Wall Bracing in the PA UCC

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Description

Act 1 of 2011 changed many things for the PA Uniform Construction Code, including that "the wall bracing requirements of sections R602.10 through R602.11.3 of the 2006 International Residential Code shall be part of the Uniform Construction Code." Many builders have questions regarding the relationship between 2006 requirements and the provisions in the 2015 IRC, including the revised wind speed requirements. This webinar will revisit some of the core 2006 wall bracing provisions and discuss the role of these requirements in the current PA Uniform Construction Code.

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Learning Objectives

1. Discuss the impact of Act 1 of 2011 language that directs builders and designers to the 2006 IRC for prescriptive wall bracing provisions.
2. Analyze the principles behind wall bracing and the methods for resisting lateral loads in order to provide a structurally sound framing system.
3. Examine the core prescriptive methodology for accounting for wall bracing requirements based on 2006 IRC requirements.
4. Illustrate wall bracing requirements through example calculations and applications to common wall framing scenarios.

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Outline

- PA Uniform Construction Code (UCC)
- Wall Bracing Principles
- 2006 International Residential Code (IRC) Requirements
- Other Considerations

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PA Uniform Construction Code

2015 I-Codes referenced in the UCC serve as "base" code

Legislative Changes

- Wall bracing
- Floor protection
- Stair geometry
- Sprinklers

Pennsylvania Code Amendments

22 residential amendments from 2015 re-review process

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Act 1 of 2011 (HB 377)

- Repeal of sprinkler provisions for 1 & 2 family dwellings
- Return to 2006 residential wall bracing provisions
- Alternative compliance methods for log home wall construction

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Act 1 of 2011

- (i) Wall bracing requirements.–Sections R602.10 through R602.12.1.6 of the 2009 International Residential Code, or its successor provisions, are excluded from the Uniform Construction Code. The wall bracing requirements of sections R602.10 through R602.11.3 of the *2006 International Residential Code* shall be part of the Uniform Construction Code.

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Wall Bracing Principles

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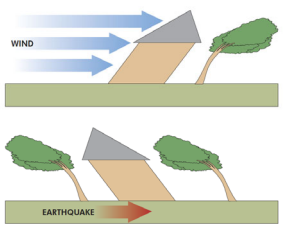
Lateral Loads



Source: Introduction to Wall Bracing in Accordance with 2006 International Residential Code (IRC), (2009); APA – Engineered Wood Association, Tacoma, WA.

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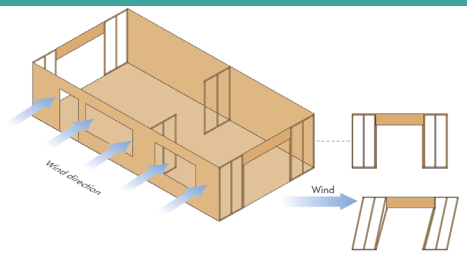
Why Wall Bracing?



Source: Introduction to Wall Bracing in Accordance with 2006 International Residential Code (IRC). (2009). APA – Engineered Wood Association, Tacoma, WA.

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Continuous vs. Intermittent

Source: Introduction to Wall Bracing in Accordance with 2006 International Residential Code (IRC). (2009). APA – Engineered Wood Association, Tacoma, WA.

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Question

- If I am sheathing the entire structure with OSB, I don't need to worry about wall bracing, right?

WRONG

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Wall Bracing in the 2006 IRC

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2006 IRC vs. 2015 IRC

- How do the 2006 IRC wall bracing provisions work with the rest of the 2015 IRC?
  - Wind speed maps changed in the 2015 IRC
- Wind Speeds in PA
  - 2006 IRC: Basic Wind Speeds for 50-Year Mean Recurrence Interval
  - 2015 IRC: Ultimate Design Wind Speeds

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Ultimate vs. Nominal

- Nominal design or basic wind speed
  - PA = 90 mph
- Ultimate design wind speed
  - PA = 115 mph
- Note: 2015 IRC Section R301.2.1.3 provides a conversion between ultimate and nominal

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2006 IRC Section R202

Wall Bracing Definitions

- **Braced wall line** – A series of braced wall panels in a single story constructed…to resist racking from seismic and wind forces
- **Braced wall panel** – A section of a braced wall line constructed in accordance with Section R602.10 for wood framing or Section R603.7 or R301.1.1 for cold-formed steel framing, which extends the full height of the wall.

