Simplifying IRC Wall Bracing Requirements

Presented by:
Kyle Tilley
Engineered Wood Specialist

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Attendee Survey

Kyle Tilley
kyle.tilley@apawood.org

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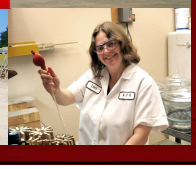
Technical Services Division

Market Access and Development



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Objectives

1. Identify performance implications of wall bracing in single-family homes.
2. List the benefits of early wall bracing design for enhancing window layout and material efficiency.
3. Be able to identify when to use prescriptive wall bracing, engineering, or a combination of both for code compliance.
4. Discuss how the APA Wall Bracing Calculator output streamlines the plan review process and optimal constructability during the building plan implementation.

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Agenda

Review a load path through a wood structure while covering a portion of the IRC Wall Bracing section.

Describe the key benefits to early wall bracing design.

Introduction to APA's Wall Bracing Calculator with a WBC entry example.

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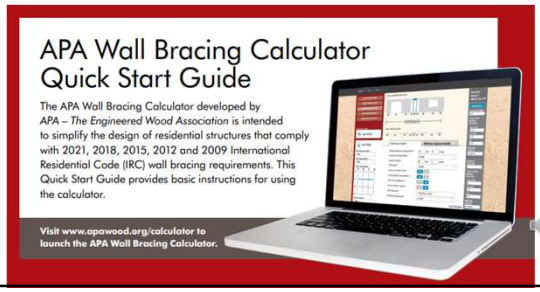
Wall Bracing Calculator



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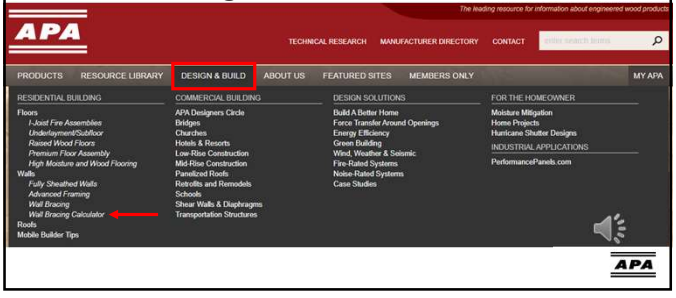
Wall Bracing Calculator



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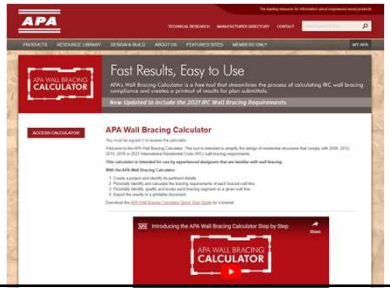
Wall Bracing Calculator



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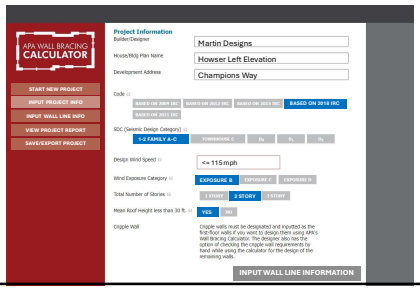
Wall Bracing Calculator



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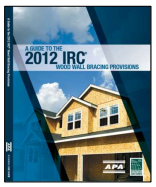
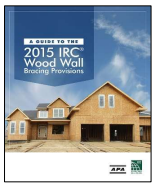
A Guide to the Wood Wall Bracing Provisions



2012 IRC Wall Bracing

- 29 pages on wall bracing (includes simplified wall bracing)
- 265-page commentary book



2015 IRC Wall Bracing

- 28 pages on wall bracing (includes simplified wall bracing)
- Commentary book available now.

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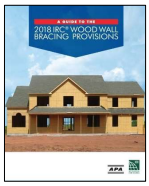
A Guide to the Wood Wall Bracing Provisions



Wall Bracing Calculator

2018 IRC Wall Bracing

- 46 pages on wall bracing (includes simplified wall bracing)
- 281-page commentary book

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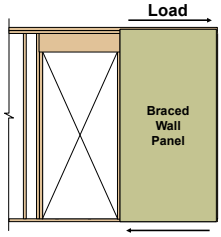
Load Path



R301.1 Application

The construction of buildings… shall result in a… complete load path… for the transfer of all loads… to the foundation.

