Shear Wall Design Examples per 2015 WFCM and 2015 SDPWS

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Description

There are several design tools and standards to assist engineers, architects, and building officials with the design of shear walls. Prescriptive approaches such as those outlined in AWC's 2015 Wood Frame Construction Manual (WFCM) for One- and Two-Family Dwellings and 2015 WFCM High Wind Guides tend to provide conservative results. Engineered approaches such as those outlined in AWC's 2015 Special Design Provisions for Wind and Seismic (SDPWS) typically result in more efficient designs. This course will outline several resources available for shear wall design and compare design results.
Learning Objectives

At the end of this program, participants will be better able to:

• Identify and understand the basic shear wall system to resist lateral loads
• Understand the difference between segmented and perforated shear wall design
• Understand hold down design
• Identify and analyze shear walls per the 2015 Wood Frame Construction Manual and 2015 Special Design Provisions for Wind and Seismic and understand the differences between them

Polling Question

What is your profession?

a) Architect
b) Engineer
c) Code Official
d) Building Designer
e) Other
Outline

Shear Wall Design Examples
- 2015 IBC/IRC Recognition
- 2015 WFCM Prescriptive
- 2015 WFCM High Wind Guide - Prescriptive
- 2015 WFCM Engineered
- 2015 SDPWS

WFCM and IRC/IBC

2015 WFCM is referenced in 2015 IRC/IBC
WFCM and IRC

IRC R301.1.1 Alternative Provisions

R301.1.1 Alternative provisions. As an alternative to the requirements in Section R301.1 the following standards are permitted subject to the limitations of this code and the limitations therein. Where engineered design is used in conjunction with these standards, the design shall comply with the International Building Code.

1. AF&PA Wood Frame Construction Manual (WFCM).

WFCM and IRC

IRC R301.2.1.1 Wind limitations

R301.2.1.1 Wind limitations and wind design required.

In regions where wind design is required in accordance with Figure R301.2(4)B or where the basic wind speed shown on Figure R301.2(4)A equals or exceeds 110 miles per hour (49 m/s), the design of buildings for wind loads shall be in accordance with one or more of the following methods:

1. AF&PA Wood Frame Construction Manual (WFCM); or
WFCM and IBC

IBC Chapter 16

1609.1.1 Determination of wind loads. Wind loads on every building or structure shall be determined in accordance with Chapters 26 to 30 of ASCE 7 or provisions of the alternate all-heights method in Section 1609.6. The type of opening protection required, the ultimate design wind speed, \( V_{aw} \) and the exposure category for a site is permitted to be determined in accordance with Section 1609 or ASCE 7. Wind shall be assumed to come from any horizontal direction and wind pressures shall be assumed to act normal to the surface considered.

Exceptions:
2. Subject to the limitations of Section 1609.1.1.1, residential structures using the provisions of AWC WFCM.

WFCM and IBC

IBC Section 2301.2

2301.2 General design requirements. The design of structural elements or systems, constructed partially or wholly of wood or wood-based products, shall be in accordance with one of the following methods:
1. Allowable stress design in accordance with Sections 2304, 2305 and 2306.
2. Load and resistance factor design in accordance with Sections 2304, 2305 and 2307.
3. Conventional light-frame construction in accordance with Sections 2304 and 2308.
4. AWC WFCM in accordance with Section 2309.
IBC Section 2309

SECTIONS 2309
WOOD FRAME CONSTRUCTION MANUAL
2309.1 Wood Frame Construction Manual. Structural design in accordance with the AWC WFCM shall be permitted for buildings assigned to Risk Category I or II subject to the limitations of Section 1.1.3 of the AWC WFCM and the load assumptions contained therein. Structural elements beyond these limitations shall be designed in accordance with accepted engineering practice.

