| | |
|---|---|
| **From:** | geckhoff@comcast.net |
| **To:** | Rosalind Fazel |
| **Subject:** | AC49 Comments |
| **Date:** | Monday, June 28, 2010 11:30:47 AM |
| **Attachments:** | NFBAref.Uplift.doc<br>LabReportEric.pdf<br>AIA.presentation.pdf<br>ReplyLetter062810.doc |

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*Comments on Criteria AC49.*

Gerald Eckhoff, P.E.
GE Engineering
239-405-8332
geckhoff@comcast.net

*Comments:*

6/28/10 To: Michael O?Reardon, P.E. FROM: Gerald Eckhoff, P.E. RE: Proposed Revisions to the Acceptance Criteria for Molded Plastic Footing Pads, Subject AC49-0610-R1 (MO/BG) Comments requested by staff; Item a) A very few post-frame residential units are ever built since they are mostly required to have conventional construction on the inside including concrete foundations and stud walls between the post. We may want to exclude these from section 1.1.2. Item b) Please refer to page 11 of the attached power point presentation, which indicate how collars at the base of column provide for uplift and pages 3 and 4 referencing embedded post design for lateral resistance. Also refer to the letter from Harvey B. Manbeck, P.E. from The National Frame Building Association (NFBA). Item c) Please refer to the letter from Eric Tompos, S.E., P.E. of NTA Inc. Testing. Item d) i ?v. Again, refer to the attached complete power point presentation by Manbeck. This was a result of full scale testing by the University of Wisconsin. It is possible that post-frame system may fit into the category as suggested in item v., but most likely will have its own type of building once post-frame is further understood. Let me know if additional information or clarifications are needed

*Attachments:*

- NFBAref.Uplift.doc
- LabReportEric.pdf
- AIA.presentation.pdf
- ReplyLetter062810.doc

National Frame
Building Association
4700 W. Lake Avenue
Glenview, IL 60025

**Phone:** 800/557-6957
**Fax:** 847/375-6495
**E-mail:** nfba@nfba.org
**Web:** www.nfba.org

September 15, 2009

Mr. Michael O'Reardon, Regional Manager
ICC Evaluation Service, Inc.
Birmingham Regional Office
900 Montclair Road, Suite A
Birmingham, AL 35213

Dear Mr. O'Reardon:

RE: AC49 Proposed Revisions to the Acceptance Criteria for Molded Plastic Footing Pads, Subject AC49-1009-R1 (MO/BG)

I am writing in response to your September 1, 2009 letter in which you requested input and testimony from the NFBA and other interested parties to clarify the following concern:

"Design procedures for post frame building systems for uplift and lateral loads for the molded plastic footings that do not have a positive connection to the post. Since the definition proposed in Section 1.4.3 implies that all loads will be transferred to the foundation by the posts, it is unclear how a complete load path for lateral and uplift loads is accomplished, since the subject footing pads are evaluated for vertical download capacity only."

ASAE/ANSI EP 486.1 (2000), Shallow Post Foundation Design, is a reference standard in the 2006 IBC (page 558, IBC 2006). This engineering practice documents clearly how the embedded post transfers the lateral loads to the soil independent of the footer pad (Figures 2 through 6, EP 486.1). The same engineering practice also documents how the embedded post with an attached concrete collar, or attached preservative treated wood cleats, near the bottom of the post develops the required uplift resistance independent of the footer pad (Figures 9 and 10, EP 486.1). Thus, the primary function of the molded plastic footer pad is to resist the downward vertical loads. The lateral loads are resisted directly by the soil embedment above the footer pad. The vertical uplift loads are resisted by the mass of the cone of soil directly above the concrete collar or preservative treated wood cleats attached to the post.

I trust that this explanation resolves your concerns. If you have questions or require further information, please contact me at hmanbeck@psu.edu or at 814-933-2269.

Sincerely,

Harvey B. Manbeck, P.E.
Technical Director

NTA INC.

ENGINEERS
PLANNERS
CONSULTANTS

306 NORTH OAKLAND AVENUE • P.O. BOX 490 • NAPPANEE, INDIANA 46550
WEB: WWW.NTAINC.COM

PHONE: 574-773-7975
FAX: 574-773-2732

September 17, 2009
GEE091709-30

Mr. Michael O'Reardon, Regional Manager
ICC Evaluation Service, Inc.
Birmingham Regional Office
900 Montclair Road, Suite A
Birmingham, AL 35213

**SUBJECT:** Response to Proposed Revisions to the Acceptance Criteria for Molded Plastic Footing Pads, Subject AC49-1009-R1 (MO/BG)

Dear Mr. O'Reardon:

**Regarding Proposed Revision 2b:**

The settlement of an individual footer, which is assessed in the Acceptance Criteria, and the amount of settlement a structure can tolerate are two fundamentally different parameters. When considering an overall structure it is not the total settlement that is of importance but the *differential* settlement. As a result, large settlements in a structure can usually be tolerated if they are similar in magnitude at all parts of a foundation (Donald W. Taylor, *Fundamentals of Soils Mechanics,* Wiley, 1967, p 606).

