Definition
DAPIA	Design Approval Primary Inspection Agency
IPIA	Inspection Primary Inspection Agency
LAHJ	Local Authority Having Jurisdiction
Fill	Material that is used to level a building site
Non-frost susceptible soil/ fill	Existing soils that are not subject to the effects of frost; they can be identified as granular soils or fill material with less than 6% of mass passing a #200 (0.074 mm) mesh sieve in accordance with ASTM D442 tests
Frost susceptible soil	Silty soils that can retain water; these soils or fill contain more than 6% by mass of their material as passed through a #200 (0.074 mm) mesh sieve in accordance with ASTM D442 tests
Frost-susceptible climate	A climate which is susceptible to seasonal ground freezing
Frost Protected Shallow Foundations	A construction method that uses below-ground insulation and drainage to raise the frost line of soil to a level that allows relatively short and shallow foundations via preventing the soil beneath the home from freezing
Frost Heave	The raising of ground height due to ice crystallization action within the soil or other material beneath the home
Design Frost Depth	A depth into ground that frost is expected to reach under a given severity of winter freezing conditions and other factors as determined by local authorities or the Air Freezing Index
Frost Free Foundations (FFF)	1. A foundation that relies exclusively on the presence of non-frost-susceptible subgrade materials such as soil or fill on a well-drained site. 2. The name of a foundation system designed by Paul

Hayman

Monolithic slab	A foundation system constructed as one single concrete pour that consists of a concrete slab with thickened portions of the slab under load bearing walls and all perimeter edges that take the place of footers
Well-drained soil	Soil (or other applicable material) which allows water to percolate through it reasonably quickly and not pool
Water Table	Depths at which groundwater collects and pools under ground
Drainage	The natural or artificial removal of surface and sub-surface water from an area
Surface drainage	Drainage performed exclusively on the ground surface by shaping the grade to shed water
Subsurface drainage	Drainage performed beneath the surface of the ground to remove water

APPENDIX C - CONFORMING DESIGNS AND PRACTICES FOR INSTALLING MANUFACTURED HOMES IN LOCATIONS SUBJECT TO FREEZING TEMPERATURES

APPENDIX C - CONFORMING DESIGNS AND PRACTICES FOR INSTALLING MANUFACTURED HOMES IN LOCATIONS SUBJECT TO FREEZING TEMPERATURES

Appendix C includes examples of foundation systems that can be used to set manufactured homes in locations that are subject to freezing temperatures. When designing a foundation system and analyzing its potential use, significant consideration should be given to longevity, cost and access. The main objective should be to provide a foundation system that will last the life of the home while also being as cost effective as possible.

Options for sites that have Non-Frost Susceptible Soil

In locations with non-frost susceptible soil, one (1) of the three (3) below options can be used for installing the foundation.

1. Place pier footings per the Manufacturers Installation Manual with pads and in accordance with 24 CFR part 3285.312.
2. Pour runners with a minimum thickness of 6 inches in accordance with 24 CFR part 3285.312.
3. Pour slabs with a minimum of 6 inches of concrete.

Options for sites where soil is untested or known as Frost Susceptible

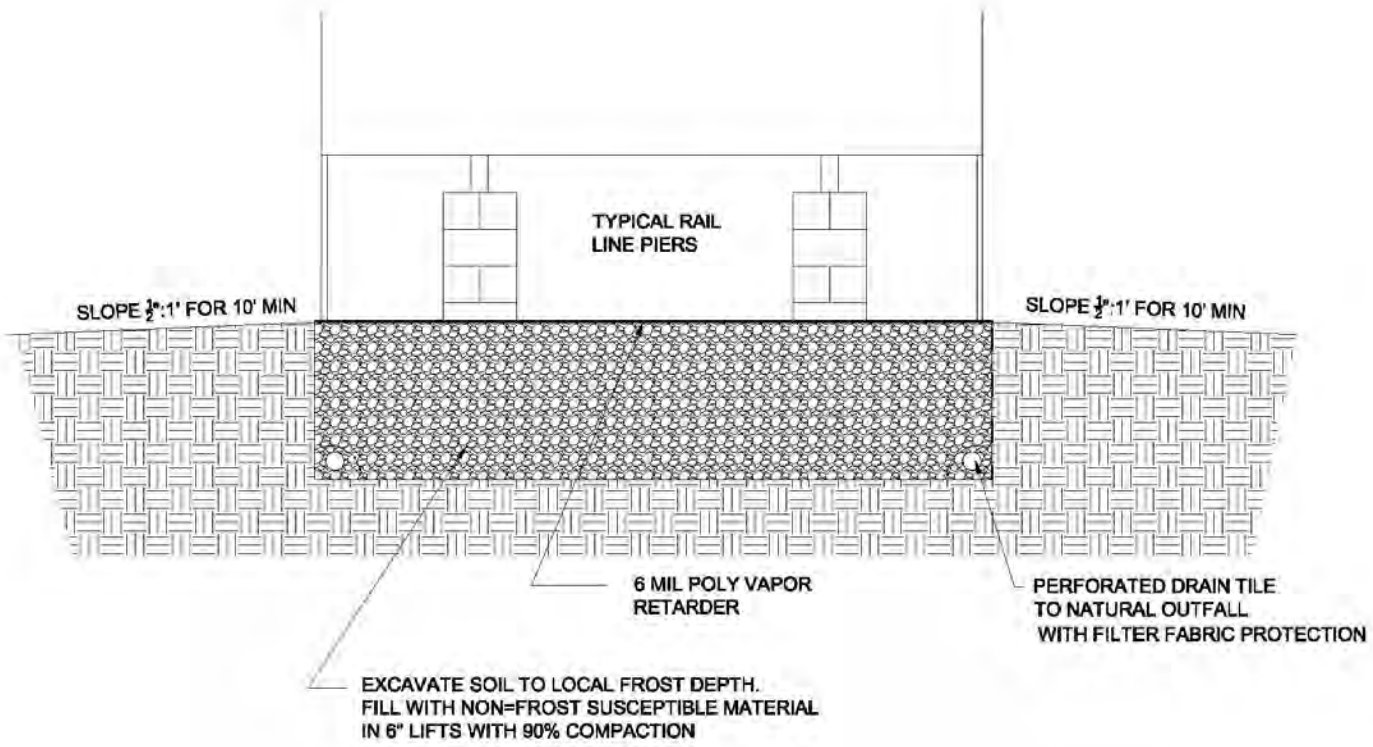
In areas with frost susceptible soil, or the soil type is unknown, the below process can be used to create a non-frost susceptible pad. These steps are required prior to beginning the foundation installation.