Applicability Limits

<table>
<thead>
<tr>
<th>Attribute</th>
<th>Limitation</th>
<th>Reference Section</th>
<th>Figures</th>
</tr>
</thead>
<tbody>
<tr>
<td>BUILDING DIMENSIONS</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mean Roof Height (MRH)</td>
<td>33'</td>
<td>1.1.3.1a</td>
<td>1.2</td>
</tr>
<tr>
<td>Number of Stories</td>
<td>3</td>
<td>1.1.3.1a</td>
<td>-</td>
</tr>
<tr>
<td>Building Length and Width</td>
<td>80'</td>
<td>1.1.3.1b</td>
<td>-</td>
</tr>
<tr>
<td>LOAD ASSUMPTIONS (See Chapter 2 or Chapter 3 tables for load assumptions applicable to the specific tabulated requirement)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Load Type</td>
<td>Load Assumption</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Partition Dead Load</td>
<td>0.8 psf of floor area</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Wall Assembly Dead Load</td>
<td>11-18 psf</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Floor Dead Load</td>
<td>10-20 psf</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Roof/Ceiling Assembly Dead Load</td>
<td>0.25 psf</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Floor Live Load</td>
<td>50-60 psf</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Roof Live Load</td>
<td>20 psf</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ceiling Live Load</td>
<td>10-20 psf</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ground Snow Load</td>
<td>0.70 psf</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Wind Load</td>
<td>110-155 mph wind speed (700-yr. return period, 3-second gust) Exposure B, C, and D</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Seismic Load</td>
<td>Seismic Design Category (SDC) SDC A, B, C, D, D1, and D2</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
2015 WFCM - Non-Res

- **Applications**
  - Single-story
  - Slab-on-grade
  - L and W < 80'

- **Examples**
  - Restaurants
  - Office Buildings

- **Design**
  - Lateral (Wind and Seismic)
  - Gravity

---

2015 WFCM

2015 WFCM uses ASCE 7-10 wind design provisions

![What's Changed](image)
ASCE 7-05 vs ASCE 7-10

Table C1.2 Wind Speed Conversion Table

<table>
<thead>
<tr>
<th>ASCE 7-05 Basic Wind Speeds (mph)</th>
<th>85</th>
<th>90</th>
<th>100</th>
<th>110</th>
<th>120</th>
<th>130</th>
<th>140</th>
<th>150</th>
</tr>
</thead>
<tbody>
<tr>
<td>Equivalent ASCE 7-10 Basic Wind Speeds (mph)</td>
<td>110</td>
<td>116</td>
<td>129</td>
<td>142</td>
<td>155</td>
<td>168</td>
<td>181</td>
<td>194</td>
</tr>
</tbody>
</table>

SDPWS and IBC

2015 SDPWS is referenced in 2015 IBC

What's Changed
SDPWS and IBC

SECTION 2305
GENERAL DESIGN REQUIREMENTS FOR LATERAL FORCE-RESISTING SYSTEMS
2305.1 General. Structures using wood-frame shear walls or wood-frame diaphragms to resist wind, seismic or other lateral loads shall be designed and constructed in accordance with AFWPA SDPWS and the applicable provisions of Sections 2305, 2306 and 2307.

SECTION 2306
ALLOWABLE STRESS DESIGN
2306.1 Allowable stress design. The design and construction of wood elements in structures using allowable stress design shall be in accordance with the following applicable standards:
American Wood Council
NDS National Design Specification for Wood Construction
SDPWS Special Design Provisions for Wind and Seismic

SECTION 2307
LOAD AND RESISTANCE FACTOR DESIGN
2307.1 Load and resistance factor design. The design and construction of wood elements and structures using load and resistance factor design shall be in accordance with AWC NDS and AWC SDPWS.

Polling Question

Which building codes reference the 2015 WFCM?

a) 2015 IRC
b) 2015 IBC
c) 2015 IFC
d) All of the above
e) a) and b)
Outline

- 2015 IBC/IRC Recognition
- 2015 WFCM Prescriptive
- 2015 WFCM High Wind Guide - Prescriptive
- 2015 WFCM Engineered
- 2015 SDPWS

Segmented Shear Wall (SSW) Method
Pouréfrated Shear Wall (PSW) Method

NOTE:
• Wind Speeds 110-195 mph
  Exp. B & C
  • Segmented & Perforated Shear Walls
  • Other Application Limits

WFCM Prescriptive
Design Example

Assumptions
- 130 mph (700-yr, 3-second gust)
- Exposure B
- L=36’
- W=30’
- 5/12 roof pitch
- Top plate to ridge = 6.25’
- 2-story
- 8’ wall height
- 6’8” door height
- 4’ window height
- Wood Structural Panel Exterior Sheathing
- Vary interior walls - with and without gypsum
- Don’t check deflection

Design Example

Design first floor shear wall
Interpolate = 12.3'