The bearing capacity of soil is the average contact stress between a foundation and the soil which will cause shear failure in the soil. Allowable bearing stress is the bearing capacity divided by a factor of safety. Sometimes, on soft soils, large settlements may occur under loaded foundations without actual shear failure occurring; in such cases, the allowable bearing stress is determined with regard to a maximum allowable settlement, which is set at ¾-inch in the case of the Acceptance Criteria.

On the issue of total settlement verses differential settlement, Samuel E. French writes in *Design of Shallow Foundations*, ASCE Press, 1999, p 207:

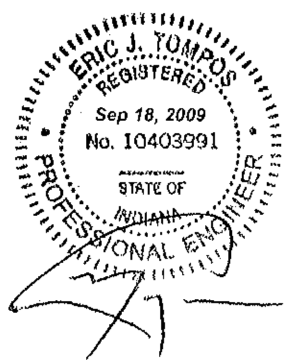
> ...The structural analysis is therefore concerned only with differential settlements, not with total settlements. In a group of footings, if the settlement of the footing that settles most is limited to 1", the differential settlement between any two footings in the group can be expected to be somewhat less than 1", say a maximum of ¾". ...There are hundreds of combinations of differential settlements that might occur in a routine structure. If however, the differential settlements are less than about ¾", the change in total stress in any of the structural members due to any reasonable combination of loads can be expected to be less than about 15% of the total. For this amount, a separate analysis for potential differential settlements is not usually considered to be necessary and is rarely performed in practice.

Extending French's example to the Acceptance Criteria settlement limit of ¾-inch, a structure utilizing such foundation elements would have less than ¾-inch differential settlement. And, as suggested by French, the resulting change in stress would be of a magnitude *not* requiring consideration by the designer.

Experience has shown that timber frame structures, especially post-frame structures, are more tolerant of differential settlements than more rigid types of construction, such as masonry. There is a wealth of anecdotal evidence relating incidents of a bearing post being removed either by accident or ignorance and the structure bridging the defect until repairs could be made.

In conclusion, it is my judgment that the proposed testing limit is a prudent and conservative test criteria which will keep *differential* settlements within tolerable limits.

Regards,




Eric Tompos, S.E., P.E.
Vice President
NTA, Inc.

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## Copyright Materials



# Post-Frame Building Design Methods and Resources

Presentation prepared by

Harvey B. Manbeck, P.E., PhD

Professor Emeritus
Penn State University

Technical Advisor
National Frame Building Association (NFBA)

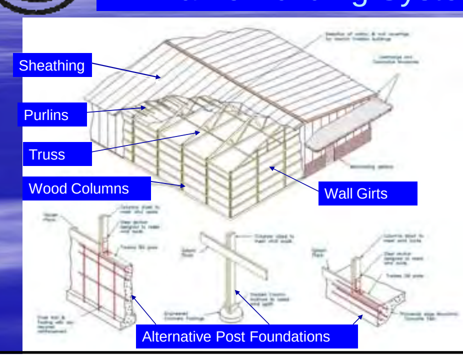
## Learning Objectives

- Identify the primary structural components of post frame (PF) building systems
- Identify the available resources for design of PF building systems
- Identify the two primary structural design methodologies for PF systems
- Learn the conceptual structural design approach for PF buildings with emphasis on those elements unique to PF systems

## Scope of the Presentation

- Presents the basic design procedures for PF
- Does not present calculations and structural detailing for a specific project; these are the topics for a one to two day NFBA Workshop on PF Design

## Pictorial of a Typical Post Frame Building System



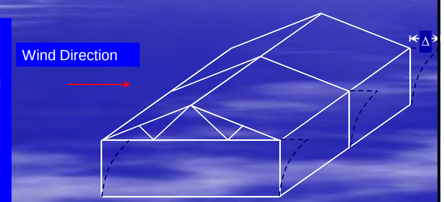
## Primary Design Approaches for PF Buildings

- 2-Dimensional Frame Design Method- Only covered very briefly.
- Diaphragm Design Method (3-Dimensional Approach)-Session Focus

## PF Response to Lateral Loads w/o Diaphragm Action

•Without diaphragm action each PF carries the full lateral wind load applied to tributary area of the frame

