Outline

- Lateral load basics
- Code acceptance of Standard
- 2005/2008 Wind & Seismic Standard Overview
- 2008 Wind & Seismic Standard

Load Path

- Wind
- Seismic (Earthquake) Motion
- IBC Section 1604.4 requires complete load path

Lateral Loads

- Wind Load Path
- Diaphragm SUPPORTS out-of-plane walls
- In-plane walls SUPPORT diaphragm

Image courtesy APA – The Engineered Wood Association 2003

Image courtesy APA – The Engineered Wood Association 2003
Building Response Motions

- horizontal force transfer
  - in-plane shear

\[ V_{\text{max}} \text{ at edges} \]

Building Response Motions

- torsion \[ \text{mass center} \neq \text{stiffness center} \]

Lateral Structural Elements

- Shear wall
- Drag strut (or collector)
- Diaphragm
- Collector beam (or drag strut)

Shear Wall - Parts

- Five parts of a shear wall

1. wood frame
2. wood structural panels
3. nails
4. plate anchors
5. hold downs
Shear Wall - Types

1. Individual Full-Height Wall Segments
2. Perforated Shear Walls
3. Force Transfer Shear Walls

- Moves hold downs to corners
- With or without force transfer around openings

Diaphragm - Types

- Rigid
  - Diaphragm behaves as a fully rigid body
  - $\Delta_{\text{diaphragm}} \leq 2\Delta_{\text{shearwalls}}$
  - Inherent and accidental torsion considered in design

- Flexible
  - Diaphragm behaves as a series of simple beams
  - $\Delta_{\text{diaphragm}} > 2\Delta_{\text{shearwalls}}$
  - No torsion
  - Tributary loading to vertical resisting elements (shear walls)

Drag Struts and Collectors

- “collects” diaphragm load and “drags” it back to a shear wall
- Occur most frequently at junction of diaphragm and shear wall

Collector Beam in Floor

- For “wall continuity”
Drag Strut in Wall

- Usually the top plate serves as collector and diaphragm chord
- Might be window or door header

Code Acceptance of Standard

- **2006 IBC**
  - Permitted alternative to Section 2305
  - References 2005 SDPWS

- **2009 IBC**
  - Mandatory
  - References 2008 SDPWS in Section 2305 for lateral design and construction

General Overview

Scope:

“The provisions of this document cover materials, design and construction of wood members, fasteners, and assemblies to resist wind and seismic forces.”

ASD and LRFD

Outline

- Chapter 1: Flowchart
- Chapter 2: General Design Requirements
- Chapter 3: Members and Connections
- Chapter 4: Lateral Force Resisting Systems
Chapter 1 – Designer Flowchart

Chapter 2 – General Requirements

- General
- Terminology
- Notation

2.1 General

2.1.1 Scope

The provisions of this document cover materials, design and construction of wood members, barriers, and assemblies to resist wind and seismic forces.

2.1.2 Design Methods

Engineered design of wood structures to resist wind and seismic forces shall be by one of the methods described in 2.1.1 and 2.1.2.

Recommendations: Wood structures shall be designed to be constructed in accordance with prescriptive provisions permitted by the authority having jurisdiction.

2.2 Terminology

ALLOWABLE STRESS DESIGN: A method of design that recognizes the properties of a material and their interactions. S liberals do not record specified allowable deflection when the structure is subjected to interaction load combinations (also called working stress design).

LOAD REDUCTION FACTOR: A factor to reduce nominal strength to an allowable stress designed (ASD) or working stress designed (WSD) capacity.

BOUNDARY ELEMENT: Diaphragms and shear walls are assumed to be sufficient to resist shear forces to which the structure is subjected.

Chapter 2 – Design Methodologies

2.1.7 Allowable Stress Design: Allowable stress design (ASD) shall be in accordance with the National Design Specification® (NDS®) for Wood Construction (ANSI/AF&PA NDS-05) and provisions of this document.