1. Cut the area of house pad to the frost depth as determined by the Local Authority Having Jurisdiction (LAHJ) or that of the Air Freezing Index (AFI). (see Cut and Fill to Make Pad details)
2. At the base level, install a drainage pipe to day light or install a mechanical means of de-watering below the frost depth. (see Cut and Fill to Make Pad details)
3. Fill cut area with non-frost susceptible free draining fill in 6 inch lifts. Compact each lift to a minimum of 90% of its relative density. Fill material must have at least a 1500 PSF bearing capacity.
4. Ensure the water table is at least two (2) feet below the frost depth at the site.

This process should be used to create a non-frost susceptible pad for a cut and fill process or filling low areas. Cut and fill is applicable when frost susceptible soil is replaced with non-frost susceptible fill on a flat site. Filling low areas or hilly areas to make a uniformly flat site may also be done with this method. In both cases organic material must be removed before fill is placed and/or added at the installation site.

Below are examples of the above described methods for creating non-frost susceptible pads prior to setting the home.

CUT AND FILL TO MAKE PAD



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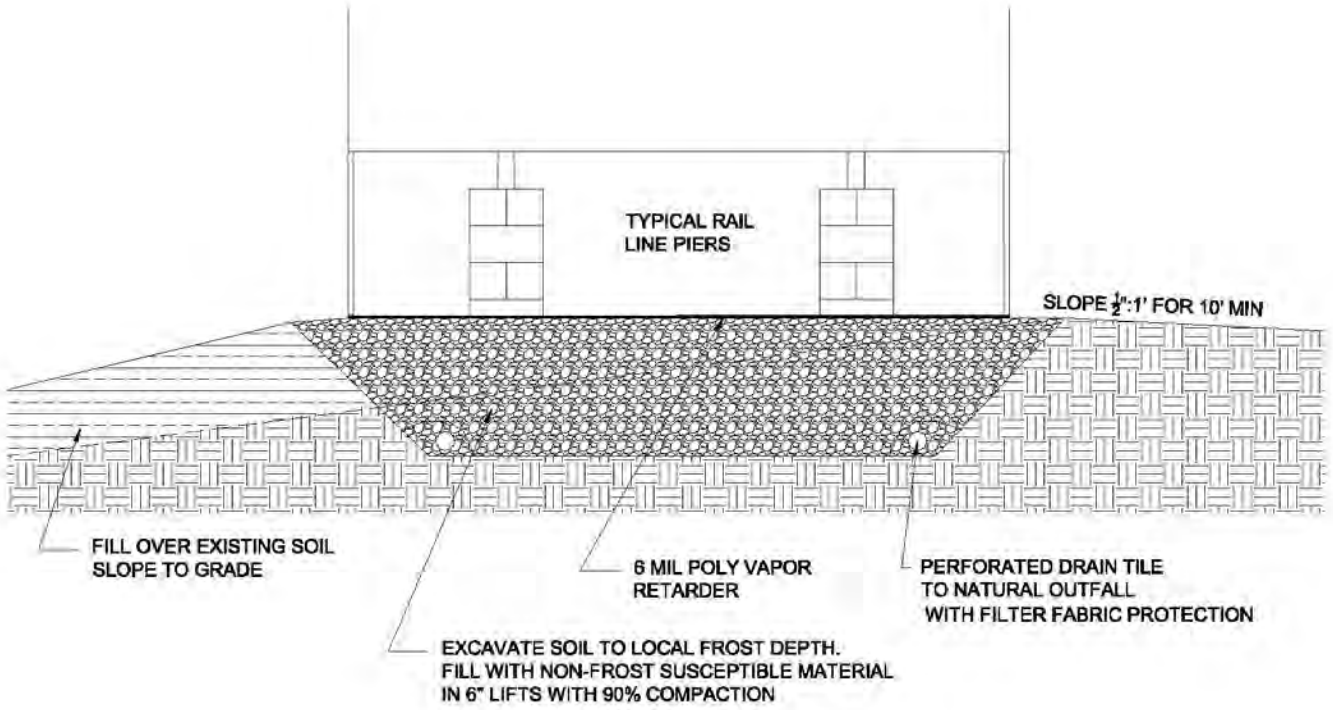
FILL EXISTING GRADE FOR PAD - SINGLE