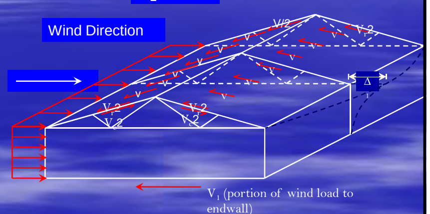
• Each post frame sways an amount, Δ at the eave




## PF Response to Lateral Loads with Diaphragm Action

• Portion of design lateral loading on sidewall and roof is transferred to the roof diaphragm
• The diaphragm exerts a resisting distributed shear force, v, to the post frame
•The post frame sway at the eave is $\Delta_1 < \Delta$ (sway of the post frame w/o diaphragm action)

$\Delta_1 < \Delta$




## Post-Frame Building Design Methods

- Advantages of Diaphragm Design in Post-Frame

  - Smaller sidewall wall posts

  - Shallower post or pier embedment depths

## Post-Frame Building Design Methods: Which to Use, When???

- 2-D Frame Method required for:

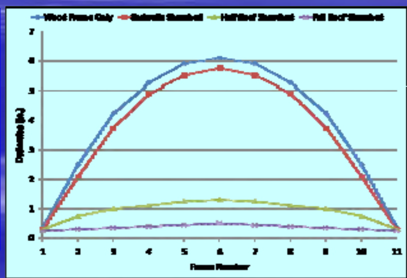
  - PF with open sidewalls or end walls
  - PF without adequate structural detailing or connection details to develop proper load paths for transfer of in-plane shear forces in and between the roof diaphragm and the shearwalls

## Post-Frame Building Design Methods: Which to Use, When???

- Diaphragm Design is used for nearly all modern PF building systems with enclosed end walls and sidewalls
  - More economical design
  - Greater structural integrity
  - More durable PF structures

## Comparison of 2-D vs. Diaphragm Design PF Performance

Fully sheathed roof and end walls reduced measured horizontal movement of eave by a factor of 12 over bare frame under typical design wind loads




## Key PF Technical Resources from NFBA


- This is the primary resource for post-frame design professionals

## Key Engineering Practices for PF

- ASAE (ASABE) EP 484, Diaphragm Design of metal-clad, post-frame rectangular buildings
- ASAE (ASABE) EP 486, Shallow post foundation design
- ASAE (ASABE) EP 559, Design requirements and bending properties for mechanically laminated columns
- EP 484, 486, and 559 referenced in Section 2306.1, IBC 2006

## PF Structural Design Resources

ASAE EPs available at:

www.asabe.org

or

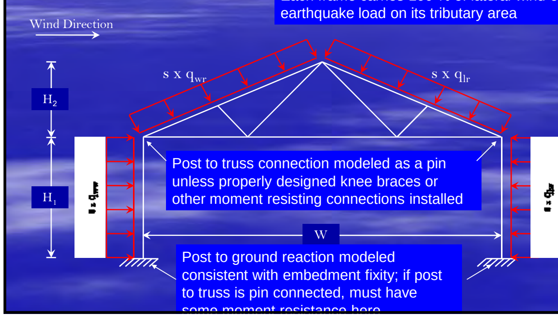
www.nfba.org

## PF Structural Design Resources

- AWC/AF&PA – (2005). National Design Specification (NDS) for Wood Construction and Supplements
- ASCE 7 - (2005) Minimum Design Loads for Buildings and Other Structures
- AWPA U1-04: USE CATEGORY SYSTEM: User Specification for Treated Wood

## 2-D Frame Design Method

Each frame carries 100 % of lateral wind or earthquake load on its tributary area




Post to truss connection modeled as a pin unless properly designed knee braces or other moment resisting connections installed

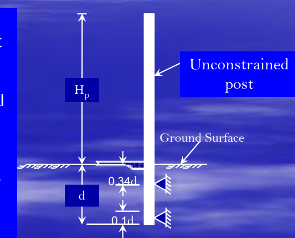
Post to ground reaction modeled consistent with embedment fixity; if post to truss is pin connected, must have some moment resistance here

## 2-D Frame Design Method

- Except for the modeling of the post-soil interaction, design similar to any other 2-D wood frame
- The most common post-soil fixity models are the
  - constrained post
  - unconstrained post

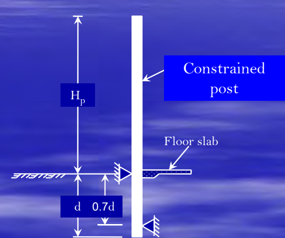
## PF Fixity Models for Post to Soil Interaction

•Shown is an approximate soil-post fixity model for a first estimate of the location of the vertical roller support for the unconstrained post case
•Procedures for more precise estimates of the pin and roller locations are discussed later