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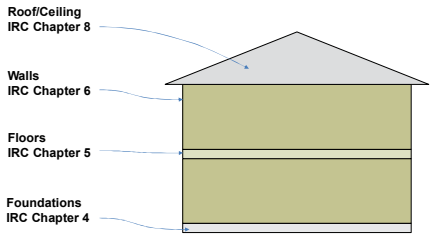
Load Path



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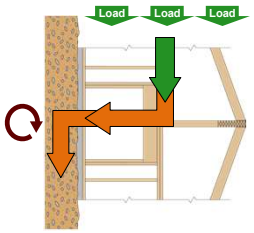
Load Path

Lateral (Sideways) Load Path



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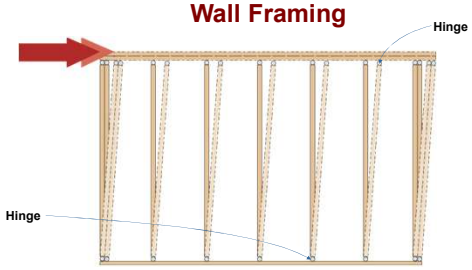
Stiffened Walls

Wall Framing



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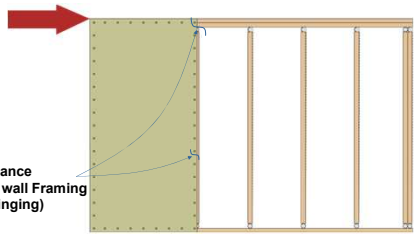
Stiffened Walls

Wall Framing



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Wall Bracing

R602.10 Wall Bracing

"Where a building, or portion thereof, does not comply with one or more of the bracing requirements in this section, those portions shall be designed and constructed in accordance with Section R301.1."

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Bracing: Panel Material – Intermittent

Intermittent Bracing Methods:

LIB — Let-in diagonal brace
DWB — 3/4" Diagonal wood boards
WSP — 3/8" Wood structural panel
BV-WSP — 7/16" Wood structural panel with stone or masonry veneer
SFB — 1/2" Structural fiberboard
GB — 1/2" Interior gypsum wallboard or gypsum sheathing particleboard
PBS — 3/8" Particleboard sheathing
PCP — Portland cement plaster on studs
HPS — 7/16" Hardboard panel siding
ABW — Alternate braced wall
PFH — Portal frame with hold-downs
PFG — Portal frame at garage door openings in SDC A-C

Table R602.10.4

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Bracing: Panel Material – Continuous

Continuous Sheathing Bracing Methods:

CS-WSP — Continuously sheathed wood structural panel
CS-G — Continuously sheathed wood structural panel adjacent to garage openings
CS-PF — Continuously sheathed portal frame
CS-SFB — Continuously sheathed structural fiberboard

Table R602.10.4

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Stiffened Walls

BWP (Prescriptive)

- **Limitations**
  - 3 story maximum
  - Wind < 140 mph(1)
  - SDC A-D_2
  - Others (see IRC Chap. 3)
- **Typically without hold-downs**

VS.

Shear Walls (Engineered)

- **Applications**
  - Any building size/shape
  - Wind – no limit
  - SDC – no limit
  - Calculations required
- **Typically with hold-downs**

(1) Areas requiring wind design in Figure R301.2(5)A may not use the IRC for lateral provisions.

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Limits: Wind Exposure

Figure R301.2.1.1 A shows where the IRC wall bracing requirements do not apply.

Another code or standard must be used to brace the walls against lateral loads.

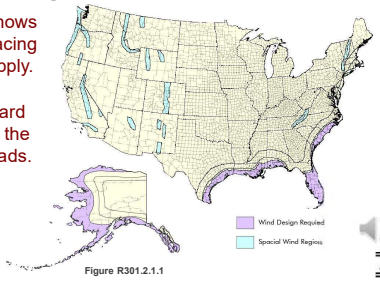

Figure R301.2.1.1

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Bracing: Required Length

Bracing Requirements Based on Wind Speed

Wind Bracing Table Based on:

- Wind Exposure Category B
- Mean roof height of 30 ft
- Eave to ridge height of 10 ft
- Wall height of 10 ft
- Two braced wall lines

Required Bracing Length is Determined by:

- Wind speed
- Story location
- Wall line spacing
- Bracing method

Table R602.10.3(1)

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Bracing: Required Length

TABLE R602.10.3(1)
BRACING REQUIREMENTS BASED ON WIND SPEED

- EXPOSURE CATEGORY B
- 30-FOOT MEAN ROOF HEIGHT
- 10-FOOT WALL HEIGHT
- 2 BRACED WALL LINES

Ultimate Design Wind Speed (mph)	Story Location	Braced Wall Line Spacing (feet)	MINIMUM TOTAL LENGTH (FEET) OF BRACED WALL PANELS REQUIRED ALONG EACH BRACED WALL LINE[a]			
			Method LIB[b]	Method GB	Methods DWB, WSP, SFB, PBS, PCP, HPS, BV-WSP, ABW, PFH, PFG, CS-SFB[c]	Methods CS-WSP, CS-G, CS-PF
≤ 110		10	3.5	3.5	2.0	1.5
		20	6.0	6.0	3.5	3.0
		30	8.5	8.5	5.0	4.5
		40	11.5	11.5	6.5	5.5
		50	14.0	14.0	8.0	7.0
		60	16.5	16.5	9.5	8.0
		10	6.5	6.5	3.5	3.0
		20	11.5	11.5	6.5	5.5
		30	16.5	16.5	9.5	8.0
		40	21.5	21.5	12.5	10.5
		50	26.5	26.5	15.5	13.0
		60	31.5	31.5	18.0	15.5
		10	NP	9.5	5.5	4.5
		20	NP	17.0	10.0	8.5
		30	NP	24.5	14.0	12.0