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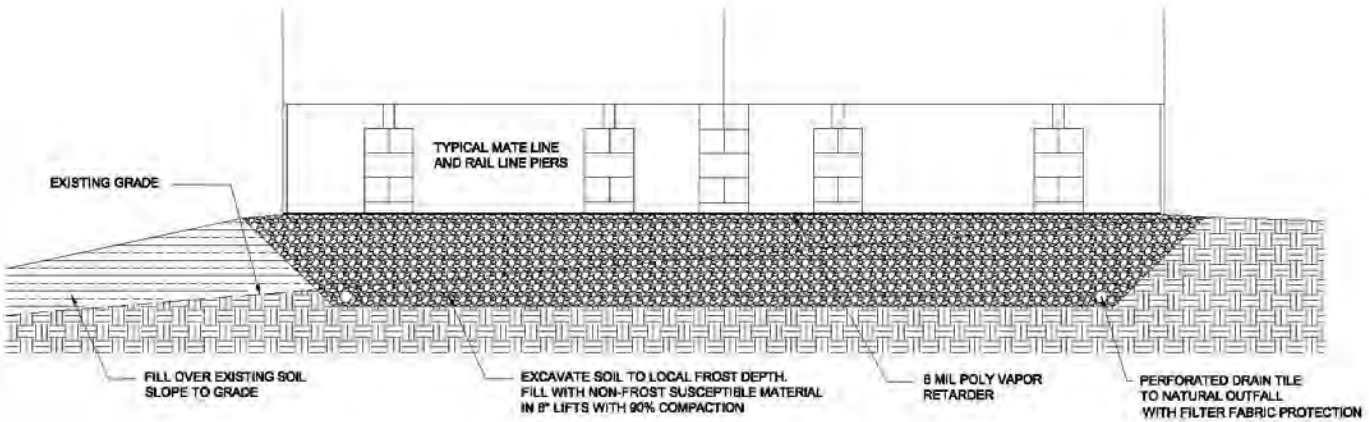
FILL EXISTING GRADE FOR PAD - DOUBLE



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The below steps and design can be used to install a monolithic slab with no insulation.

1. Remove all organic material from the pad site.
2. Place 4 inches of stone with 2 drain pipes to day light or provide a mechanical drain.
3. Form and pour the slab with tied #4 rebar as in diagram.
4. For best results the slab should have at least 1 inch center crown for drainage.
5. Grade around the perimeter of the slab so that there is at least ½ inch of fall for the first 10 feet. In areas that are too tight to achieve this, swales and surface drains can be used.

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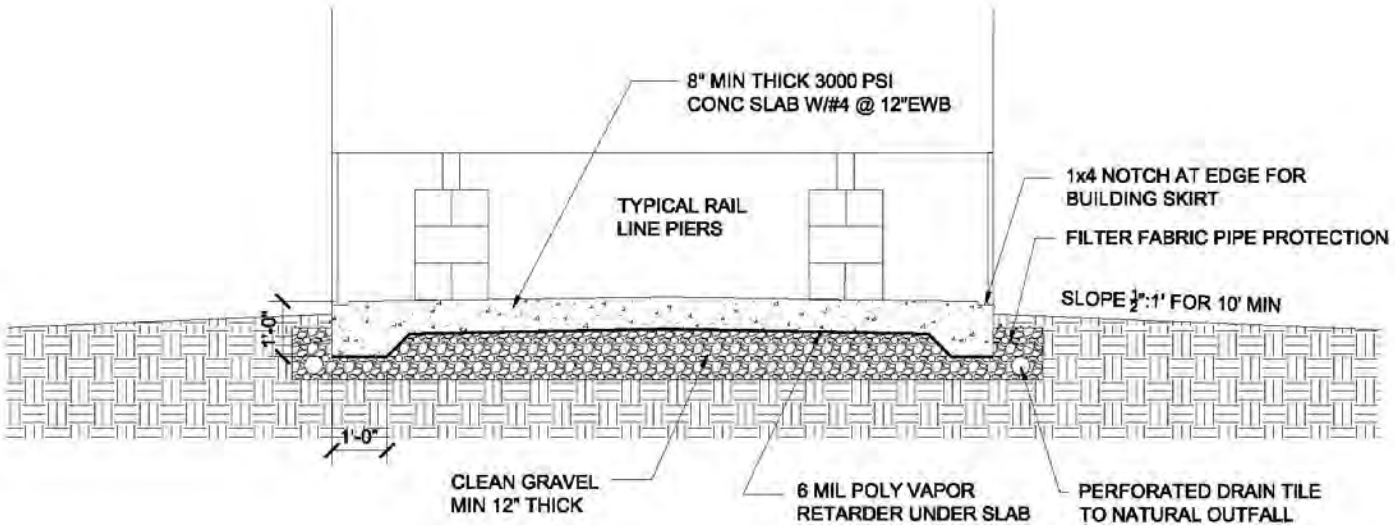
MONOLITHIC SLAB ALL SOIL - SINGLE