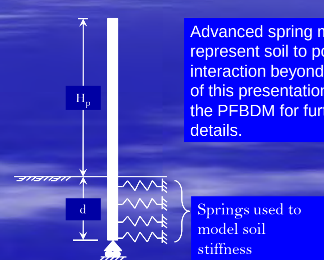



## PF Fixity Models for Post to Soil Interaction

•Shown is an approximate soil-post fixity model for a first estimate of the location of the vertical roller support for the constrained post case
•Procedures for more precise estimates of the location are discussed later




## PF Fixity Models for Post to Soil Interaction

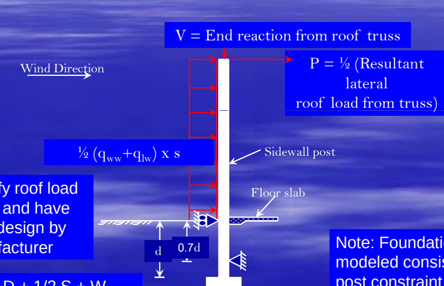



Advanced spring models to represent soil to post interaction beyond scope of this presentation; See the PFBDM for further details.

## 2-D Frame Design Method

- Conduct structural analysis using any standard computer analysis/design program which incorporates NDS wood design requirements and calculates Interaction Values for combined bending and compression/tension of wood members
- Consider the several load combinations prescribed in ASCE 7
- Dead + ½ Snow + Wind usually controls post design
- Dead + Snow usually controls roof framing design

## Simplified 2-D Post-Frame Design Method




Specify roof load levels and have truss design by manufacturer

Post: D + 1/2 S + W
Roof Framing: D+ S

Note: Foundation modeled consistent with post constraint at ground line

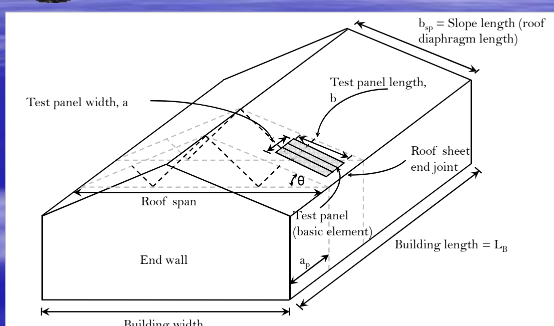
## 2-D Frame Design Method

- Once post moments and shears at ground line determined, post-embedment depth determined using ASAE EP 486.1
- Post embedment requirements covered more fully after presentation of Diaphragm Design methodology
- Post, purlin, girt, etc. design then follows NDS specs for combined loading; i.e.; I ≤ 1.0

## Diaphragm Design Method

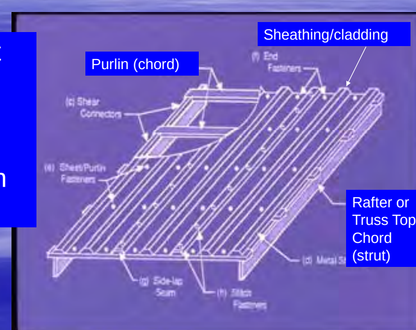
- Incorporates the contribution of the in-plane strength and stiffness of the sheathing (metal cladding or structural wood panels) in the roof and endwalls
- A 3-D approach
- Results in significant decreases in wall framing materials (At least one nominal size difference in post cross section dimensions)

## Diaphragm Design Method




## Post Frame Building Design-Diaphragm Design

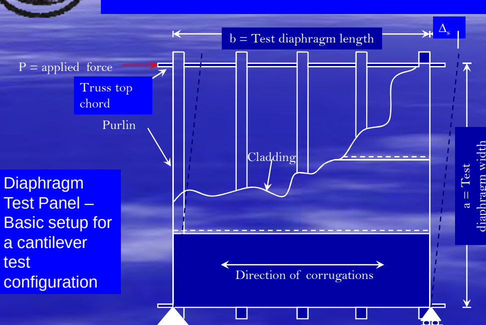
Typical Post Frame Diaphragm Panel Construction and Details




## Diaphragm Design Method

- In-plane shear strength and stiffness of the roof and endwall diaphragms usually obtained by testing small diaphragm test panels
- Recently sponsored research at NFBA developed calculation procedures to predict the in-plane shear strength and stiffness of metal-clad, wood-frame structural diaphragms
- NFBA now working to obtain IBC adoption of the calculation procedures for panel strength/stiffness