2.1.2 Strength Design: Load and resistance factor design (LRFD) of wood structures shall be in accordance with the National Design Specification (NDS) for Wood Construction (ANSI/AF&PA NDS-05) and provisions of this document.

Chapter 3 – Members and Connections

- Framing
- Sheathing
- Connections

• Covers out-of-plane wind load resistance of shear walls and diaphragms
Chapter 3 - Members and Connections

Framing – walls
• Accounts for composite action

<table>
<thead>
<tr>
<th>Stud Size</th>
<th>System Factor</th>
</tr>
</thead>
<tbody>
<tr>
<td>2x4</td>
<td>1.50</td>
</tr>
<tr>
<td>2x6</td>
<td>1.35</td>
</tr>
<tr>
<td>2x8</td>
<td>1.25</td>
</tr>
<tr>
<td>2x10</td>
<td>1.20</td>
</tr>
<tr>
<td>2x12</td>
<td>1.15</td>
</tr>
</tbody>
</table>

Extension of 1.15 repetitive member factor, Cr

Sheathing – walls

<table>
<thead>
<tr>
<th>Table 3.2.1 Nominal Uniform Load Capacities (psf) for Wall Sheathing Resisting Out-of-Plane Wind Loads</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sheathing Type</td>
</tr>
<tr>
<td>----------------</td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td>Plywood</td>
</tr>
<tr>
<td></td>
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<tr>
<td></td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td></td>
</tr>
</tbody>
</table>

Chapter 3 - Members and Connections

Sheathing – roof

<table>
<thead>
<tr>
<th>Table 3.2.2 Nominal Uniform Load Capacities (psf) for Roof Sheathing Resisting Out-of-Plane Wind Loads</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sheathing Type</td>
</tr>
<tr>
<td>----------------</td>
</tr>
<tr>
<td></td>
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<tr>
<td>Plywood</td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td></td>
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</tr>
<tr>
<td></td>
</tr>
</tbody>
</table>

Chapter 4 - Lateral Force-Resisting Systems

• General
• Wood Diaphragms
• Wood Shear Walls

• Covers in-plane wind and seismic load resistance of shear walls and diaphragms
Chapter 4 - Lateral Force-Resisting Systems

Wood Diaphragms

4.2.2 Deflection

Calculations of diaphragm deflection shall account for bending and shear deflections, fastener deformation, chord splice slip, and other contributing sources of deflection.

The diaphragm deflection, \( \delta_{di} \), is permitted to be calculated by use of the following equation:

\[
\delta_{di} = \frac{5vL^3}{384EA} + \frac{0.25vL}{1000Gb} + \frac{\sum(xA_x)}{2W} \quad (4.2-1)
\]

Chapter 4 - Lateral Force-Resisting Systems

Wood Diaphragms

\[
G_a = \frac{\nu}{G_s + 0.75c_s}
\]

where:

- \( G_s \) = panel shear stiffness, lb/inch of panel depth;
- \( c_s \) = nail slip, inches; and
- \( \nu = 1.4 \) times the ASD unit shear value of the shear wall or diaphragm, plf.

Chapter 4 - Design Value Format

Nominal design values tabulated for diaphragms:

- ASD reduction factor (2.0)
- LRFD resistance factor \( \phi \) (0.80)

4.2.3 Unit Shear Capacities

Nominal unit shear capacities for seismic design are provided in Column A of Tables 4.2A, 4.2B, and 4.2C, and for wind design in Column B of Tables 4.2A, 4.2B, and 4.2C. The ASD allowable unit shear capacity shall be determined by dividing the nominal unit shear capacity by the ASD reduction factor of 2.0. No further increases shall be permitted. The LRFD factored unit resistance shall be determined by multiplying the nominal unit shear capacity by a resistance factor, \( \phi \), of 0.80.
Chapter 4 - Lateral Force-Resisting Systems

Wood Diaphragms

Table 4.2.4 Maximum Diaphragm Aspect Ratios
(Horizontal or Sloped Diaphragms)