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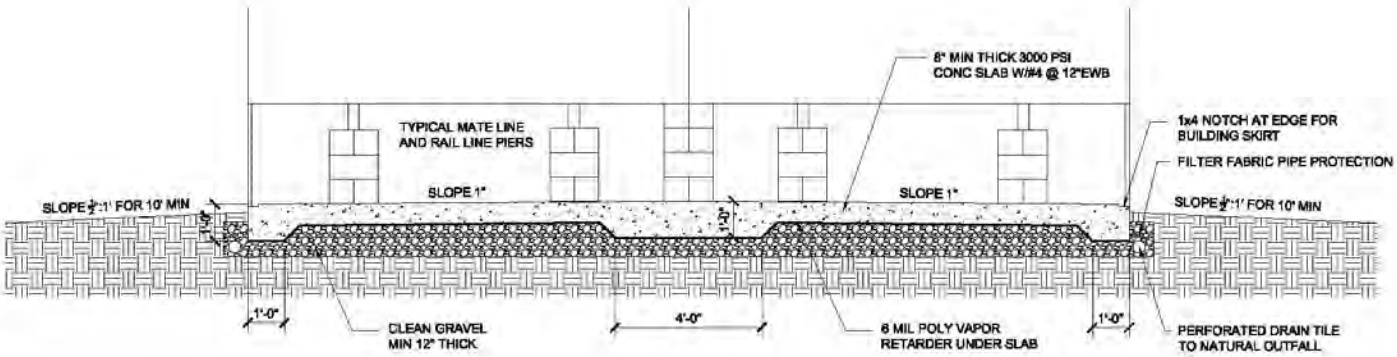
MONOLITHIC SLAB ALL SOIL - DOUBLE



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Examples of designs that are currently used in frost susceptible climates that utilize insulation to make a frost protected foundation systems.

Clayton Homes provided permission to include its plans SU-ADD 107.2, SU-ADD 107.3, and SU-ADD 107.4 to SU-ADD 107.6 in this Appendix. These systems have been approved for use in the state of New York, are designed by an engineer/architect and are approved by the Manufacturer and its DAPIA pursuant to 24 CFR Part 3285.2. The plans use AFI to determine the local frost depth requirements. This allows one plan to cover the entire state by referencing the localities' AFI, allowing for proper adjustments to current home designs. Future use of AFI will guarantee a plan to be applicable to the entire United States and thus increase usability. Several companies are currently working on similar plans and intend to have their products available on a national level. It is estimated that these plans will be available by the first quarter of 2017.