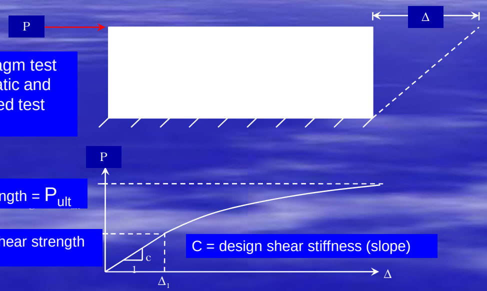
## Diaphragm Design Method




Diaphragm Test Panel – Basic setup for a cantilever test configuration

## Diaphragm Design Method

Diaphragm test schematic and simplified test results



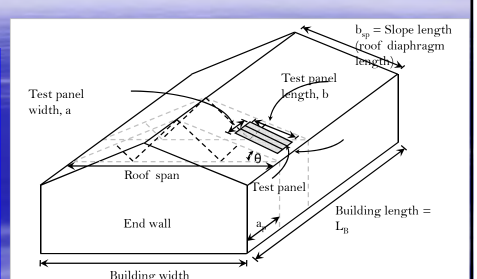

Ult. Strength = $P_{ult}$

Design shear strength = 0.4 $P_{ult}$

C = design shear stiffness (slope)

## Diaphragm Design Method

- Test Panel width, a, is often, but not necessarily, the same as the PF bay spacing, $a_p$
- Test diaphragm length, b, is usually much smaller than the roof diaphragm panel length, $b_{sp}$




- Thus the actual roof or ceiling panel shear strength and stiffness must be deduced from the small test panel results

## Diaphragm Design Method

- The in-plane shear stiffness of a roof or ceiling diaphragm with width $a_p$ and slope length $b_{sp}$ derived from basic mechanics is:

$$c_p = c\,(a/b)\,(b_{sp}/a_p)$$

- In-plane strength is a linear function of diaphragm length, $b_{sp}$

V = (unit shear)(roof diaphragm length)

$$V = 0.4(P_{ult}/b)(b_{sp})$$

## Diaphragm Design Method

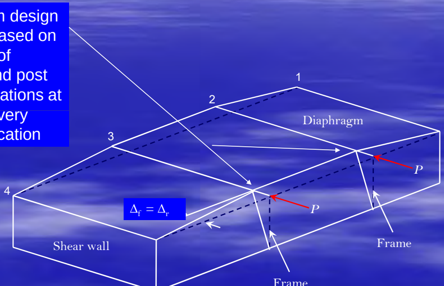
- For a roof diaphragm sloped at angle, Θ, the in-plane stiffness in the horizontal direction , $c_h$ is defined as:

$$c_h = c_p\,(\cos^2 \Theta)$$

- The horizontal stiffness component is required later in the development for compatibility of horizontal displacements of the post frame and the roof diaphragm at the building eave line.

## Diaphragm Design Method

PF diaphragm design procedures based on compatibility of diaphragm and post frame deformations at the eave at every post frame location




## Diaphragm Design Method

- For compatibility of deformations at the eave,

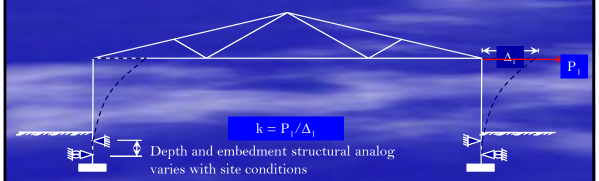
$$\Delta_{ri} = \Delta_{fi}$$

where $\Delta_{ri} = f(c_{h,i}, c_{h,i+1}, k_i)\,P_i$

$$\Delta_{fi} = P_i/k_i$$

## Diagram Design Method

Determination of frame stiffness, k, and diaphragm stiffness, $c_h$, are the first steps in the PF diaphragm method




## Diaphragm Design Method

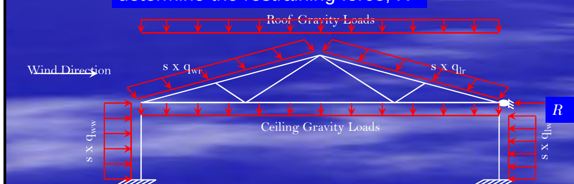
- ASAE EP and NFBAs PFBDM procedures for PF cases for which:
  - post frames are equally spaced
  - all interior post frames have equal stiffness, k
  - both endwalls have the same stiffness, $k_e$
  - all roof and ceiling diaphragms have equal stiffness

## Diaphragm Design Method

- ASAE EP approach yields results for the most highly loaded frame (centermost post) and maximum shear load in diaphragm (at endwall)
- Methods for post frames buildings which don't meet the scope and limitations of the EP are also included in PFBDM

## Diaphragm Design Method

Apply a vertical roller to the bare post frame at the eave and determine the restraining force, R