Table R602.10.3(1)

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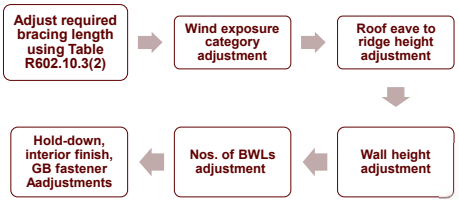
Bracing: Required Length

Adjustments to the required bracing length for wind forces:



Only required when adjustment is greater than 1.0

Table R602.10.3(2)

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Bracing: Required Length

Bracing Requirements Based on Wind Speed— Adjustment Factors

Wind bracing adjustment factors are in Table R602.10.3(2)

1. Wind exposure category
2. Eave-to-ridge height
3. Story height
4. Number of braced wall lines
5. 800-pound hold-down on top story
6. Application of interior gypsum board finish
7. Gypsum board fastening
8. Horizontal blocking

Table R602.10.3(2)

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Bracing: Required Length

Adjustment Factor —
Wind Exposure Category, Mean Roof Height

Number of Stories	Exposure/Height Factor		
	Exposure B	Exposure C	Exposure D
1	1.0	1.2	1.5
2	1.0	1.3	1.6
3	1.0	1.4	1.7

Table R602.10.3(2)

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Bracing: Required Length

Adjustment Factor —
Roof Eave-to-Ridge Height

Support Condition	Roof Eave-to-Ridge Height			
	≤ 5'	10'	15'	20'
Roof only	0.7	1.0	1.3	1.6
Roof + floor	0.85	1.0	1.15	1.3
Roof + 2 floors	0.9	1.0	1.1	NP

NP – Not Permitted

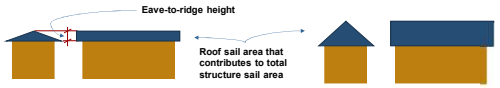

Table R602.10.3(2)

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Bracing: Required Length

Adjustment Factor —
Story Height

Wall Height (ft)	Adjustment Factor
8'	0.90
9'	0.95
10'	1.00
11'	1.05
12'	1.10

Table R602.10.3(2)

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Bracing: Required Length

Adjustment Factor — Number of Braced Wall Lines

Number of Braced Wall Lines	Adjustment Factor
2	1.00
3	1.30
4	1.45
≥ 5	1.60

– Braced wall line
x – Braced wall line spacing

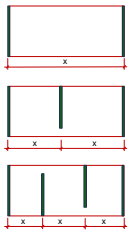

Table R602.10.3(2)

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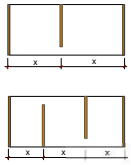
Bracing: Required Length

Adjustment Factor — Number of Braced Wall Lines (Footnote c)

Number of Braced Wall Lines	Adjustment Factor
2	1.00
3	1.30
4	1.45
≥ 5	1.60

Table R602.10.3(2) Footnote c allows the adjustment factor to be 1.0 when the braced wall line spacing on exterior lines neglects the interior lines.

For example—when interior BWLs are only need for seismic bracing or when they are only needed to support BWLs in the story above.



– Braced wall line
x – Braced wall line spacing

Table R602.10.3(2)

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Bracing: Required Length

Adjustment Factor — Wind Continued

Adjustment Factor	Bracing Method	Adjustment Factor
Additional 800-pound hold-down at each BWP for top story only	DWB, WSP, SFB, PBS, PCP, and HPS	0.8
Interior finish	DWB, WSP, SFB, PBS, PCP, HPS, CS-WSP, CS-G, and CS-SFB	1.4
Gypsum board fastening—4" o.c. at all panel edges, blocked horizontal joints	GB	0.7
Horizontal blocking	WSP, CS-WSP	2.0

Table R602.10.3(2)

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Bracing: Required Length

Bracing Requirements Based on Wind Speed — Adjustment Factors

Wind bracing adjustment factors are in Table R602.10.3(2)

1. Wind exposure category
2. Eave-to-ridge height
3. Wall height
4. Number of braced wall lines
5. 800-pound hold-down on top story
6. Application of interior gypsum board finish
7. Gypsum board fastening
8. Horizontal blocking

Table R602.10.3(2)

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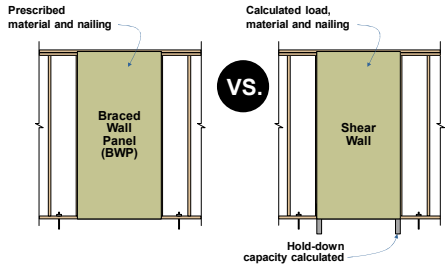
Stiffened Walls