Interpolate = 0.68
Adjusted = 12.3' (0.68) = 8.4'
WFCM Prescriptive

2015 WFCM Prescriptive - Segmented - required = 8.4'

4’ + 4’ + 2.5’ + 2.5’ = 13’ > 8.4’ OK
Assumes gypsum on interior

WFCM Prescriptive

2015 WFCM Prescriptive - Segmented

Table 3.17D Shear Wall Assembly Allowable Unit Shear Capacities, Maximum Shear Wall Segment Aspect Ratios, and Sheathing Type Adjustments

<table>
<thead>
<tr>
<th>Exterior Wall Sheathing</th>
<th>Interiors Wall Sheathing</th>
<th>ASD Unit Shear Capacity of Wall Assembly (psf)</th>
<th>Maximum Shear Wall Segment Aspect Ratio</th>
<th>Sheathing Type Adjustment Factor</th>
</tr>
</thead>
<tbody>
<tr>
<td>3/8”, 7/16”, and 15/32” Wood Structural Panels (Blocked), maximum nail spacing 16” on center</td>
<td>No sheathing or non-rated sheathing</td>
<td>8d common nails - 6” edge spacing</td>
<td>355</td>
<td>250</td>
</tr>
<tr>
<td>1/2” Gypsum Wallboard (Unblocked)</td>
<td>4d common nails - 7” edge spacing</td>
<td>436</td>
<td>320</td>
<td>3.5:1</td>
</tr>
<tr>
<td>3/8”, 7/16”, and 15/32” Wood Structural Panels (Blocked)</td>
<td>8d common nails - 6” edge spacing</td>
<td>672</td>
<td>475</td>
<td>3.5:1</td>
</tr>
</tbody>
</table>
### WFCM Prescriptive

#### 2015 WFCM Prescriptive - Segmented

Table 3.17D Shear Wall Assembly Allowable Unit Shear Capacities, Maximum Shear Wall Segment Aspect Ratios, and Sheathing Type Adjustments

<table>
<thead>
<tr>
<th>Exterior Wall Sheathing</th>
<th>Nails and Spacing Requirements</th>
<th>ASD Unit Shear Capacity of Wall Assembly (psf)</th>
<th>Maximum Shear Wall Segment Aspect Ratio</th>
<th>Sheathing Type Adjustment Factor</th>
</tr>
</thead>
<tbody>
<tr>
<td>Interior Wall Sheathing</td>
<td></td>
<td>Wind</td>
<td>Solisic</td>
<td>Wind</td>
</tr>
<tr>
<td>3/8&quot;, 7/16&quot;, and 15/32&quot; Wood Structural Panels (Blocked)</td>
<td>8d common nail - 6&quot; edge spacing</td>
<td>358</td>
<td>239</td>
<td>3.5:1</td>
</tr>
<tr>
<td>1/4&quot; gypsum wallboard (unblocked)</td>
<td>8d common nail - 7&quot; edge spacing</td>
<td>&gt;500</td>
<td>233</td>
<td>3.5:1</td>
</tr>
<tr>
<td>3/8&quot;, 7/16&quot;, and 15/32&quot; Wood Structural Panels (Blocked)</td>
<td>8d common nail - 6&quot; edge spacing</td>
<td>672</td>
<td>478</td>
<td>3.5:1</td>
</tr>
</tbody>
</table>

**What if we don’t count the gypsum on interior?**

8.4’ x 1.3 = 10.9’

#### 2015 WFCM Prescriptive Segmented - required = 10.9’

Segmented shear wall - assuming **no interior gypsum**

4’ + 2.5’ + 2.5’ + 4’ = 13’ > 10.9’ OK
WFCM Prescriptive

2015 WFCM Prescriptive – Segmented – Hold-downs

With and Without Gypsum

Segmented shear wall – requires hold downs on each segment

WFCM Prescriptive

2015 WFCM Prescriptive – Perforated Shear Wall

% Full-height sheathing
8.4' / 36' = 23%
Interpolated = 1.86
8.4'(1.86) = 15.6'
with gypsum