## Diaphragm Design Method-Post Design

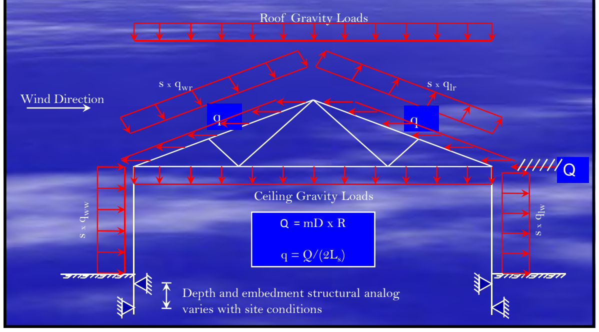
- Calculate the ratio, $c_h/k$
- Determine the proportion, mD, of the eave roller reaction force, R, that is transferred to the frame by the roof diaphragm
  - mD = f($c_h$/k, $k_e$/k, N) = sway restraining force factor
  - $k_e$ = stiffness of the bare endwall post frame
  - mD values tabulated in ASAE EP 484 and in the PFBDM for range of $c_h$/k nd $k_e$/k ratios and N, the number of post frames in the building

## Diaphragm Design Method-Post Design

- Selected mD values from Table 5.2 of the PFBDM
- mD = sideway restraining force modifier

| | $k_e/k$ | $C_h/k$ | N = 3 | N = 5 | N = 10 |
|---|---|---|---|---|---|
| Soft Diaph | 5 | 5 | 0.75 | 0.52 | 0.18 |
| | 5 | 1000 | 0.82 | 0.69 | 0.50 |
| | 50 | 5 | 0.81 | 0.68 | 0.26 |
| Stiff Diaph | 50 | 1000 | 0.98 | 0.96 | 0.91 |

## Diagram Design Method- Post Design




## Diaphragm Design Method- Post Design

- Conduct the structural design analysis of the post frame with the design loads and the distributed sidesway restraining force, q
- The controlling design load is usually the Dead + ½ Snow + Wind or Earthquake combination
- However, it is often prudent to conduct the design analysis for each design load combination with lateral load components
- Note that R and Q are not the same for each load combination

## Diaphragm Design Method- Diaphragm Strength Check

- Diaphragm Strength Check
  - Roof diaphragm strength, $V_{all}$ varies linearly with panel length

    $V_{all}$ = v (Length of roof diaphragm)

    v = unit shear strength of diaphragm from panel tests ($0.4P_{ult}/b$)
- Design Criteria for Diaphragm Shear Capacity

  $V_{max} \leq V_{all}$

## Diaphragm Design Method- Diaphragm Strength Check

- Maximum Shear in Roof Diaphragm Occurs in Outermost Diaphragm panel (at the endwall)
- $V_{max} = V_h$ = mS (R)------HORIZONTAL component
- mS = shear force modifier
- mS = $f(c_h/k, k_e/k, N)$

## Diaphragm Design Method- Diaphragm Strength Check

- Selected mS values from Table 5.1 of the PFBDM

| $k_e/k$ | $C_h/k$ | N = 3 | N = 5 | N = 10 |
|---|---|---|---|---|
| 5 | 5 | 0.88 | 1.33 | 1.65 |
| 5 | 1000 | 0.91 | 1.54 | 2.49 |
| 50 | 5 | 0.95 | 1.79 | 2.14 |
| 50 | 1000 | 0.99 | 1.94 | 4.14 |

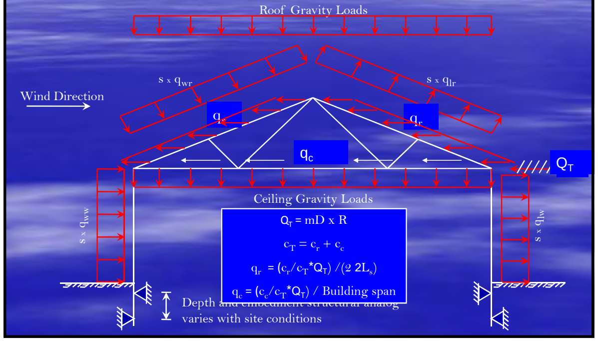
## Diaphragm Design Method- Diaphragm Strength Check

- Note that $V_h$ is the horizontal component of the shear force in the roof panel and in the roof diaphragm to shearwall connections
- For diaphragms sloped at an angle, Θ, the in-plane shear force, $V_p$ is
  - $V_p = V_{max} = V_h/\cos\Theta$

## Diaphragm Design Method- Diaphragm Strength Check

- Diaphragm Strength must exceed $V_{max}$
- Connections between the end of roof diaphragm and the top of the endwall must be able to transfer $V_{max}$ to the shearwall
- The shear wall in-plane shear strength must be greater than $V_p = V_{max}$