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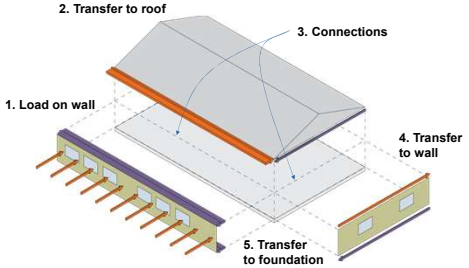
Load Path



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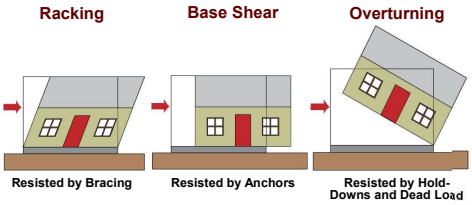
Lateral Forces

Effects of Forces



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Load Path Continuity

Racking

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Load Path Continuity

Base Shear

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Load Path Continuity

2003 Missouri Tornado

Overturning

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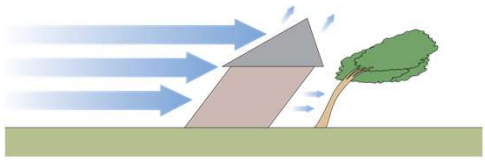
Lateral Forces

Wind Speed



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Early Wall Bracing Design

Cost Savings

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Early Wall Bracing Design

Key Benefits

Optimized Window Layout
- Enhanced Aesthetics
- Improved Natural Lighting
- Views and Ventilation

Material Efficiency
- Reduced Waste
- Optimal Use of Structural Components
- Cost Savings

Structural Integrity and Safety
- Balanced Load Distribution
- Code Compliance

Flexibility in Architectural Design
- Creative Freedom
- Integrated Systems

Streamlined Construction Process
- Reduced Rework
- Faster Construction Timeline

Energy Efficiency
- Thermal Performance
- Sustainable Design

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Designer Benefits

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Builder Benefits

Informed framing crews can properly install wall sheathing and save not only material, but time as well.

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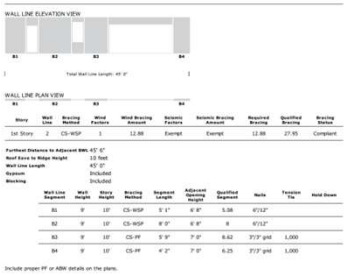
Code Official Benefits



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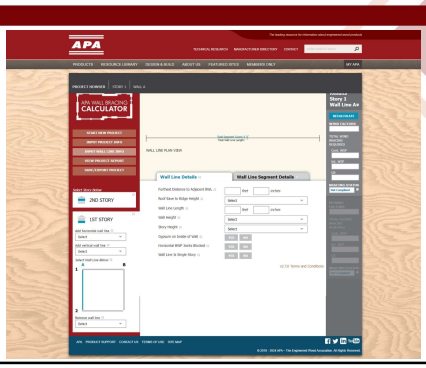

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Important Basics: BWL vs. BWP

The code defines a braced wall panel (BWP) as a full-height section of a braced wall line (BWL) with no vertical or horizontal offsets.

The IRC defines a BWL as a series of BWPs in a single story.

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Important Basics

Braced Wall Lines R602.10.1

- Straight
- Run in each plan direction
- Required on every floor
- 4' offset each side of BWL allowed
- BWL not required to align with physical walls
- Angled walls allowed

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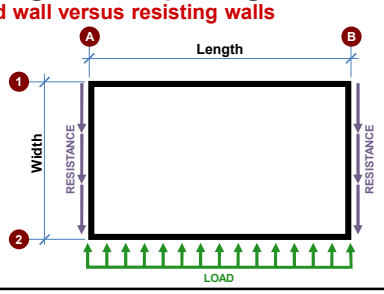
Bracing: BWL Spacing

Loaded wall versus resisting walls



R602.10.1

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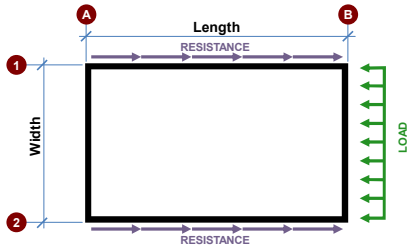
Bracing: BWL Spacing

Loaded wall versus resisting walls



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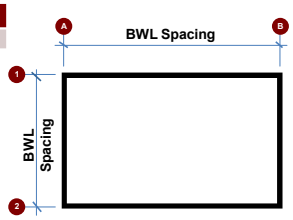
Bracing: BWL Spacing

Table R602.10.1.3

Wind
BWL Spacing = 60' max.



