About you

- Designers
- Plans examiners
- Inspectors
- Builders
- Contractors
- Architects & Engineers
Description

- This seminar provides a comprehensive explanation of the 2018 International Residential Code® (IRC®) simplified wall bracing requirements. It guides the participant through an in-depth review and analysis of the bracing requirements for wood-framed residential structures.

Objectives

Upon completion, participants will be better able to:
1. Identify the forces that act on a house.
2. Determine bracing materials available with simplified wall bracing.
3. Apply simplified wall bracing provisions.
4. Review connections required at floor and roof.

Resources

www.iccsafe.org
Item # 7102S18
Lateral Forces

Lateral Forces – Wind Speed

Wind Speed – USA
Lateral Forces – Wind Speed

- Las Vegas, NV
  - 115 mph, no special wind region

Lateral Forces – Wind Speed

Wind Design Required – USA

hazards.atcouncil.org
hazards.atcouncil.org

Lateral Forces - Earthquakes

Lateral Forces - Earthquakes

Copyright 2019 International Code Council
Lateral Forces - Earthquakes

S\text{\textsubscript{SDS}} = 0.46g = S\text{\textsubscript{SDS C}}

per Table R301.2.2.1.1

Lateral Forces

Effects of Forces

Racking

Base Shear

Overturning

Resisted by Bracing

Resisted by Anchors

Resisted by hold-downs & Dead Load

Lateral Forces – Effects of Forces

Racking

Resisted by Bracing
Simplified Wall Bracing

Prescriptive Limits

- SDC A or B, C for dwellings
- Max. Wind Speed = 130 mph
- Exposure Category B or C
- 1, 2 or 3 story
- WSP
- Braced Wall Panel Material
- SFB

Exposure Category

B or C

Building Length

Max. Wall Height = 10 ft

Max. Eave to Ridge Height = 15 ft

Max. Cantilever = 24 in.

Procedure:

1. Draw a rectangle around the perimeter of the building
Simplified Wall Bracing

Procedure cont.:

2. Determine type of bracing to use.

<table>
<thead>
<tr>
<th>Material</th>
<th>Stud Spacing &amp; Fastener Criteria</th>
<th>Fastener Spacing Criteria</th>
<th>Bracing Unit Method</th>
<th>Minimum Bracing Unit Length (feet)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wood Structural Panel</td>
<td>Table R602.3(3)</td>
<td>6&quot; edge 12&quot; field</td>
<td>Continuous</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Intermittent</td>
<td>4</td>
</tr>
<tr>
<td>Structural Fiberboard Sheathing</td>
<td>Max 18&quot; spacing Table R602.3(1)</td>
<td>3&quot; edge 6&quot; field</td>
<td>Continuous</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Intermittent</td>
<td>4</td>
</tr>
</tbody>
</table>

a. Mixing of wood structural panel and structural fiberboard sheathing in one building is not permitted.
b. Continuous and intermittent bracing units may be mixed from one story to another.
c. Continuous and intermittent bracing unit methods may not be mixed within one story.

Panel Material - Intermittent

Method WSP – Wood Structural Panel

- 3/8" min. thickness
- Nailing per Table R602.3(3) for exterior, per Table R602.3(1) or (2) for interior walls
- Nail spacing 6:12
Panel Material - Intermittent

Method WSP – Wood Structural Panel

Panel Material - Continuous

Method CS-WSP
Full-height sheathed wall segments having a length equal or greater than Table R602.10.5 are counted toward the total bracing length. Wall minimum length is based on wall height and height of the adjacent clear opening.

Simplified Wall Bracing

Procedure cont.:
3. Identify the number of bracing units required on each side of the rectangle.
## Simplified Wall Bracing

Minimum Number of Bracing Units on Each Side of the Circumscribed Rectangle

<table>
<thead>
<tr>
<th>Ultimate Design Wind Speed (mph)</th>
<th>Story Level</th>
<th>Eave to Ridge Height (ft)</th>
<th>Minimum Number of Bracing Units on Each Long Side</th>
<th>Minimum Number of Bracing Units on Each Short Side</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>Length of Short Side (ft)</td>
<td>Length of Long Side (ft)</td>
</tr>
<tr>
<td>115</td>
<td>10</td>
<td>10</td>
<td>1 2 3 4 5 6 7</td>
<td>1 2 3 4 5 6 7</td>
</tr>
<tr>
<td></td>
<td>15</td>
<td>12</td>
<td>1 2 3 4 5 6 7</td>
<td>1 2 3 4 5 6 7</td>
</tr>
</tbody>
</table>

- **Ultimate Design Wind Speed (mph)**: The ultimate design wind speed is a critical factor in determining the number of bracing units required. Different wind speeds correspond to different levels of structural integrity, with higher wind speeds requiring more bracing units for safety.