<table>
<thead>
<tr>
<th>Diaphragm</th>
<th>Maximum Sheathing Type</th>
<th>L/W Ratio</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wood structural panel, unblocked</td>
<td>3:1</td>
<td></td>
</tr>
<tr>
<td>Wood structural panel, blocked</td>
<td>4:1</td>
<td></td>
</tr>
<tr>
<td>Single-layer straight lumber sheathing</td>
<td>2:1</td>
<td></td>
</tr>
<tr>
<td>Single-layer diagonal lumber sheathing</td>
<td>3:1</td>
<td></td>
</tr>
<tr>
<td>Double-layer diagonal lumber sheathing</td>
<td>4:1</td>
<td></td>
</tr>
</tbody>
</table>

Chapter 4 – Nominal Design Value

Wind nominal unit shear capacity $v_w$
- IBC allowable stress design value $\times 2.8$

Seismic nominal unit shear capacity $v_s$
- $v_s = \frac{v_w}{1.4}$

Table 4.2A Nominal Unit Shear Capacities for Wood-Frame Diaphragms

Chapter 4 - Lateral Force-Resisting Systems

Wood Shear Walls

4.3.2 Deflection

Calculations of shear wall deflection shall account for bending and shear deflections, fastener deformation, anchorage slip, and other contributing sources of deflection.

The shear wall deflection, $\delta_{sw}$, is permitted to be calculated by use of the following equation:

$$\delta_{sw} = \frac{8vh^2}{EAb} \times \frac{v}{1000G_{da}}$$

(4.3.1)

Chapter 4 – Design Value Format

Nominal design values tabulated for shear walls:
- ASD reduction factor (2.0)
- LRFD resistance factor $\phi$ (0.80)

4.3.3 Unit Shear Capacities

The ASD allowable unit shear capacity shall be determined by dividing the tabulated nominal unit shear capacity, modified by applicable footnotes, by the ASD reduction factor of 2.0. No further increases shall be permitted. The LRFD factored unit resistance shall be determined by multiplying the nominal unit shear capacity by a resistance factor $\phi$, of 0.80.
Chapter 4 - Lateral Force-Resisting Systems

Wood Perforated Shear Walls

Table 4.3.3.4 Shear Capacity Adjustment Factor, Gc

<table>
<thead>
<tr>
<th>Wall Height, k</th>
<th>h/b, Ratio 1</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>8</th>
<th>10</th>
</tr>
</thead>
<tbody>
<tr>
<td>6′ Wall</td>
<td>0.87</td>
<td>0.87</td>
<td>0.91</td>
<td>0.93</td>
<td>0.95</td>
<td>1.00</td>
<td></td>
</tr>
<tr>
<td>8′ Wall</td>
<td>0.67</td>
<td>0.71</td>
<td>0.71</td>
<td>0.77</td>
<td>0.83</td>
<td>1.00</td>
<td></td>
</tr>
<tr>
<td>10′ Wall</td>
<td>0.57</td>
<td>0.60</td>
<td>0.67</td>
<td>0.77</td>
<td>0.83</td>
<td>1.00</td>
<td></td>
</tr>
</tbody>
</table>

Effective Shear Capacity Ratio

1. For design to resist seismic forces, the shear wall aspect ratio shall not exceed 2:1 unless the nominal unit shear capacity is multiplied by 2b/h.
2. Walls having aspect ratios exceeding 4:1 shall be blocked.

Panel Widths for Shear Walls

- 4.3.7.1…Panels shall not be less than 4′x8′, except at boundaries and changes in framing where 24″ is allowed unless spacing members or blocking is provided at the edges of all panels.

Adhesive Attachment of Shear Wall Sheathing

Table 1.—Adhesive attachment of shear wall sheathing.