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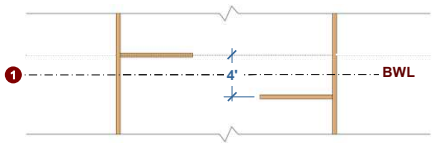
Bracing: BWL Spacing



R602.10.1.2

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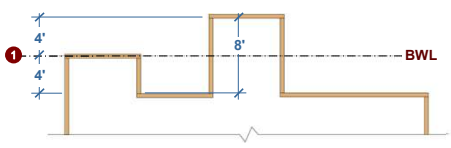
Bracing: BWL Spacing



R602.10.1.2

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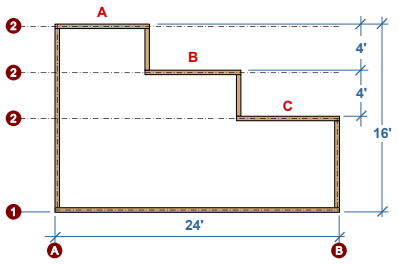
Bracing: BWL Spacing



R602.10.1.2

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Bracing: 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.

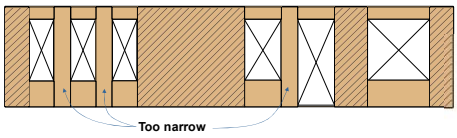

Table R602.10.5

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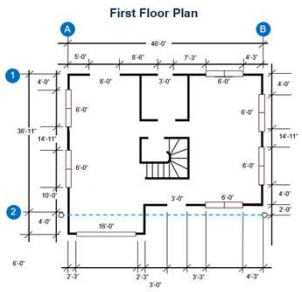

Front Elevation

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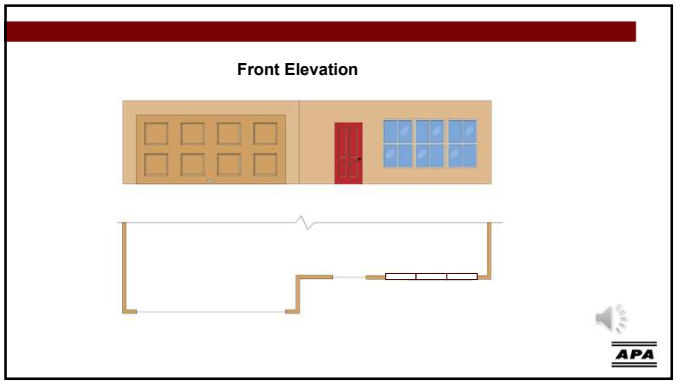
Front Elevation
APA

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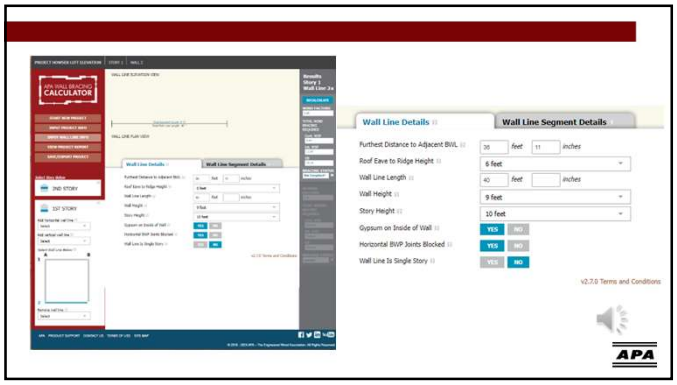
APA WALL BRACING CALCULATOR
Wall Line Details
Wall Line Segment Details
Furthest Distance to Adjacent BWL
Roof Eave to Ridge Height
6 feet
Wall Line Length
Wall Height
9 feet
Story Height
10 feet
Gypsum on Inside of Wall
YES
Horizontal BWP Joints Blocked
YES
Wall Line Is Single Story
YES
v2.7.0 Terms and Conditions
APA

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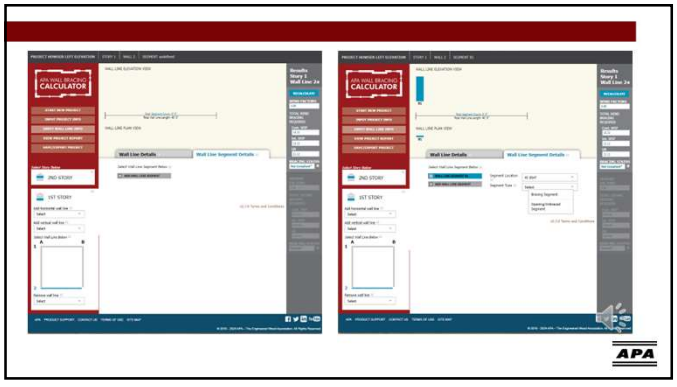
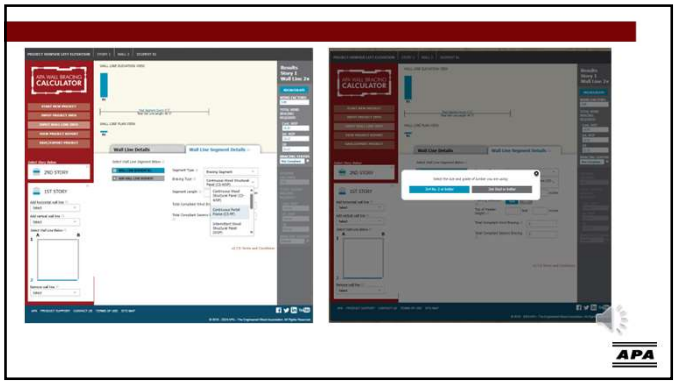