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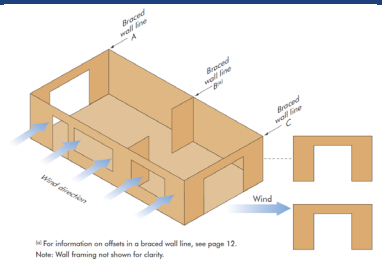
Braced Wall Lines



[a] For information on offsets in a braced wall line, see page 12.
Note: Wall framing not shown for clarity.

Source: Introduction to Wall Bracing in Accordance with 2006 International Residential Code (IRC), (2009), APA – Engineered Wood Association, Tacoma, WA.

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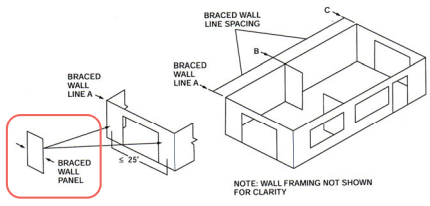
Braced Wall Line vs. Braced Wall Panel



1 foot = 304.8 mm.

FIGURE R602.10.1.4(1)
BRACED WALL PANELS AND BRACED WALL LINES

Source: International Code Council (ICC), (2006), 2006 International Residential Code, Country Club Hill, Ill.

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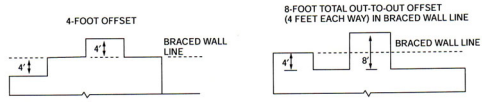
2006 IRC Section R602.10.1

Location of Braced Wall Panels

- Braced wall panels may be offset out-of-plane up to 4' from the braced wall line
  - Provided that the total out-to-out offset of braced wall panels in a braced wall line is not > 8'-0"



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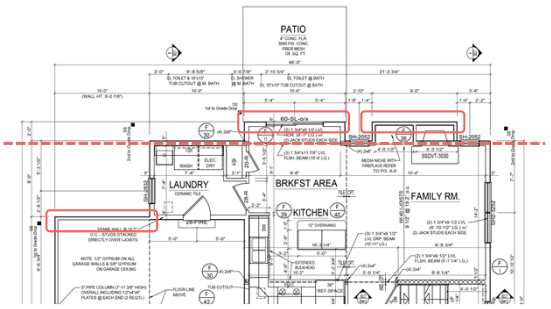

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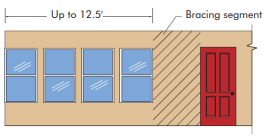
2006 IRC Section R602.10.1

Location of Braced Wall Panels

- Braced wall panels shall begin no more than 12.5 feet from each end of a braced wall line



Source: Introduction to Wall Bracing in Accordance with 2006 International Residential Code (IRC), (2009), APA – Engineered Wood Association, Tacoma, WA.

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2006 IRC Section R602.10.1

Location of Braced Wall Panels

- Braced wall panels shall be located at least every 25 feet on center

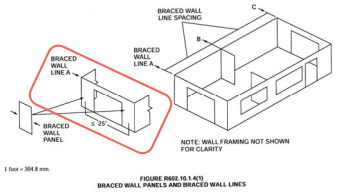

FIGURE R602.10.1.4(1)
BRACED WALL PANELS AND BRACED WALL LINES

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2006 IRC Section R602.10.1.1

Spacing of Braced Walls

- Maximum spacing for braced wall lines is 35' o.c.
  - In both longitudinal and transverse directions
- May be increased to 50' o.c.
  - When two conditions are met
    - (see exceptions)

Max house dimensions without interior braced walls

50'

50'

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2006 IRC Section R602.10.1.1

Spacing of Braced Walls

- Exceptions
  - Spacing of braced wall lines not exceeding 50 feet shall be permitted where:
    1. The wall bracing installed equals or exceeds the amount of bracing required by Table R602.10.1 multiplied by a factor equal to the braced wall line spacing divided by 35 feet **and**
    2. The length-to-width ration for the floor or roof diaphragm does not exceed 3:1

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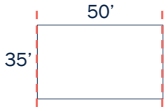
2006 IRC Section R602.10.1.1

Spacing of Braced Walls

- **Example: 2 story house, 35 feet x 50 feet – Wood structure panel sheathing (Method 3)**
  - Table R602.10.1 requires 16% of wall line to be braced
  - Braced wall line spacing is 50 feet o.c. (maximum allowed)
    - 50 feet / 35 = 1.43 (multiplier because spacing exceeds 35 feet o.c.)
    - 16% of 50 = 8 feet of bracing x 1.43 = **19.44** feet of bracing required
  - Length to width ratio shall not exceed 3:1
    - 50 feet long / 35 feet wide = 1.4 (< 3 is OK)