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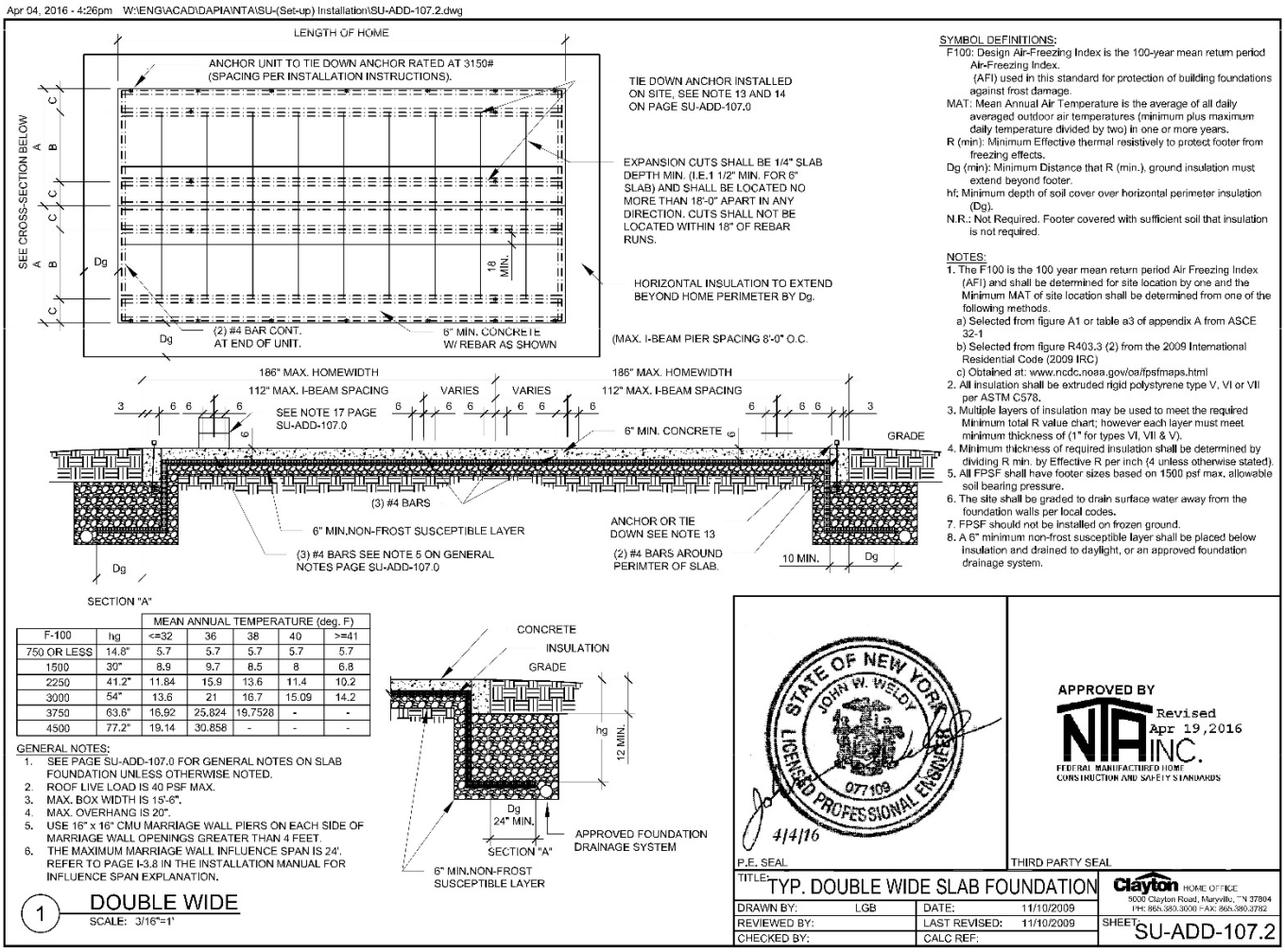
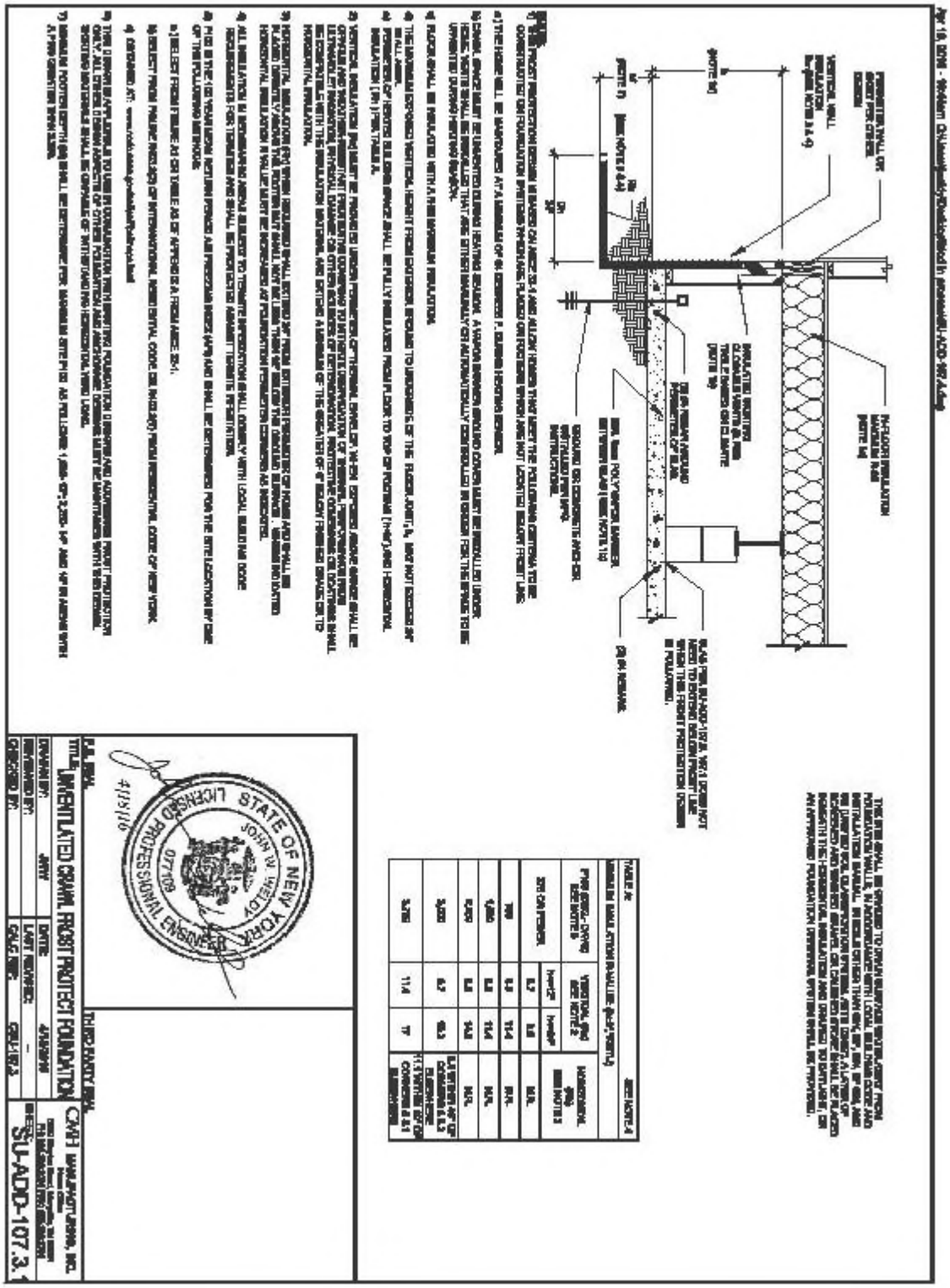
New York Frost Protected Foundation Design (SU-ADD 107.2)

This plan shows how to use insulation under the slab to create a frost protected foundation system.



New York Frost Protected Foundation Design (SU-ADD 107.3)

This plan shows how to use insulated skirting to provide a frost protected foundation system.