10.9' / 36' = 30%
Interpolated = 1.72
10.9'(1.72) = 18.7'
without gypsum

21' Full-height sheathing > 18.7'
PSW requires fully sheathed wall

PSW requires hold-downs only at the ends
**WFCM Prescriptive**

2015 WFCM Prescriptive – Perforated – Hold-downs

Hold-downs = 3,488 lbs w/ gypsum

\[
\frac{3,488}{1.3} = 2,683 \text{ lbs w/o gypsum}
\]

- Need to combine with top floor hold-down requirements
- Based on capacity of first shear wall panel
- Does not include dead load

### Table 3.17f

<table>
<thead>
<tr>
<th>Wall Height (ft)</th>
<th>Wind</th>
<th>Seismic</th>
</tr>
</thead>
<tbody>
<tr>
<td>5</td>
<td>3458</td>
<td>1724</td>
</tr>
<tr>
<td>9</td>
<td>3924</td>
<td>2251</td>
</tr>
<tr>
<td>10</td>
<td>4360</td>
<td>2390</td>
</tr>
<tr>
<td>12</td>
<td>5232</td>
<td>2608</td>
</tr>
<tr>
<td>14</td>
<td>6104</td>
<td>3340</td>
</tr>
<tr>
<td>16</td>
<td>8975</td>
<td>3824</td>
</tr>
<tr>
<td>18</td>
<td>7848</td>
<td>4302</td>
</tr>
<tr>
<td>20</td>
<td>8720</td>
<td>4790</td>
</tr>
</tbody>
</table>

1. Required hold-down capacities assume walls are sheathed in accordance with Section 3.4.4.2. For other wall sheathing types the tabulated hold-down capacity shall be divided by the appropriate sheathing type adjustment factor in Table 3.17.1.
2. Hold-down capacities are tabulated per story. Required hold-down capacities shall be summed from the story above to the story below.

### Polling Question

WFCM Prescriptive provisions include which of the following:

a) 110-195 mph wind loads
b) Exposure B & C
c) Segmented and perforated shear walls
d) All of the above
Outline

- 2015 IBC/IRC Recognition
- 2015 WFCM Prescriptive
- 2015 WFCM High Wind Guide - Prescriptive
- 2015 WFCM Engineered
- 2015 SDPWS

WFCM High Wind Guide - Prescriptive

• Derived from WFCM
• Individual Wind Speeds
• 115 – 160 mph Exp. B & C
WFCM High Wind Guide - Prescriptive

Table 13. Percentage of Full-Height Sheathing in Various Exterior Sheathing Types

<table>
<thead>
<tr>
<th>Exterior Sheathing Type</th>
<th>Building Aspect Ratio (L/W)</th>
<th>Percent Full-Height Sheathing on End</th>
<th>Percent Full-Height Sheathing on Wall Line</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1.00</td>
<td>51%</td>
<td>48%</td>
</tr>
<tr>
<td></td>
<td>1.25</td>
<td>52%</td>
<td>46%</td>
</tr>
<tr>
<td></td>
<td>1.50</td>
<td>45%</td>
<td>35%</td>
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<td></td>
<td>1.75</td>
<td>40%</td>
<td>31%</td>
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<tr>
<td></td>
<td>2.00</td>
<td>38%</td>
<td>27%</td>
</tr>
<tr>
<td></td>
<td>2.25</td>
<td>32%</td>
<td>20%</td>
</tr>
<tr>
<td></td>
<td>2.50</td>
<td>30%</td>
<td>22%</td>
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<tr>
<td></td>
<td>2.75</td>
<td>27%</td>
<td>21%</td>
</tr>
<tr>
<td></td>
<td>3.00</td>
<td>25%</td>
<td>19%</td>
</tr>
</tbody>
</table>

L/W = 36'/30' = 1.2
Interpolated = 54% = 19.4'
Available = 21’ OK
Hold-down = 4,360 lbs

Assumes perforated shear wall with hold-downs only at the ends
Polling Question

Perforated shear walls must be fully sheathed between hold-downs?