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2006 IRC Section R602.10.1

Length of Wall Bracing

- **Total minimum <u>LENGTH</u> of Braced Wall Panels on a Braced Wall Line (BWL) are dependent on:**
  - Loading conditions (supporting what)
  - Method of bracing used

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2006 IRC Table R602.10.1

Wall Bracing – Design Conditions

SEISMIC DESIGN CATEGORY OR WIND SPEED	CONDITION	TYPE OF BRACE	AMOUNT OF BRACING[a]
Category A and B (S_s ≤ 0.35g and S₁ ≤ 0.13g) or 100 mph or less	One story Top of two or three story	Methods 1, 2, 3, 4, 5, 6, 7 or 8	Located in accordance with Section R602.10 and at least every 25 feet on center but not less than 16% of braced wall line for Methods 2 through 8.
	First story of two story Second story of three story	Methods 1, 2, 3, 4, 5, 6, 7 or 8	Located in accordance with Section R602.10 and at least every 25 feet on center but not less than 16% of braced wall line for Method 3 or 25% of braced wall line for Methods 2, 4, 5, 6, 7 or 8.
	First story of three story	Methods 2, 3, 4, 5, 6, 7 or 8	Located in accordance with Section R602.10 and at least every 25 feet on center but not less than 25% of braced wall line for Method 3 or 35% of braced wall line for Methods 2, 4, 5, 6, 7 or 8.

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Ultimate vs. Nominal

- Nominal design or basic wind speed
  - PA = 90 mph
- Ultimate design wind speed
  - PA = 115 mph
- Note: 2015 IRC Section R301.2.1.3 provides a conversion between ultimate and nominal

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2006 IRC Section R602.10.3
Braced Wall Panel Construction Methods

BRACING METHODS	
1	Let-in bracing
2	Diagonal wood boards
3	Wood structural panels
4	Fiberboard
5	Gypsum board
6	Particle board
7	Portland cement plaster
8	Hardboard panel siding

Most Common

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2006 IRC Section R602.10.3
Braced Wall Panel Construction Methods

1. Nominal 1-inch-by-4-inch continuous diagonal braces let in to the top and bottom plates and the intervening studs or approved metal strap devices installed in accordance with the manufacturer's specs.
3. Wood structural panel sheathing with a thickness not less than 5/16 inch for 16-inch stud spacing and not less than 3/8 inch for 24-inch stud spacing. Wood structural panels shall be installed in accordance with Table R602.3(3).

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Method 1 – Let-In Bracing

- Nominal 1-inch-by-4-inch continuous diagonal braces let in to the top and bottom plates and the intervening studs or approved metal strap devices installed in accordance with the manufacturer's specs.
- The let-in bracing shall be placed at an angle not more than 60 degrees or less than 45 degrees from the horizontal.

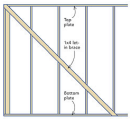

Image Source: https://www.finehomebuilding.com/2011/05/19/4-options-for-shear-bracing-foam-sheathed-walls

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Let-In Bracing – Metal Strap Devices

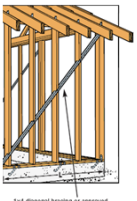

Image Source: www.strongtie.com

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Let-In Bracing

Image Source: www.strongtie.com

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Method 3 – Wood Structural Panels

Source: Introduction to Wall Bracing in Accordance with 2006 International Residential Code (IRC). (2009). APA – Engineered Wood Association, Tacoma, WA.

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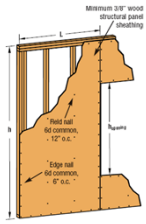
Wood Structural Panel



- Wood structural panel sheathing with a thickness not less than 5/16 inch for 16-inch stud spacing and not less than 3/8 inch for 24-inch stud spacing. Wood structural panels shall be installed in accordance with Table R602.3(3).