- **Story Level**: The story level signifies the floor or level of the building. It is crucial in calculating the length of the eave to ridge height, which in turn affects the bracing requirements.

- **Eave to Ridge Height**: This measurement is essential in determining the length of the sides of the circumscribed rectangle, which is then used to calculate the number of bracing units needed for each side.

### Footnotes
- **a.** Interpolation shall not be permitted.
- **b.** Cripple walls and wood-framed basement walls = first story, stories above redesignated.
- **c.** Actual lengths of the sides of the circumscribed rectangle shall be rounded to the next highest unit of 10.
- **d.** For Exposure Category C, multiply bracing units by:
  - 1.20 for a one-story building
  - 1.30 for a two-story building
  - 1.40 for a three-story building

---

**Copyright 2019 International Code Council**
Simplified Wall Bracing

Procedure cont.:

4. Check that maximum distances between units and ends of the wall are not exceeded.

Distribution of Bracing Units

- Bracing unit within 12 feet of the ends of a wall.
- Bracing units edges within 20 feet of each other.
- Walls > 8 feet in length must have at least one bracing unit.

Narrow Bracing Method

<table>
<thead>
<tr>
<th>Narrow Bracing Method</th>
<th>Equivalent Bracing Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>CS-G</td>
<td>0.5</td>
</tr>
<tr>
<td>CS-PF</td>
<td>0.75</td>
</tr>
<tr>
<td>PFH</td>
<td>1</td>
</tr>
<tr>
<td>PFG</td>
<td>0.75</td>
</tr>
<tr>
<td>ABW</td>
<td>1</td>
</tr>
</tbody>
</table>

Each narrow bracing method is worth one-half to one full 3 ft. or 4 ft. bracing unit.
### Panel Material - Continuous

**Method CS-G**  
Wood structural panel adjacent to garage opening
- Full-height sheathed wall segments to either side of garage openings
- Where walls support only roof load or gable end wall
- Dead load ≤ 3psf in high seismic regions
- Applied to one wall line of garage only
- Panel length = bracing length
- 4:1 aspect ratio

---

**Extended Header**  
6:1 Aspect Ratio (16" min.)

---

**Panel Material - Continuous**  

**Method CS-PF**  
FULLY BREATHED

Story above permitted

---

Panel Material - Continuous
Panel Material - Continuous

**Method CS-PF**  Continuous portal frame

- No hold-downs required
- OK on raised floor
- Top of header at 10’ max
- Top of wall at 12’ max
- Panel length = 1.5 x bracing length (SDC A-C)

**No hold-downs required**
- OK on raised floor
- Top of header at 10’ max
- Top of wall at 12’ max
- Panel length = 1.5 x bracing length (SDC A-C)

Garage Opening

**Fully sheathed wall line**

Panel Material - Continuous

**Method CS-PF**

Garage Opening

**Panel Material - Continuous**

**Panel Material - Continuous**
Panel Material - Intermittent

Method PFH – Intermittent Portal Frame with hold-downs

- 16" min panel length for 1-story, 24" min for 2-story
- Each vertical panel replaces a 48" braced wall panel

Extended header

Opening

Opening

8’ to 10’

16” or 24” min.

Panel Material - Intermittent

Method PFG – Intermittent Portal Frame at Garage

- For use in SDC A-C only
- Bracing length = 1.5 x length of panel
- Minimum 24” length
- Single row of nails on studs

Extended header

Min. 1,000 lb strap (opposite side from sheathing)

No hold-downs required

Panel Material - Intermittent

Method PFG – Intermittent Portal Frame at Garage

- For use in SDC A-C only
- Bracing length = 1.5 x length of panel
- Minimum 24” length
- Single row of nails on studs

Extended header

Min. 1,000 lb strap (opposite side from sheathing)

No hold-downs required

Panel Material - Intermittent

Method PFH – Intermittent Portal Frame with hold-downs

- 16" min panel length for 1-story, 24" min for 2-story
- Each vertical panel replaces a 48" braced wall panel

Extended header

Opening

Opening

8’ to 10’

16” or 24” min.
Panel Material - Intermittent
Method PFG – Intermittent Portal Frame at Garage

- Extended header
- 3" o.c. nailing
- 1,000 lb strap capacity (opposite side)
- Min. 7/16" thick wood structural panel
- No hold-downs required
- Single sole plate allowed
- (2) 1/2" anchor bolts and min. 2" x 2" x 3/16" plate washers