APA WALL BRACING CALCULATOR
APA

60



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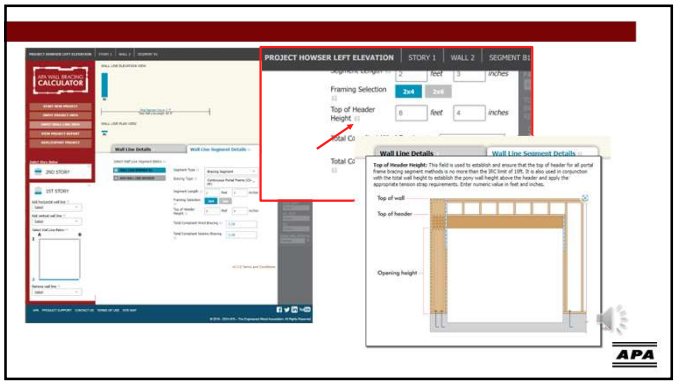
PROJECT HOWSER LEFT ELEVATION
STORY 1
WALL 2
SEGMENT B1
Framing Selection
2x4
2x6
Top of Header Height
feet
inches
Wall Line Details
Wall Line Segment Details
Top of wall
Top of header
Opening height

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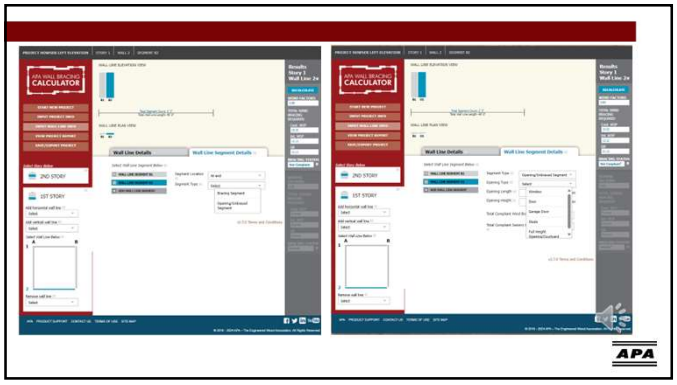

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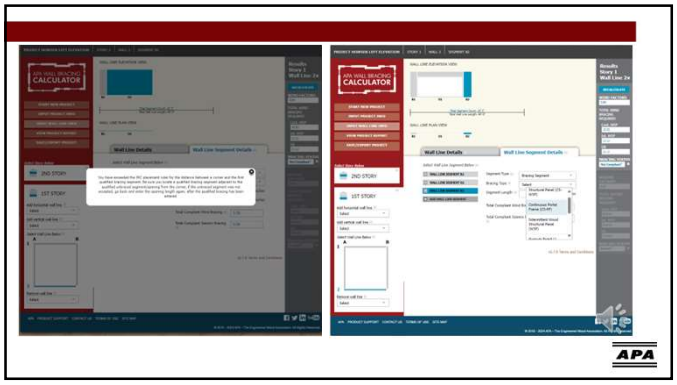

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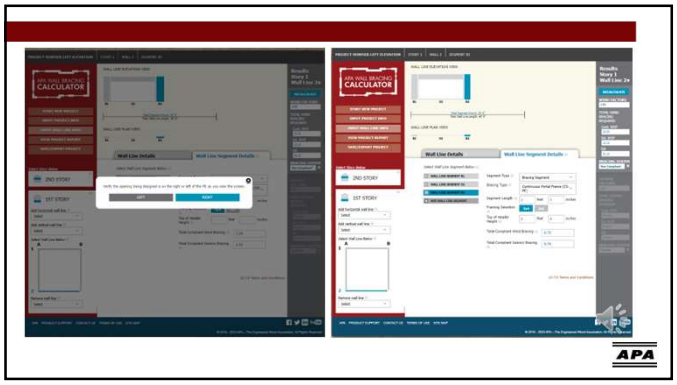

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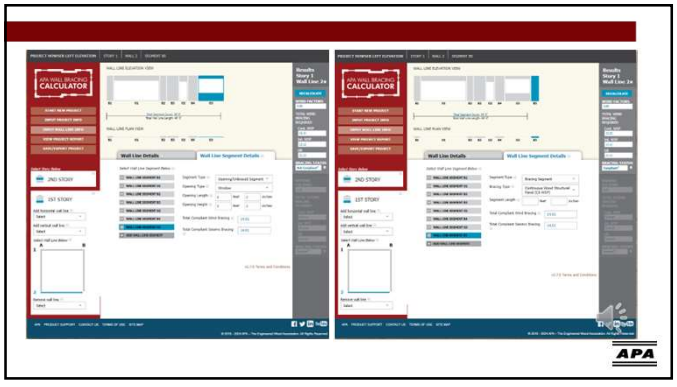