True or False?
2015 WFCM Engineered

\[ w_{\text{roof}} = 94 \text{ plf} \]
\[ w_{\text{floor}} = 128(0.82) = 105 \text{ plf} \]
\[ w_{\text{total}} = 199 \text{ plf} \]
\[ \frac{199(30')}{2} = 2,985 \text{ lbs} \]

*Footnote 2: \((H+1)/11\) adjustment = \((8+1)/11\)

---

### Table 2.58 Lateral Diaphragm Loads from Wind - Parallel to Ridge

(For Calculating In-Plane Shear in Roof and Floor Diaphragms)

<table>
<thead>
<tr>
<th>Roof Pitch</th>
<th>Roof Type (FT)</th>
<th>Unit Lateral Load for Roof Diaphragms, ( \frac{w_{u}}{k_{u}} ) (psi)</th>
</tr>
</thead>
<tbody>
<tr>
<td>2:12 - 3:12</td>
<td>120</td>
<td>250</td>
</tr>
<tr>
<td>4:12</td>
<td>120</td>
<td>300</td>
</tr>
</tbody>
</table>

**Footnote:**

Roof Area = gable + \( \frac{1}{2} \) wall
Floor Area = \( \frac{1}{2} \) wall + \( \frac{1}{2} \) wall

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### Table 3.17D Shear Wall Assembly Allowable Unit Shear Capacities, Maximum Shear Wall Segment Aspect Ratios, and Sheathing Type Adjustments

<table>
<thead>
<tr>
<th>Exterior Wall Sheathing</th>
<th>Nails and Spacing Requirements</th>
<th>ASD Unit Shear Capacity of Wall Assembly (psi)</th>
<th>Maximum Shear Wall Segment Aspect Ratio</th>
<th>Sheathing Type Adjustment Factor</th>
</tr>
</thead>
<tbody>
<tr>
<td>3/8&quot;, 7/16&quot;, and 15/32&quot; Wood Structural Panels (Blocked), maximum nailing spacing 10&quot; on center</td>
<td>8d common nails - 6&quot; edge spacing</td>
<td>350</td>
<td>3.5:1</td>
<td>2.2</td>
</tr>
<tr>
<td>1/2&quot; Gypsum Wallboard (Unblocked)</td>
<td>8d common nails - 7&quot; edge spacing</td>
<td>450</td>
<td>3.5:1</td>
<td>2.1</td>
</tr>
<tr>
<td>3/8&quot;, 7/16&quot;, and 15/32&quot; Wood Structural Panels (Blocked)</td>
<td>8d common nails - 6&quot; edge spacing</td>
<td>672</td>
<td>3.5:1</td>
<td>2.1</td>
</tr>
</tbody>
</table>

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**WFCM Engineered**

**2015 WFCM Engineered – Segmented**

- Required Capacity = 2,985 lbs
- 7/16” WSP Capacity = 336 plf
- 1/2” Gypsum Capacity = 100 plf
  - Total = 436 plf

\[
\frac{2,985}{436} = 6.8' \text{ (w/ gypsum)}
\]

\[
\frac{2,985}{336} = 8.9' \text{ (w/o gypsum)}
\]

4’ + 4’ = 8’ > 6.8’

assuming interior gypsum    OK
WFCM Engineered

2015 WFCM Engineered - Segmented

4' + 2.5' + 2.5' + 4' = 13' > 8.9'
assuming NO interior gypsum OK

WFCM Engineered

2015 WFCM Engineered - Perforated

Reference SDPWS Capacities and Adjustments

V = 2,985 lbs

v = 436 plf (w/ gypsum)
v = 336 plf (w/o gypsum)

% FHS = 21' / 36' = 58%
Interpolated Factor = 0.62

436 (0.62) = 270 plf
2,985/270 = 11.1' (w/ gypsum)

336 (0.62) = 208 plf
2,985/208 = 14.4' (w/o gypsum)
WFCM Engineered

2015 WFCM Engineered - Perforated

21' Full-height sheathing > 14.4' OK

WFCM Engineered

2015 WFCM Engineered - Hold-downs

\[ T = v \cdot h \]

\[ v = 436 \text{ plf (w/ gypsum)} \]

\[ v = 336 \text{ plf (w/o gypsum)} \]

\[ h = 8' \]

\[ T = 436(8') = 3,488 \text{ lbs} \]

\[ T = 336(8') = 2,688 \text{ lbs} \]

- Need to combine with top floor hold-down requirements
- Based on capacity of first shear wall panel
- Can account for dead load (WFCM 2.2.4)
Polling Question

WFCM tabulated hold-down capacity requirements are based on the capacity of the first shear wall panel?

True or False?