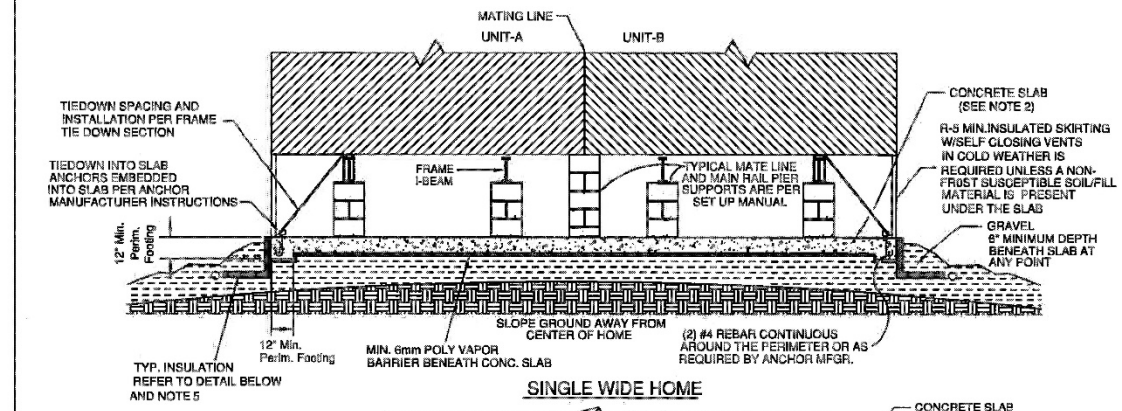


New York Slab Design – Insulated Skirting (SU-ADD 107.4 to SU-ADD 107.6)

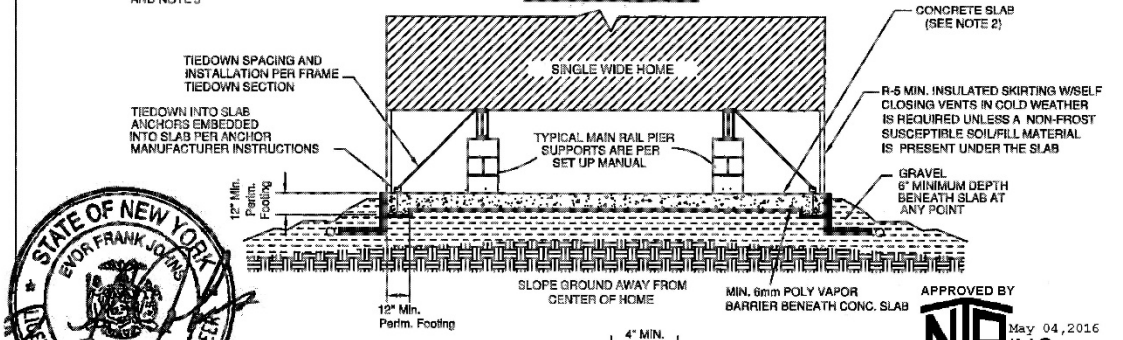
CLAYTON HOMES

ADDENDUM TO HUD INSTALLATION MANUAL

(NEW YORK STATE SLAB-ON-GROUND REQUIREMENTS USING INSULATED SKIRTING OPTION)



SINGLE WIDE HOME



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ENOR FRANK JOHNS
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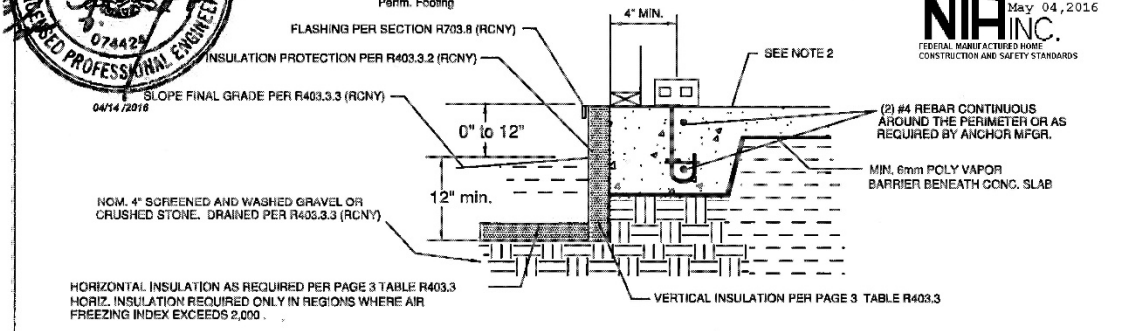
LICENSED PROFESSIONAL ENGINEER
04/14/2016

APPROVED BY NTA INC. May 04,2016
FEDERAL MANUFACTURED HOME CONSTRUCTION AND SAFETY STANDARDS



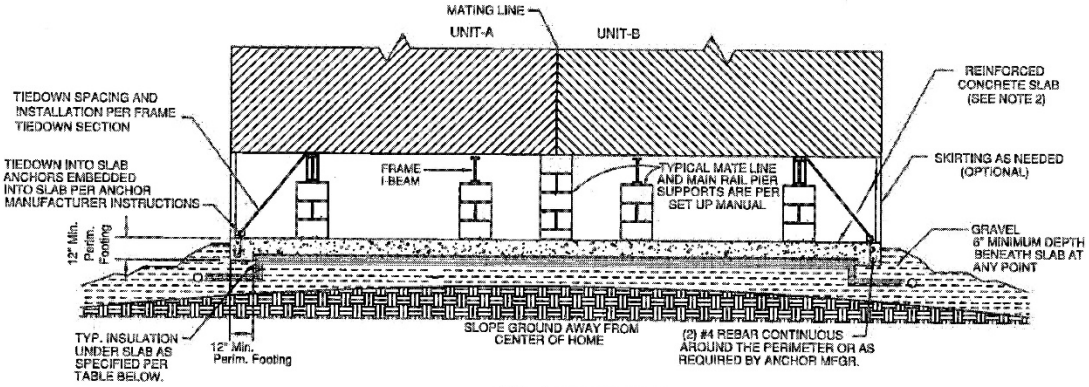
NOTES :