Image Source: www.strongtie.com

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2006 IRC Table R602.10.1

Amount of Wall Bracing

- Method 3 – Wood Structural Panel

  ≥ 16% of braced wall line for
  - Top story, or
  - 1st story of 2 stories, or
  - 2nd story of 3 stories

  } I.e. supporting one floor plus a roof

  ≥ 25% of braced wall line for: 1st story of 3 stories

  Continuous wood structural panel
  - Per Table R602.10.5

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2006 IRC Section R602.10.4

Amounts of Wall Bracing

- **Minimum length of Braced Wall Panels for methods 2, 3, 4, 6, 7 and 8:**
  - Each panel:
    - Must be ≥ 48" in length and
    - Cover at least:
      - 3 studs @ 16" o.c.
      - 2 studs @ 24" o.c.

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2006 IRC Section R602.10.5

Continuous Wood Structural Panel Sheathing

- **CWSP method may be used when:**
  - WSP's are applied to all sheathable areas of exterior walls
  - Braced wall panel lengths are in accordance with Table R602.10.5
  - WSP sheathing is installed at corners in accordance with Figure R602.10.5

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2006 IRC Section R602.10.5

Continuous Wood Structural Panel Sheathing

- **The bracing amounts in Table R602.10.1 for Method 3 shall be permitted to be multiplied by:**
  - **A factor of 0.9** for a wall with a maximum opening height that does not exceed 85 percent of the wall height, or
  - **A factor of 0.8** for walls with a maximum opening height that does not exceed 67 percent of the wall height

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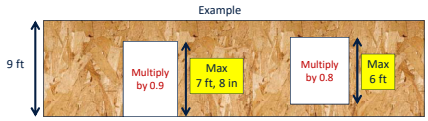
2006 IRC Section R602.10.5
Continuous Wood Structural Panel Sheathing



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2006 IRC Section R602.10.5
Continuous Wood Structural Panel Sheathing

- For example:
  - Condition: 1st story of 2 stories
  - Braced Wall Line = 48 ft
  - Method 3 requires bracing length = 48 ft x 0.16 = 7.68 ft

If maximum opening is ≤ 67% of wall height:
- Requires bracing length = 7.68 ft x 0.8 = 6.14 ft

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2006 IRC Section R602.10.5
Continuous Wood Structural Panel Sheathing

- Minimum panel length
- Table R602.10.5: Length requirements for braced wall panels in a continuously sheathed wall

MINIMUM LENGTH OF BRACED WALL PANEL (inches)			MAXIMUM OPENING HEIGHT NEXT TO THE BRACED WALL PANEL (% of wall height)
8-foot wall	9-foot wall	10-foot wall	
48	54	60	100
32	36	40	85
24	27	30	65

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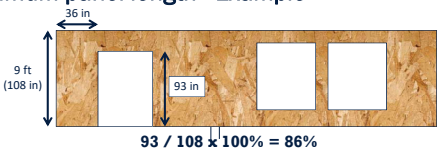
2006 IRC Section R602.10.5

Continuous Wood Structural Panel Sheathing

- Minimum panel length - Example



93 / 108 x 100% = 86%

Maximum opening adjacent to a 36 inch panel is 85% (Table R602.10.5

Panel does **NOT** count toward required bracing length

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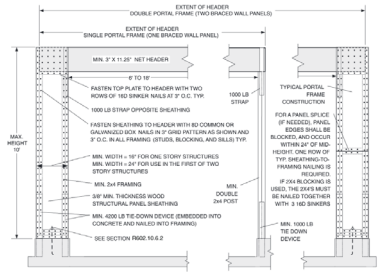
2006 IRC Section R602.10.6.2

Alternate Braced Wall Panel Adjacent to a Door or Window Opening



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Can I Mix Methods?

- 2006 IRC is silent about mixing methods:
  - On separate BWLs
  - Within BWLs
- Mixing is ok from an engineering perspective
  - Not including CWSP in same BWL
  - Each method must comply its own requirements
  - If required bracing length differs between methods – use most conservative (longest)

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Questions

- What about proprietary systems?
  - If proprietary wall sheathing products are not specifically approved per the 2006 IRC (but ARE approved for 2009 and beyond), is this an issue in PA?

1.0 EVALUATION SCOPE

1.1 Compliance with the following codes:

- 2015, 2012 and 2009 *International Building Code*® (IBC)
- 2015, 2012 and 2009 *International Residential Code*® (IRC)
- 2015, 2012 and 2009 *International Energy Conservation Code*® (IECC)

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Summary

- Wall bracing requirements are unique to the PA UCC
- Prescriptive wall bracing provisions from the 2006 IRC are applicable per the UCC
- Manufacturers, design professionals, and code officials must be consulted (as applicable)

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Questions?

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