<table>
<thead>
<tr>
<th>Seismic design category</th>
<th>Seismic design coefficient</th>
</tr>
</thead>
<tbody>
<tr>
<td>SDPWS</td>
<td>IBC 2006</td>
</tr>
<tr>
<td>A, B, and C</td>
<td>R = 1.5, Ω0 = 2.5</td>
</tr>
<tr>
<td>D</td>
<td>Not permitted</td>
</tr>
</tbody>
</table>

SDPWS 4.3.6.3.1 Exception…
Chapter 4 – Nominal Design Value

Wind nominal unit shear capacity \( v_w \)
- IBC allowable stress design value \( \times 2.8 \)

Seismic nominal unit shear capacity \( v_s \)
- \( v_s = v_w / 1.4 \)

Chapter 4 – Nominal Unit Shear Capacities

**ASD Reduction factor = 2.0**
- Wind \( v_w / 2.0 \)
- Seismic \( v_s / 2.0 \)

**LRFD \( \phi = 0.8 \)**
- Wind \( v_w \times 0.8 \)
- Seismic \( v_s \times 0.8 = v_w / 1.4 \\
  = v_w \times 0.57 \)

LRFD has up to 12% strength benefit for seismic design for shear when using the following IBC load factors:
- LRFD: 1.0E or 1.6W
- ASD: 0.7E or 1.0W

Chapter 4 - Lateral Force-Resisting Systems

**Summing Shear Capacities**
- 4.3.3.2 Summing Shear Capacities… For shear walls sheathed with dissimilar materials on opposite sides, the combined nominal unit shear capacity, \( (v_{sc}) \) or \( (v_{wc}) \), shall be either two times the smaller nominal unit shear capacity or the larger nominal unit shear capacity, whichever is greater.

Appendix A

**Nominal Shear Capacity Tables**
- Wood-Frame **Plywood Blocked Wood Structural Panel Diaphragms**
- Wood-Frame **Plywood Unblocked Wood Structural Panel Diaphragms**
- Wood-Frame **Plywood Shear Walls**

**Table A.4.2A Nominal Unit Shear Capacities for Wood-Frame Plywood Diaphragms**
2008 Wind & Seismic Standard

Top Ten Changes!
1. High load diaphragms
2. WSP - combined uplift and shear
3. Unblocked shear walls
4. Shear wall anchorage provisions - 3x square
5. WSP over gypsum shear walls
6. Shear walls sheathed on 2 sides
7. Fiberboard shear wall aspect ratio adjustment
8. Increased strength limit for PSW
9. PSW shear strength equation
10. Appendix: Standard Nail Sizes and Cut Washers

High Load Diaphragms (4.2.7.1.2)
- Consistent with IBC 2006
- Includes apparent shear stiffness (G_a)

Table 4.2B Nominal Unit Shear Capacities for Blocked Wood-Frame Diaphragms Utilizing Multiple Rows of Fasteners (High Load Diaphragms)

<table>
<thead>
<tr>
<th>Sheathing Grade</th>
<th>Common Nail Size</th>
<th>Minimum Purlin Sheathing Thickness (In.)</th>
<th>Minimum Nailing Material Thickness (%)</th>
<th>Nailing Material Width (In.)</th>
<th>Minimum Panel Edge Blocking (In.)</th>
<th>L/H/V Ratio of Panel Derate</th>
</tr>
</thead>
<tbody>
<tr>
<td>Treated Wood</td>
<td>10d</td>
<td>1-1/2</td>
<td>15/32</td>
<td>2</td>
<td>2</td>
<td>4</td>
</tr>
<tr>
<td>Structural</td>
<td>10d</td>
<td>1-1/2</td>
<td>15/32</td>
<td>2</td>
<td>2</td>
<td>4</td>
</tr>
<tr>
<td>Structural</td>
<td>10d</td>
<td>1-1/2</td>
<td>15/32</td>
<td>3</td>
<td>2</td>
<td>4</td>
</tr>
<tr>
<td>Structural</td>
<td>10d</td>
<td>1-1/2</td>
<td>15/32</td>
<td>4</td>
<td>3</td>
<td>4</td>
</tr>
</tbody>
</table>

High Load Diaphragms
- 4.2.7.1.2 rules for building them
- Need 3" or greater nominal members

The width of the nailed face of framing members and blocking shall be 3" nominal or greater. The width of the nailed face not located at boundaries or adjoining panel edges shall be 2" nominal or greater.
Combined Wind Uplift & Shear - WSP