1. SITE ONLY ON WELL DRAINED SOIL WITH AVERAGE MOISTURE CONTENT LESS THAN 25% TO FROST DEPTH. SOIL CONDITIONS AS INDICATED ARE ADEQUATE FOR SLAB INSTALLED ABOVE FROST LINE.
2. THE THICKNESS OF THE SLAB IS SET AT 6" FOR AN ASSUMED 2000 PSF SOIL BEARING CAPACITY. FOR 1000 PSF MIN SOIL BEARING CAPACITY, USE 8" THICK CONCRETE SLAB. CONCRETE COMPRESSIVE STRENGTH: 3500 PSI MIN.
3. ALL INSULATION SHALL BE EXTRUDED POLYSTYRENE TYPE V, VI, OR VII PER ASTM C578.
4. INSULATION FOR SLAB IS NOT REQUIRED IF PLACED ON A LAYER OF WELL DRAINED, UNDISTURBED GROUND OR FILL THAT IS NOT SUSCEPTIBLE TO FROST. CLASSIFICATION OF FROST SUSCEPTIBILITY OF SOIL SHALL BE DETERMINED BY A SOILS OR GEOLOGICAL ENGINEER UNLESS OTHERWISE APPROVED. THE DETERMINATION PROVIDED TO THE LAHJ BY THE SOILS ENGINEER SHALL INCLUDE DATA THAT DESCRIBES THE SOIL CONDITIONS TO A MINIMUM DEPTH THAT INCLUDES THE FROST DEPTH.
5. REFER TO PAGE 3 FOR TABLE R403.3 (RCNY) SPECIFYING REQUIRED INSULATION LENGTH AND R-VALUES AND TABLE R-403.3(1) (RCNY) FOR AIR FREEZING INDEX VALUES PER GEOGRAPHIC LOCATION.
6. REFER TO INSTALLATION INSTRUCTIONS FOR ANCHOR TIE DOWN REQUIREMENTS AND SPACING. REFER TO ANCHOR MANUFACTURER INSTALLATION INSTRCUTIONS FOR ALL OTHER REQUIREMNTS.

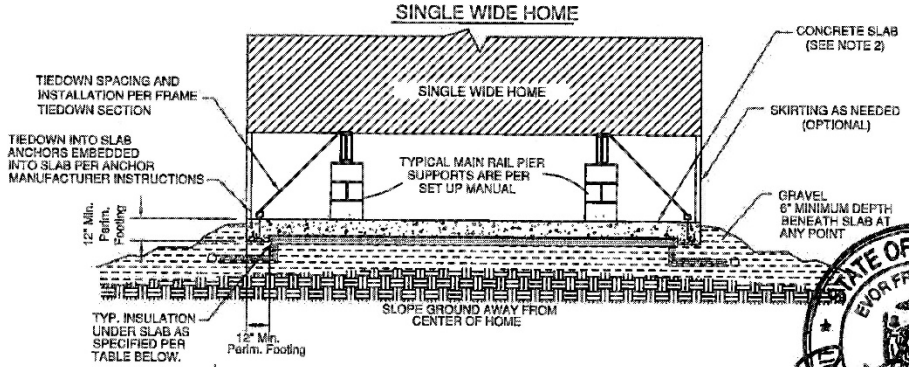
CLAYTON HOMES

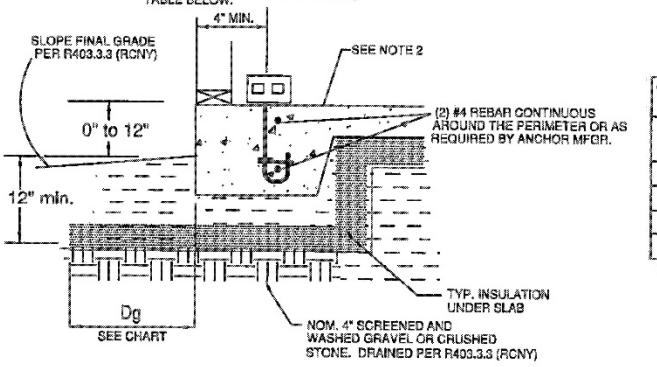
ADDENDUM TO HUD INSTALLATION MANUAL

(NEW YORK STATE SLAB-ON-GROUND REQUIREMENTS USING INSULATED SLAB OPTION)



SINGLE WIDE HOME





CONTINUOUS SLAB INSULATION REQUIREMENTS (PER TABLE 8 OF SEI/ASCE 32-01)		
AIR FREEZING INDEX (See page A-13.3)	Dg	REQUIRED R-VALUE * Assumes Mean Annual Temp. ≥ 41° F
750 OR LESS	30"	5.5
1500	49"	6.5
2280	63"	8.9
3000	79"	13.9

* INSULATION IS REDUCED BY 0.3 FOR R-VALUE OF 8" MINIMUM CONCRETE SLAB

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APPROVED BY
NTA INC.
May 04,2016
FEDERAL MANUFACTURED HOME CONSTRUCTION AND SAFETY STANDARDS

NOTES :

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2. THE THICKNESS OF THE SLAB IS SET AT 6" FOR AN ASSUMED 2000 PSF SOIL BEARING CAPACITY. FOR 1000 PSF MIN SOIL BEARING CAPACITY, USE 8" THICK CONCRETE SLAB. CONCRETE COMPRESSIVE STRENGTH: 3500 PSI MIN.
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5. REFER TO INSTALLATION INSTRUCTIONS FOR ANCHOR TIE DOWN REQUIREMENTS AND SPACING. REFER TO ANCHOR MANUFACTURER INSTALLATION INSTRCUTIONS FOR ALL OTHER REQUIREMNTS.