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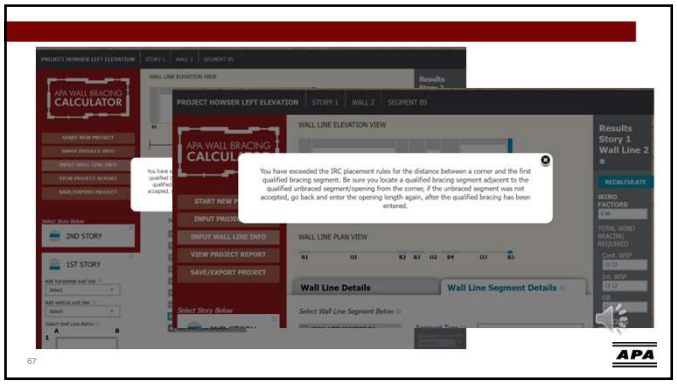
APA WALL BRACING CALCULATOR
PROJECT HOWSER LEFT ELEVATION
STORY 1
WALL 2
SEGMENT B5
WALL LINE ELEVATION VIEW
WALL LINE PLAN VIEW
You have exceeded the IRC placement rules for the distance between a corner and the first qualified bracing segment. Be sure you locate a qualified bracing segment adjacent to the qualified unbraced segment/opening from the corner, if the unbraced segment was not accepted, go back and enter the opening length again, after the qualified bracing has been entered.
Results
Story 1
Wall Line 2
RECALCULATE
2ND STORY
1ST STORY
INPUT WALL LINE INFO
VIEW PROJECT REPORT
SAVE/EXPORT PROJECT
Wall Line Details
Wall Line Segment Details
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APA

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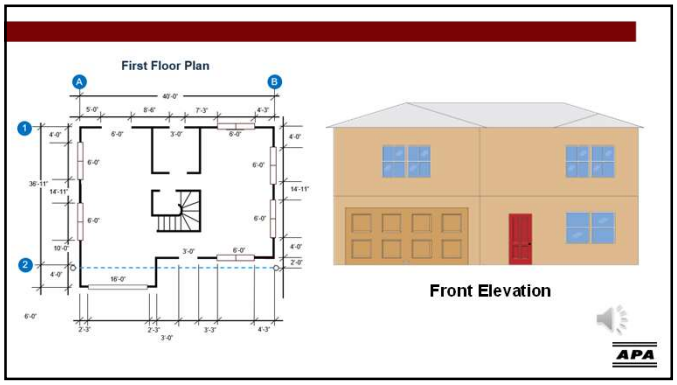
First Floor Plan
Front Elevation
APA

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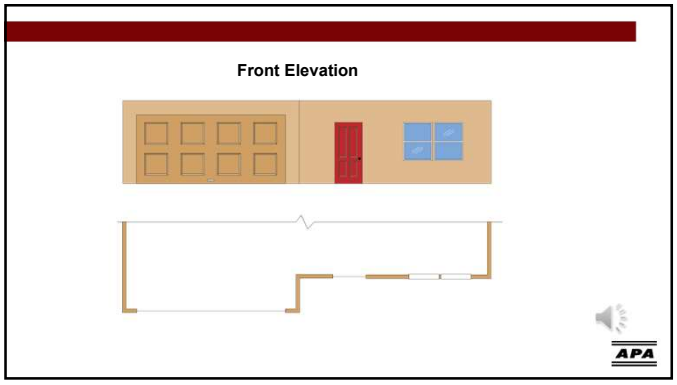
Front Elevation
APA

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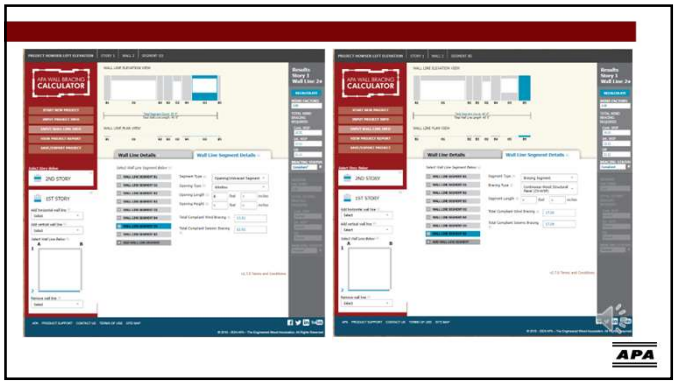
APA WALL BRACING CALCULATOR
APA