• Wood structural panels (WSP)
  – Resist combined wind uplift and shear
  – Resist tension only from wind uplift
  – Alternate to metal straps

Table 4.4.1 Shear & Uplift

- amount of available uplift capacity beyond shear capacity

Combined Wind Uplift & Shear - WSP

- Tabulated capacity limits based on recent testing
- Minimum panel thickness = 7/16"
- Minimum spacing of fasteners in a row = 3"
- Figures show critical details

Critical details

- Note minimum edge distance is 1/2"
Combined Wind Uplift & Shear - WSP

Multi-story – sheets break at band joist

Combined Wind Uplift & Shear - WSP

Multi-story – sheets break at stud mid-height

Combined Wind Uplift & Shear - WSP

Sheathing tension splice options (blocking of free edges)

- 110 MPH Exposure B
- Uplift to resist: 277 plf
  - Use \(2.0 \times 277 = 554\) plf and Table 4.4.1 below

**Table 4.4.1 Nominal Uplift Capacity of 7/16" Minimum Wood Structural Panel Sheathing or Siding When Used for Both Shear Walls and Wind Uplift Simultaneously over Framing with a Specific Gravity of 0.42 or Greater**

<table>
<thead>
<tr>
<th>Uplift Capacity psi</th>
<th>0</th>
<th>100</th>
<th>200</th>
<th>300</th>
<th>400</th>
<th>500</th>
<th>600</th>
</tr>
</thead>
<tbody>
<tr>
<td>6d Common Nail</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4&quot; panel edge spacing</td>
<td>12°</td>
<td>10°</td>
<td>8°</td>
<td>6°</td>
<td>4°</td>
<td>2°</td>
<td>0°</td>
</tr>
<tr>
<td>6d Common Nail</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>6&quot; panel edge spacing</td>
<td>12°</td>
<td>10°</td>
<td>8°</td>
<td>6°</td>
<td>4°</td>
<td>2°</td>
<td>0°</td>
</tr>
<tr>
<td>6d Common Nail</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4&quot; panel edge spacing</td>
<td>12°</td>
<td>10°</td>
<td>8°</td>
<td>6°</td>
<td>4°</td>
<td>2°</td>
<td>0°</td>
</tr>
<tr>
<td>6d Common Nail</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>6&quot; panel edge spacing</td>
<td>12°</td>
<td>10°</td>
<td>8°</td>
<td>6°</td>
<td>4°</td>
<td>2°</td>
<td>0°</td>
</tr>
</tbody>
</table>

Combined Wind Uplift & Shear - WSP

Nail spacing limited to address tension perp
Example: Splice over studs

- Uplift too high to allow multi-story splice to occur over band joist, so design splice over studs

4.4.1.7 Splicing Splices
1. In multi-story applications where the upper story and lower story sheathing adjoin over a common horizontal framing member, the nail spacing shall not be less than 3” o.c. for a single row or 6” o.c. for a double row. In Table 4.4.1 (see Figure 4.4a).

<table>
<thead>
<tr>
<th>Nail</th>
<th>Single Row</th>
<th>Double Row</th>
</tr>
</thead>
<tbody>
<tr>
<td>8d</td>
<td>1400</td>
<td>1600</td>
</tr>
<tr>
<td>6d</td>
<td>1200</td>
<td>1400</td>
</tr>
<tr>
<td>5d</td>
<td>1000</td>
<td>1200</td>
</tr>
<tr>
<td>4d</td>
<td>800</td>
<td>1000</td>
</tr>
<tr>
<td>3d</td>
<td>600</td>
<td>800</td>
</tr>
<tr>
<td>2d</td>
<td>400</td>
<td>600</td>
</tr>
<tr>
<td>1d</td>
<td>200</td>
<td>400</td>
</tr>
</tbody>
</table>

See 4.4.1.7(1)
Combined Wind Uplift & Shear - WSP

- Example: Splice over studs

Check field nailing requirements for stud supporting 4 x 8 panel:

- Min. length sheathing on lower 4 x 8 panel = 31.875”
- Total # nails required/stud = 4 x 4 = 16 nails

Specify 4” o.c. in field

Spacing: 31.875”/(8-1) = 4.55”

Combined Wind Uplift & Shear - WSP

- Uplift only case
  - Single or double row of fasteners
  - Tension not shear
  - Test verified

Table 4.4.2 Nominal Uplift Capacity of 3/8” Minimum Wood Structural Panel Sheathing or Siding When Used for Wind Uplift Only over Framing with a Specific Gravity of 0.42 or Greater

- New shear wall anchorage provisions at foundation – Section 4.3.6.4.3
  - 3” x 3” x 0.229” steel
  - slotted hole permitted
  - placed within ½” of sheathing material (automatically satisfied for 2x4 plate)
Shear Wall Anchorage – 3" x 3" Default
• New shear wall anchorage provisions at foundation—Section 4.3.6.4.3
  – Exception: round washers permitted provided hold down appropriately sized for overturning

Unblocked Shear Walls
• Nails 6" panel edge spacing
• Up to 2:1 aspect ratio
• 16' height limit
• Based on cyclic testing
• Shear capacity reduction

<table>
<thead>
<tr>
<th>Nail Spacing (in.)</th>
<th>Stud Spacing (in.)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Supported Edges</td>
<td>Intermediate Framing</td>
</tr>
<tr>
<td>6</td>
<td>6</td>
</tr>
<tr>
<td>12</td>
<td>1.0</td>
</tr>
<tr>
<td>10</td>
<td>0.8</td>
</tr>
<tr>
<td>9</td>
<td>0.6</td>
</tr>
<tr>
<td>8</td>
<td>0.5</td>
</tr>
<tr>
<td>6</td>
<td>12</td>
</tr>
</tbody>
</table>

Unblocked Shear Walls
• Deflection (4.3.2.2)
  – Less stiffness
  – Deflection component amplified by:

\[ \frac{v}{C_{ub}} \]

WSP over Gypsum Shear Walls
• Section 4.3.7.2 and Table 4.3B
• Consistent with *IBC 2006*
• Shear wall with fire resistance
Shear Walls Sheathed on 2 Sides

- **IBC 2006** provisions for shear walls sheathed on two sides
- Table 4.3A Footnote 6

6. Where panels are applied on both faces of a shear wall and nail spacing is less than 6” on center on either side, panel joints shall be offset to fall on different framing members. Alternatively, the width of the nailed face of framing members shall be 3” nominal or greater at adjoining panel edges and nails at all panel edges shall be staggered.

Shear Walls Sheathed on 2 Sides

- Adjoining Panel Edge Details

  ![Diagram showing adjoining panel edge details](image)

  Adjoining panel edge

  3x framing or blocking

  Adjoining panel edge

  Adjoining panel edges staggered

  Adjoining panel edges not staggered

Structural Fiberboard Shear Walls

- Aspect ratio adjustment for structural fiberboard shear walls
  - Table 4.3.4 Footnote 3
  - Now permitted up to 3.5:1 based on cyclic testing
    - used to be 1.5:1
Structural Fiberboard Shear Walls

- Aspect ratio adjustment
  - If < 1:1 reduce design unit shear
  - Wind factor tied to strength
    - At 3.5:1 wind factor = 0.78
  - Seismic factor tied to equivalent stiffness for same seismic drift level
  - At 3.5:1 seismic factor = 0.36

<table>
<thead>
<tr>
<th>Shear Wall Sheathing Type</th>
<th>Maximum h/b Ratio</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wood structural panels, unblocked</td>
<td>2:1</td>
</tr>
<tr>
<td>Wood structural panels, blocked</td>
<td>3.5:1</td>
</tr>
<tr>
<td>Particleboard, blockboard</td>
<td>2:1</td>
</tr>
<tr>
<td>Dispersed shearboard, conventional</td>
<td>2:1</td>
</tr>
<tr>
<td>Gypsum wallboard</td>
<td>2:1</td>
</tr>
<tr>
<td>Portland cement plaster</td>
<td>2:1</td>
</tr>
<tr>
<td>Structural Fiberboard</td>
<td>3:1</td>
</tr>
</tbody>
</table>

1. For design to resist seismic forces, the shear wall aspect ratio shall not exceed 2:1 unless the nominal wall shear capacity is multiplied by 2.0. Walls having aspect ratios exceeding 2:1 shall be blocked above walls.