TABLE R403.3
MINIMUM INSULATION REQUIREMENTS FOR FROST-PROTECTED FOOTINGS IN HEATED BUILDINGS[a]

AIR FREEZING INDEX (°F-days)[b]	VERTICAL INSULATION R-VALUE[c, d]	HORIZONTAL INSULATION R-VALUE[c, e]		HORIZONTAL INSULATION DIMENSIONS PER FIGURE R403.3(1) (inches)		
		Along walls	At corners	A	B	C
1,500 or less	4.5	Not required	Not required	Not required	Not required	Not required
2,000	5.6	Not required	Not required	Not required	Not required	Not required
2,500	6.7	1.7	4.9	12	24	40
3,000	7.8	6.5	8.6	12	24	40
3,500	9.0	8.0	11.2	24	30	60
4,000	10.1	10.5	13.1	24	36	60

a. Insulation requirements are for protection against frost damage in heated buildings. Greater values may be required to meet energy conservation standards. Interpolation between values is permissible.
b. See Table R403.3.1 for Air Freezing Index values.
c. Insulation materials shall provide the stated minimum *R*-values under long-term exposure to moist, below-ground conditions in freezing climates. The following *R*-values shall be used to determine insulation thicknesses required for this application: Type II expanded polystyrene-2.4*R* per inch; Type IV extruded polystyrene-4.5*R* per inch; Type VI extruded polystyrene-4.5*R* per inch; Type IX expanded polystyrene-3.2*R* per inch; Type X extruded polystyrene-4.5*R* per inch.
d. Vertical insulation shall be expanded polystyrene insulation or extruded polystyrene insulation.
e. Horizontal insulation shall be extruded polystyrene insulation.

TABLE R403.3(1)
AIR FREEZING INDEX (BASE 32° FAHRENHEIT) RETURN PERIOD OF 100 YEAR (99% PROBABILITY)

Station Name	Station Number	Air Freezing Index	Station Name	Station Number	Air Freezing Index
ALBANY WSO	300042	1350	LIBERTY	304731	1515
ALCOVE DAM	300063	1451	LITTLE FALLS CITY RES	304791	1586
ALFRED	300085	1499	LITTLE VALLEY	304808	1540
ALLEGANY STATE PARK	300093	1494	LOCKPORT 2 NE	304844	1147
ANGELICA	300183	1421	LOWVILLE	304912	1768
BAINBRIDGE	300360	1349	MILLBROOK	305334	1246
BATAVIA	300443	1310	MINEOLA	305377	496
BOONVILLE 2 SSW	300785	1963	MOHONK LAKE	305426	1109
BRIDGEHAMPTON	300889	510	MOUNT MORRIS 2 W	305597	1355
BROCKPORT 2 NW	300937	1195	NEW YORK CNTRL PK WSO	305801	440
CANANDAIGUA 3 S	301152	1185	NY WESTERLEIGH STAT IS	305821	521
CANTON 4 SE	301185	2124	NORWICH 1 NE	306085	1679
CARMEL 1 SW	301207	1093	OGDENSBURG 3 NE	306164	2038
CHASM FALLS	301387	1952	OSWEGO EAST	306314	1164
CHAZY	301401	1997	PATCHOGUE 2 N	306441	599
COOPERSTOWN	301752	1454	PENN YAN 2 SW	306510	1075
CORTLAND	301799	1396	PERU 2 WSW	306538	1733
DANNEMORA	301966	1794	PORT JERVIS	306774	990
DANSVILLE	301974	1230	POUGHKEEPSIE FAA AP	306820	1160
DOBBS FERRY	302129	576	RIVERHEAD RESEARCH	307134	510
ELIZABETHTOWN	302554	2078	ROCHESTER WSO	307167	1199
ELMIRA	302610	1361	SALEM	307405	1706
FRANKLINVILLE	303025	1715	SCARSDALE	307497	618
FREDONIA	303033	1143	SETAUKET	307633	452
GENEVA RESEARCH FARM	303184	1297	SODUS CENTER	307842	1248
GLENHAM	303259	985	SPENCER 3 W	308088	1514
GLENS FALLS FAA AP	303294	1688	STILLWATER RESERVOIR	308248	2483
GLOVERSVILLE	303319	1500	SYRACUSE WSO	308383	1213
GOUVERNEUR	303346	1877	TUPPER LAKE SUNMOUNT	308631	2372
GRAFTON	303360	1516	UTICA FAA AP	308737	1545
HEMLOCK	303773	1436	WANAKENA RANGER SCHOOL	308944	2192
INDIAN LAKE 2 SW	304102	2317	WATERTOWN	309000	1701
ITHACA CORNELL UNIV.	304174	1367	WESTFIELD 3 SW	309189	1247
LAKE PLACID CLUB	304555	2318	WEST POINT	309292	899
LAWRENCEVILLE	304647	1956	WHITEHALL	309389	1594