## Diaphragm Design Method- Roof and Ceiling Diaphragm




## Diaphragm Design Method- Roof and Ceiling Diaphragm

- Diaphragm maximum shear force, $V_T$

  $V_T = mS\ (R)$

- Distribution of $V_T$ to roof and ceiling diaphragms

  $V_r = c_r/c_T\ (V_T)$

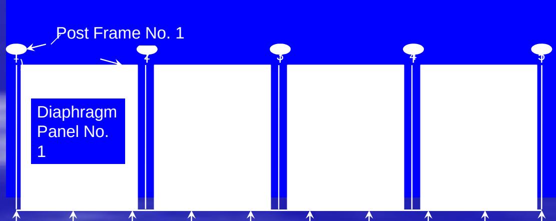
  $V_c = c_c/c_T\ (V_T)$

## Diaphragm Design Method – DAFI

- DAFI is a computer based PF diaphragm analysis program that calculates eave displacements, frame element loads, and diaphragm element shear forces for each post frame in the building
- DAFI inputs are post frame eave loads, $P_i$, stiffness, $k_i$, for each post frame and diaphragm stiffness, $c_{hi}$, for each diaphragm element in the post frame building

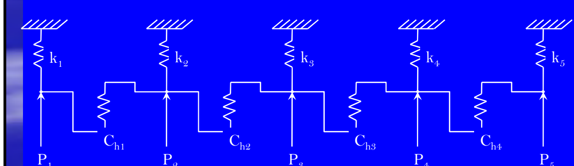
## Diaphragm Design Method – DAFI

- Panel and PF Layout for Structural Analog of a 4 Bay Building for DAFI




## Diaphragm Design Method – DAFI

- Spring analogy for DAFI Solution for a 4 bay PF building system; roof diaphragm represented by individual frame and diaphragm panel stiffnesses and eave loads



## Diaphragm Design Method – DAFI

- DAFI more flexible because it can be used for for post frame building systems for which:
  - the stiffnesses, $k_i$, of each post frame element are **not** the same
  - the stiffnesses, $c_{hi}$, of each diaphragm panel element are ***not*** the same
  - the stiffnesses of the two endwalls are ***not*** the same

## Diaphragm Design Method – DAFI

- DAFI is available to designers on-line at:

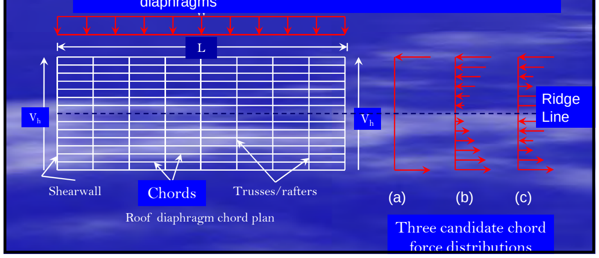
www.nfba.org

## Diaphragm Design Method – Diaphragm Chord Forces

(a) – outside chords carry entire chord force

(b) - all chords loaded; two roof slopes act as one diaphragm

(c) - all chords loaded; two roof slopes act as two independent diaphragms




## Diaphragm Design Method – Diaphragm Chord Forces

- Diaphragm bending moment, $M_d$

  $M_d = V_h L/4 = wL^2/8$

- Maximum chord force, $P_e$

  $P_e = M_d \alpha / b$

  $\alpha$ = f(chord force distribution)

## Diaphragm Design Method – Diaphragm Chord Forces

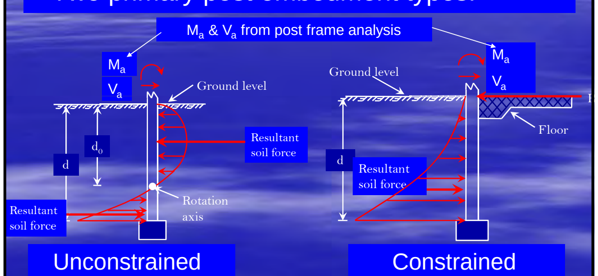
- Chord force distribution factor, α

  α = 1 (conservative, assumes outer chord carries all the force)

  α defined for other cases on page 5-16 of the PFBDM (includes the chord force distributions in a previous slide

## Post/Pier Embedment Design

- Two primary post embedment types:




Procedures for calculating depth documented in PFBDM and ASAE EP 486

## Post Embedment Design

- Post embedment details must resist:
  - Shear force and moments from lateral loadings
  - Uplift post loads
  - Downward acting gravity loads

  (Nothing unique to post-frame)

## Post/Pier Embedment Design-Unconstrained Case

- $d^2 = (6V_a + 8\ M_a/d)/(S'b)$

  d = embedment depth

  $V_a$, $M_a$ = shear and bending moment applied to foundation at ground surface (from PF structural analysis)

  S´ = adjusted allowable lateral soil pressure

  b = eff. post width (1.4B if narrow width of rectangular post pushing on soil)