Outline

- 2015 IBC/IRC Recognition
- 2015 WFCM Prescriptive
- 2015 WFCM High Wind Guide - Prescriptive
- 2015 WFCM Engineered
- 2015 SDPWS
2015 SDPWS
- Engineered
- Res and Non-Res
- ASD & LRFD
- Efficiencies in designs
- Shear wall provisions
  - Segmented
  - Perforated
  - Force Transfer Around Openings

Minimum Design Loads

ASCE 7-10 Minimum Design Loads for Buildings and Other Structures

14.5.1 Reference Documents
The quality, testing, design, and construction of members and their fastenings in wood systems that resist seismic forces shall conform to the requirements of the applicable following reference documents:
1. AF&PA NDS
2. AF&PA SDPWS
2015 SDPWS – WSP Capacity

ASD Capacity = 670/2 = 335 plf

2015 SDPWS – Gypsum Capacity

ASD Capacity = 200/2 = 100 plf
2015 SDPWS
Required Capacity = 2,985 lbs
WSP = 335 plf
Gypsum = 100 plf
Total = 435 plf

2,985 / 435 = 6.9' (w/ gypsum)
2,985 / 335 = 8.9' (w/o gypsum)

SDPWS - Segmented Shear Wall

4' + 4' = 8' > 6.9' OK
assuming interior gypsum
**SDPWS**

**2015 SDPWS – Segmented Shear Wall**

2,985 lbs

4’ + 2.5’(0.625) + 2.5’(0.625) + 4’ = 11.1’ > 8.9’ OK assuming NO interior gypsum

Note: 0.625 per SDPWS 4.3.3.4.1 Exception 1 = 2b/s/h

**SDPWS**

**2015 SDPWS – Perforated Shear Wall**

Shear Capacity Adjustment Factor

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

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

\( h = 8' \)

\( L_i = 16' + 2[2(2.5)/8]' = 17.25' \)

\( L_{\text{tot}} = 36' \)

\( A_o = 4(4')(2.5') + (5')(6.67') = 73.4 \text{ ft}^2 \)

\( r = 0.65 \)

\( C_o = 0.80 \) (based on total sheathed area)

Comparison: SDPWS/WFCM Engineered (tabulated) \( C_o = 0.62 \)

Note: \( L_i \) per SDPWS 4.3.4.3 adjustment = 2b/s/h
2015 SDPWS - Perforated Shear Wall

\[ C_0 = 0.80 \]

\[ \text{w/ gypsum} \]

\[ 435 \times (0.80) = 348 \]

\[ \frac{2,985}{348} = 8.6' \]

\[ \text{w/o gypsum} \]

\[ 335 \times (0.80) = 268 \]

\[ \frac{2,985}{268} = 11.1' \]

17.25' Full-height sheathing > 11.1' OK

17.25' Full-height sheathing > 11.1' OK
2015 SDPWS - Hold-downs (Segmented)

\[ T = v \cdot h \]

\[ v = \frac{2,985}{8'} = 347 \text{ plf (w/ gyp)} \]

\[ v = \frac{2,985}{13'} = 230 \text{ plf (w/o gyp)} \]

\[ h = 8' \]

\[ T = 347(8') = 2,985 \text{ lbs (w/ gyp)} \]

\[ T = 230(8') = 1,840 \text{ lbs (w/o gyp)} \]

- Need to combine with top floor hold-down requirements
- Based on loads
- Can account for dead load (4.3.6.4.2)

2015 SDPWS - Hold-downs (Perforated)

\[ V = 2,985 \text{ lbs (w/ gyp)} \]

\[ h = 8' \]

\[ C_o = 0.8 \]

\[ L_i = 16' + 2[2(2.5)/8'] \]

\[ L_i = 17.25' \]

\[ T = 1,730 \text{ lbs} \]

\[ V = 1,840 \text{ lbs (w/o gyp)} \]

\[ T = 1,067 \text{ lbs} \]

- Need to combine with top floor hold-down requirements
- Based on loads
- Can account for dead load (4.3.6.4.2)
Polling Question

The equation for the shear capacity adjustment factor, Co, gives the same results as the tabulated values?

True or False?