Panel Material - Intermittent
Method ABW - Alternate Braced Wall

- Min. 3/8" thick wood structural panel sheathing
- 12" x 12" min. footing
- #4 bars top and bottom
- Anchor bolts 1/2" (2)
- Hold-down capacity per Table R602.10.6.1

Panel Material - Intermittent
Method ABW - Alternate Braced Wall

Minimum Hold-down Forces For Method ABW Braced Wall Panels – Table R602.10.6.1

<table>
<thead>
<tr>
<th>Seismic Design Category and Wind Speed</th>
<th>Supporting/Story</th>
<th>Hold Down Force (lbs) Height of Braced Wall Panel</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ultimate design wind speed ≤ 140 mph</td>
<td>One story</td>
<td>1,800, 1,800, 1,800, 2,000, 2,200</td>
</tr>
<tr>
<td>SDC A, B, and C</td>
<td>First of two stories</td>
<td>3,000, 3,000, 3,000, 3,300, 3,600</td>
</tr>
<tr>
<td>Ultimate design wind speed &gt; 140 mph</td>
<td>One story</td>
<td>1,800, 1,800, NP, NP</td>
</tr>
<tr>
<td>SDC D0, D1, and D2</td>
<td>First of two stories</td>
<td>3,000, 3,000, NP, NP</td>
</tr>
</tbody>
</table>
Simplified Wall Bracing

Procedure cont.:

6. Check connection to roof.

Connections

BWP Connection Requirements to Roof Framing

<table>
<thead>
<tr>
<th>SDC</th>
<th>Distance (bottom of roof sheathing to top of plate)</th>
<th>Blocking</th>
</tr>
</thead>
<tbody>
<tr>
<td>SDC A, B, C</td>
<td>9.25” or less</td>
<td>Not required, attach per R602.3(1)</td>
</tr>
<tr>
<td></td>
<td>9.25” to 15.25”</td>
<td>Per R602.10.8.2 Item 1 and Figure R602.10.8.2(1)</td>
</tr>
<tr>
<td>SDC D, D₁, D₂</td>
<td>15.25” or less</td>
<td>Per R602.10.8.2 Item 2 and Figure R602.10.8.2(2)</td>
</tr>
<tr>
<td>All SDCs</td>
<td>15.25” to 48”</td>
<td>Per R602.10.8.2 Item 3 and Figure R602.10.8.2(3) or engineered design</td>
</tr>
</tbody>
</table>

Connections

BWP Perpendicular to Rafters or Roof Trusses

For SDC A, B and C,

- Where distance from top of the rafters to perpendicular top plates is > 9.25” and ≤ 15.25”.
- Connect rafters to top plates of braced wall panels with blocking [Figure R602.10.8.2(1) and Table R602.3(1)].
Connections
BWP Perpendicular to Rafters or Roof Trusses

For SDC D₀, D₁, and D₂,
  • Where distance from top of rafters or roof trusses to perpendicular top plates is < 15.25"
  • Connect rafters to the top plates of braced wall panels with blocking [Figure R602.10.8.2(1) and Table R602.3(1)]

Connections
BWP Perpendicular to Rafters or Roof Trusses

For all Seismic Design Categories,
• Where distance from top of rafters or roof trusses to perpendicular top plates is > 15.25"
• Connect rafters to the top plates of braced wall panels [Figure R602.10.8.2(2) or Figure R602.10.8.2(3)]
Examples

Example 1: 115 mph, Exp B

- SDC B
- Wind 115 mph, Wind Exposure B
- Method CS-WSP
- 1 Story
- Walls - 9 ft.
- Eave to ridge height - 12 ft.

Example Highlights:
- Strategic placement of bracing units

Step 1: Draw a Rectangle
1. Draw rectangle around the entire building
2. Check the length of the N-S and E-W sides of the rectangle
Less than 60 ft.? OK
Step 2: Determine bracing material

- Intermittent
  - 4 ft segments
  - WSP
- Continuous sheathing
  - 3 ft segments
  - WSP