  B = narrow width of the post

## Post Embedment Design-Unconstrained Case

- Embedment depth solution requires an iterative solution
  - $M_a$ and $V_a$ depend upon post embedment analog in frame design/analysis
  - d depends up magnitude of $M_a$ and $V_a$
  - d = 4 to 4.5 ft. is a good 1st assumption

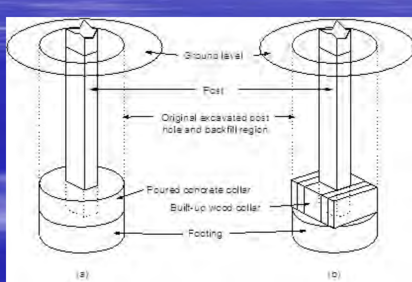
## Post/Pier Embedment-Constrained Case

$$d = [4\ M_a / S'\ b]^{1/3}$$

(Terms same as defined for the unconstrained case)

## Post Foundations – Special Considerations

Concrete collars around posts embedded in ground

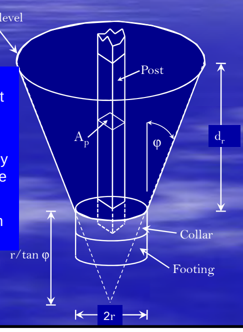



## Post Embedment – Design for Post Uplift Forces

- Uplift resistance provided by:
  - mass of the footer and any collar mechanically attached to bottom of the post
  - mass of truncated cone of soil above any footer and collar mechanically attached to the post

## Post Embedment – Design for Post Uplift Forces

- Mass of soil in shaded truncated cone resists post withdrawal due to uplift forces
- Post must be mechanically attached to the collar or the footing
- Equation for volume given in PFBDM




## Special Considerations for Post Foundations

- Place footer below frost line
- Do not use partial concrete collars immediately below ground line (top collars)
- Provide good drainage away from post holes
- Use only preservative treated wood for all wood elements in contact with the ground

## Post Frame Design Consideratons

- Alternative PF foundations summarized in presentation, "Introduction to PF Building Systems"
- Alternative wood posts (solid sawn, glue-laminated, and nail-laminated) summarized in same presentation

## Special Considerations for Post Frame Design

- Use hot dipped galvanized or stainless hardware for all below ground applications
- Use hot dipped galvanized or stainless hardware when in contact with preservative treated wood. (Contact preservative treatment suppliers for recommendations)

## Post Frame Building Design

- Primary differences include:
  - Embedded posts, or one of the post foundation alternatives, serve as building foundation
  - Diaphragm design procedures for post frame are unique, but well formulated and documented
  - PF very often utilizes mechanically or glued laminated sidewall and endwall posts

## More Information about Post Frame???

NFBA (National Frame Building Association)

www.PostFrameAdvantage.com
or
www.NFBA.org

OR

NFBA
4840 Bob Billings Parkway
Lawrence, KS 66049-3862

## Post Frame Building Design

Questions????

## Today's Agenda

8:30 am - 9:30 am:

*Wood Framing in Commercial Buildings –Yes You Can Design with Wood*

Scott Lockyear, P.E. , Woodworks

9:40 am – 10:40 am:

*Introduction to Post-Frame Construction, Buildings & Design*

Dr. Harvey Manbeck, P.E., Professor Emeritus of Agricultural Eng, PSU.

10:50 am – 11:50 am:

*Post-Frame Building Design Resources & Design Methods*

Dr. Harvey Manbeck, P.E., Professor Emeritus of Agricultural Eng, PSU

11:50 am – 1:00 pm: Lunch Served

6/28/10

To: Michael O'Reardon, P.E.
FROM: Gerald Eckhoff, P.E.

RE: Proposed Revisions to the Acceptance Criteria for Molded Plastic Footing Pads, Subject AC49-0610-R1 (MO/BG)

Comments requested by staff;

**Item a)** A very few post-frame residential units are ever built since they are mostly required to have conventional construction on the inside including concrete foundations and stud walls between the post. We may want to exclude these from section 1.1.2.

**Item b)** Please refer to page 11 of the attached power point presentation, which indicate how collars at the base of column provide for uplift and pages 3 and 4 referencing embedded post design for lateral resistance.
Also refer to the letter from Harvey B. Manbeck, P.E. from The National Frame Building Association (NFBA).

**Item c)** Please refer to the letter from Eric Tompos, S.E., P.E. of NTA Inc. testing.

**Item d) i –v.** Again, refer to the attached complete power point presentation by Manbeck. This was a result of full scale testing by the University of Wisconsin.
It is possible that post-frame system may fit into the category as suggested in item v., but most likely will have its own type of building once post-frame is further understood.

Let me know if additional information or clarifications are needed