Design Example - Summary

2015 WFCM/ SDPWS Shear Wall Length Comparison
1st of 2-story; W=30' span; 5/12 pitch; 130 mph Exp. B

<table>
<thead>
<tr>
<th>AWC Standard</th>
<th>Segmented</th>
<th>Perforated</th>
<th>Hold-downs, lbs</th>
</tr>
</thead>
<tbody>
<tr>
<td>2015 HWG</td>
<td>n/a</td>
<td>19.4'</td>
<td>4,360</td>
</tr>
<tr>
<td>2015 WFCM</td>
<td>8.4' (10.9')</td>
<td>15.6' (18.7')</td>
<td>3,488 (2,683)</td>
</tr>
<tr>
<td>2015 WFCM</td>
<td>6.8' (8.9')</td>
<td>11.1' (14.4')</td>
<td>3,488 (2,688)</td>
</tr>
<tr>
<td>2015 SDPWS</td>
<td>6.9' (8.9')</td>
<td>8.6' (11.1')</td>
<td>2,985 (1,840) [SSW]</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>1,730 (1,067) [PSW]</td>
</tr>
</tbody>
</table>

Parenthetical values assume NO interior gypsum
### Design Example - Summary

**2012 WFCM/SDPWS Shear Wall Length Comparison**

1st of 2 Story; W=30' span; 5/12 pitch; 130 mph Exp. B

<table>
<thead>
<tr>
<th>AWC Standard</th>
<th>Segmented</th>
<th>Perforated</th>
<th>Hold-downs</th>
</tr>
</thead>
<tbody>
<tr>
<td>2012 WFCM Prescriptive</td>
<td>8.4' (10.9')</td>
<td>15.6' (18.7')</td>
<td>3,488 (2,683) lbs</td>
</tr>
<tr>
<td>2012 WFCM Engineered</td>
<td>6.8' (8.9')</td>
<td>11.1' (14.4')</td>
<td>3,488 (2,688) lbs</td>
</tr>
<tr>
<td>2008 SDPWS</td>
<td>6.9' (8.9')</td>
<td>9.2' (11.9')</td>
<td>2,985 (1,840) lbs (1,516 lbs (PSW))</td>
</tr>
</tbody>
</table>

Parenthetical values assume NO interior gypsum

### Resources

- [Diaphragms and Shear Walls](www.apawood.org)
- [Evaluation of Force Transfer Around Openings – Experimental and Analytical Studies](www.apawood.org)
Purchase online:

woodworks-software.com

10% discount for AWC members

Design Office: $895 ($805.50)
Sizer: $295 ($265.50)

Also:
Discounts for NEW multi-seat purchases
Free for educators and code officials

Download a free DEMO at
www.woodworks-software.com

Free technical support: support@woodworks-software.com
Sales support: sales@woodworks-software.com
Questions?

- This concludes The American Institute of Architects Continuing Education Systems Course

www.awc.org
info@awc.org

AMERICAN WOOD COUNCIL

Utilize WoodWorks Resources

- Wood Project Assistance
  - help@woodworks.org

- WoodWorks Website
  - WoodWorks.org
  - Educational Literature
  - Monthly Webinars
  - Recorded Presentations
  - CEUs Available
  - Educational schedule - WSF, workshops and lunch seminars
Design Professional Membership

- **Target Audience**
  - Engineers
  - Architects
  - Code Officials

- **Benefits**
  - Wood Design Focus
  - Wood Design & Building
  - IMPACT Newsletter
  - Pubs Discounts
  - Online searchable directory
  - Cost $100

www.awc.org/membership

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Code Official Connections Benefits

- No cost to qualifying participants:
  - Code Officials
  - Inspectors
  - Plans Examiners
- Free electronic AWC technical publication
- Discounted publications
- One free WoodWorks access per department
- WoodPost bi-weekly e-newsletter
- Free Online Tools and updates
- Free continuing education
  - ICC Preferred Provider
  - National Council of Structural Engineers Association
  - American Institute of Architects

www.awc.org/codeconnections
Remember...

Follow-up email TODAY - 30-40 minutes after webinar

- Survey Link
- Information on Certificates of Completion (2 weeks)
- Links to NCSEA quiz and pdf of presentation and other resources

Upcoming Educational Events

- February 11, 2016 - Design of Bolted Connections per the 2015 NDS (DES335)
- Self-Directed Study Program - go to www.awc.org / Education / Online Courses to see a list of available CEUs
- Interested in booking a live presentation for a large group? Contact us at education@awc.org

More Information

- education@awc.org
- www.awc.org