Step 3: Determine bracing required

Table R602.12.4 Minimum Number of Bracing Units

<table>
<thead>
<tr>
<th>Ultimate Design Wind Speed (mph)</th>
<th>Story level</th>
<th>Eave to ridge height (ft)</th>
<th>Minimum number of bracing units on each long side</th>
<th>Minimum number of bracing units on each short side</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>Length of short side (ft)</td>
<td>Length of long side (ft)</td>
</tr>
<tr>
<td>115</td>
<td>10</td>
<td>1</td>
<td>1 2 3 4 5 6 7</td>
<td>1 2 3 4 5 6 7</td>
</tr>
<tr>
<td></td>
<td>20</td>
<td>2</td>
<td>2 3 4 5 6 7 9</td>
<td>2 3 4 5 6 7 9</td>
</tr>
<tr>
<td></td>
<td>30</td>
<td>3</td>
<td>3 4 5 6 7 9 2</td>
<td>3 4 5 6 7 9 2</td>
</tr>
<tr>
<td></td>
<td>40</td>
<td>4</td>
<td>4 5 6 7 9 2 3</td>
<td>4 5 6 7 9 2 3</td>
</tr>
<tr>
<td></td>
<td>50</td>
<td>5</td>
<td>5 6 7 9 2 3 4</td>
<td>5 6 7 9 2 3 4</td>
</tr>
<tr>
<td></td>
<td>60</td>
<td>6</td>
<td>6 7 9 2 3 4 5</td>
<td>6 7 9 2 3 4 5</td>
</tr>
</tbody>
</table>

Step 4: Check panel spacing

Distribution of Bracing Units

- Bracing unit within 12 feet of the ends of a wall.
- Bracing units edges within 20 feet of each other.
- Walls > 8 feet in length must have at least one bracing unit.
1. 4 bracing units required along each wall line.
2. With CS-WSP, the minimum bracing unit length is 3 ft.
3. Panels must be within 12 ft. of the end of wall line and within 20 ft. of one another.

No narrow panels needed!
Step 5: Check for areas needing narrow panels

- Add narrow panels to garage – preferably a portal frame without hold-downs
Step 6: Check roof connections

Example 2: 115 mph, Exp C

Example:
- SDC B
- Wind 115 mph, Wind Exposure C
- Method CS-WSP
- 1 Story
- Walls - 9 ft.
- Eave to ridge height - 12 ft.

Example Highlights:
- Exposure Category C requirements

1. Draw rectangle around the entire building
2. Check the length of the N-S and E-W sides of rectangle
Less than 60 ft.? OK
### Bracing: Simplified Wall Bracing

#### Table R602.12.4  Minimum Number of Bracing Units

<table>
<thead>
<tr>
<th>Ultimate Design Wind Speed (mph)</th>
<th>Story level</th>
<th>Eave to ridge height (ft)</th>
<th>Minimum number of bracing units on each long side</th>
<th>Minimum number of bracing units on each short side</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>115</td>
<td>15</td>
<td>1 2 3 4 5 6</td>
<td>1 2 3 3 5 5</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>2 4 5 6 7</td>
<td>2 4 5 6 7</td>
</tr>
</tbody>
</table>

**Table R602.12.4 footnotes**

For Exposure Category C, multiply bracing units by a factor of 1.20 for a one-story building, 1.30 for a two-story building and 1.40 for a three-story building.

Minimum bracing units in each direction = 4 units x 1.20 = 4.8 units. Call it 5 units.
North side of dwelling: 5 units
South side of dwelling: 3 + 3 x 0.75 = 5.25 units
Example 3: 115 mph, Exp B

Example:
- SDC B
- Wind 115 mph, Wind Exposure B
- Method CS-WSP
- 1 Story
- Walls - 9 ft.
- Eave to ridge height - 12 ft.

Example Highlights:
- Circumscribed rectangle longer than 60 ft

APA alternate

1. Draw rectangle around the entire building
2. Check the length of the N-S and E-W sides of the rectangle

Less than 60 ft?
No
**Combined Bracing**

- Use Appendix A of this report when a circumscribed rectangle is greater than 60 ft long.

  - apa.org

**APA SR 102D**

**Final Reflection**

- What? What happened and what was observed in the training?
- So what? What did you learn? What difference did this training make?
- Now what? How will you do things differently back on the job as a result of this training?
Copyright Materials

This presentation is protected by US and International Copyright laws. Reproduction, distribution, display and use of the presentation without written permission of the speaker is prohibited.

© International Code Council 2018

Thank you for participating

To schedule a seminar, contact:

The ICC Training & Education Department
1-888-ICC-SAFE (422-7233) Ext. 33821
or
E-mail: Learn@iccafe.org

International Code Council is a Registered Provider with The American Institute of Architects Continuing Education Systems. Credit earned on completion of this program will be reported to CES Records for AIA members. Certificates of Completion for non-AIA members are available on request.

This program is registered with the AIA/CES for continuing professional education. As such, it does not include content that may be deemed or construed to be an approval or endorsement by the AIA of any material of construction or any method or manner of handling, using, distributing, or dealing in any material or product. Questions related to specific materials, methods, and services will be addressed at the conclusion of this presentation.
Thank You For Attending