- Wind factor tied to strength
  - At 3.5:1 wind factor = 0.78

- Seismic factor tied to equivalent stiffness for same seismic drift level
  - At 3.5:1 seismic factor = 0.36

Nails shall be located at least 3/4" from edges of panels at top and bottom plates and at least 3/8" from all other edges of panels. Maximum nail spacing at panel edges shall be 4" on center.

PSW Increased Strength Limit

- Increased strength limit for perforated shear walls - Section 4.3.5.3 (3)
  - 1740 plf nominal seismic shear capacity (980 plf nominal in 2005 SDPWS)
  - 2435 plf nominal wind shear capacity (1370 plf nominal in 2005 SDPWS)
  - Tests with 10d nails @ 2" o.c. edge

PSW Shear Strength Equation

<table>
<thead>
<tr>
<th>Wall Height, h</th>
<th>Maximum Opening Height</th>
<th>Percent Full-Height Sheathing</th>
<th>Effective Shear Capacity</th>
</tr>
</thead>
<tbody>
<tr>
<td>h/3</td>
<td>h/4</td>
<td>100%</td>
<td>1.00</td>
</tr>
<tr>
<td>h/4</td>
<td>h/4</td>
<td>90%</td>
<td>0.90</td>
</tr>
<tr>
<td>h/5</td>
<td>h/5</td>
<td>80%</td>
<td>0.80</td>
</tr>
<tr>
<td>h/6</td>
<td>h/6</td>
<td>70%</td>
<td>0.70</td>
</tr>
<tr>
<td>h/7</td>
<td>h/7</td>
<td>60%</td>
<td>0.60</td>
</tr>
<tr>
<td>h/8</td>
<td>h/8</td>
<td>50%</td>
<td>0.50</td>
</tr>
<tr>
<td>h/9</td>
<td>h/9</td>
<td>40%</td>
<td>0.40</td>
</tr>
<tr>
<td>h/10</td>
<td>h/10</td>
<td>30%</td>
<td>0.30</td>
</tr>
<tr>
<td>h/11</td>
<td>h/11</td>
<td>20%</td>
<td>0.20</td>
</tr>
<tr>
<td>h/12</td>
<td>h/12</td>
<td>10%</td>
<td>0.10</td>
</tr>
</tbody>
</table>
PSW Shear Strength Equation

- Section 4.3.3.5

\[
C_v = \left( \frac{r}{3-2r} \right) \frac{L_{tot}}{\sum L_i}
\]

\[
r = \frac{1}{1 + \frac{A_o}{h \sum L_i}}
\]

PSW Shear Strength Equation

- Alternative to tabulated values – Section 4.3.3.5
  - Allows more efficient designs
  - Actual area of openings
  - Table requires maximum opening size
  - Example: 1 door & 2 windows
  - Table assumes windows are same height as door
  - Takes away panel shear area

Wind & Seismic Standards

- More details on changes
  - Wood Design Focus papers
    - 2005 Special Design Provisions for Wind and Seismic (SDPWS)
    - 2008 Special Design Provisions for Wind and Seismic
    - Use of Wood Structural Panels to Resist Combined Shear and Uplift from Wind

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Table

Standard Nails and Cut Washers

Appendix A

<table>
<thead>
<tr>
<th>Table A2 Standard Cut Washers</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
</tr>
<tr>
<td>-----------------------------</td>
</tr>
<tr>
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</tr>
<tr>
<td>0.25</td>
</tr>
<tr>
<td>0.5</td>
</tr>
</tbody>
</table>

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