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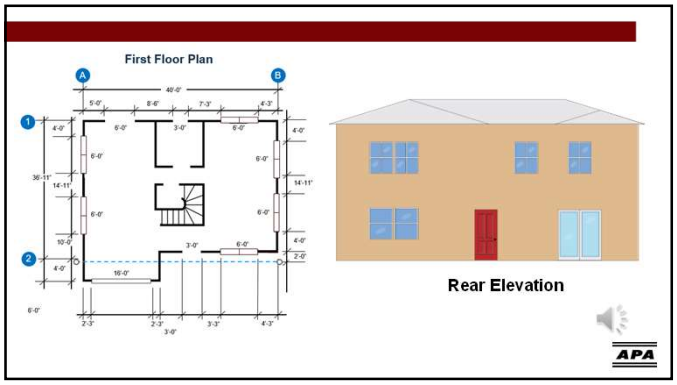
First Floor Plan
Rear Elevation
APA

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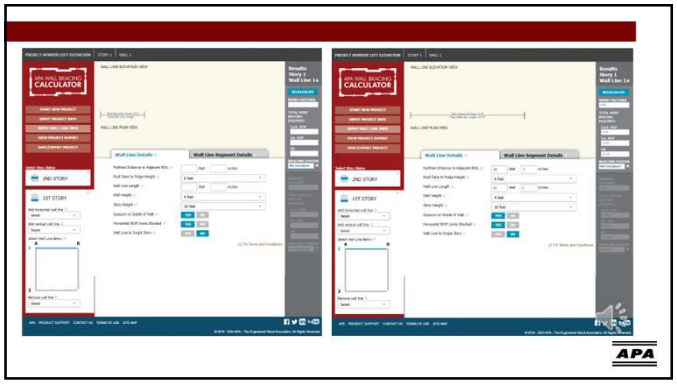
APA WALL BRACING CALCULATOR
APA

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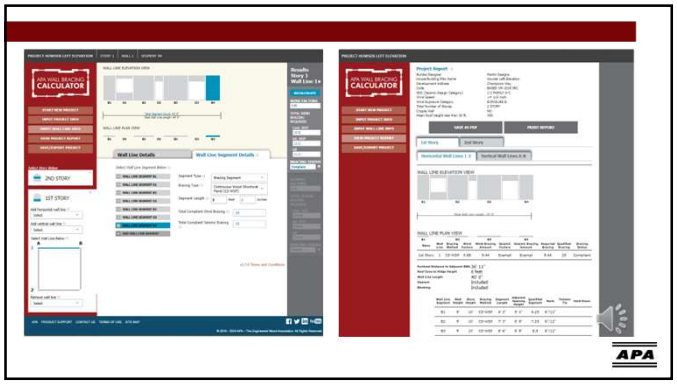
APA WALL BRACING CALCULATOR
APA WALL BRACING CALCULATOR
APA

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First Floor Plan
APA WALL BRACING CALCULATOR
APA

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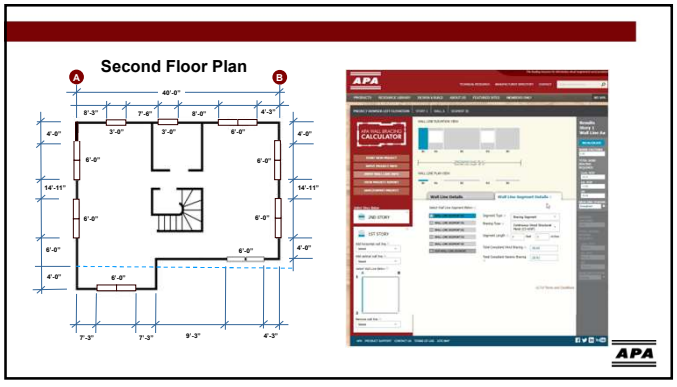
Second Floor Plan
APA
APA

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Questions?

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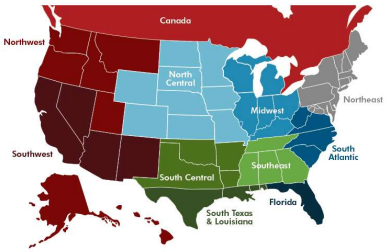
APA Field Staff

apawood.org/field-services



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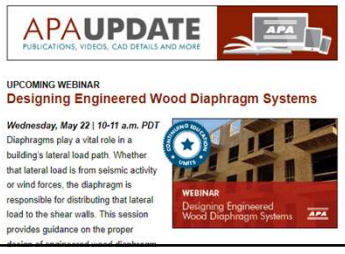
APA Update Newsletter

(www.apawood.org)



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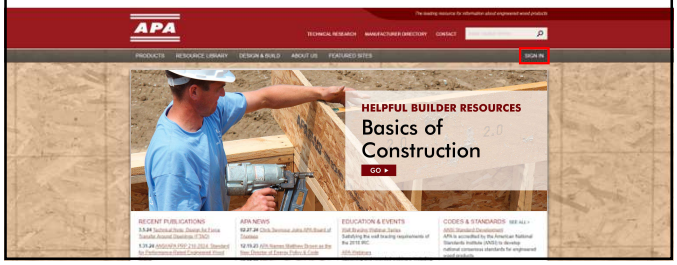
APA Update Newsletter
(www.apawood.org)



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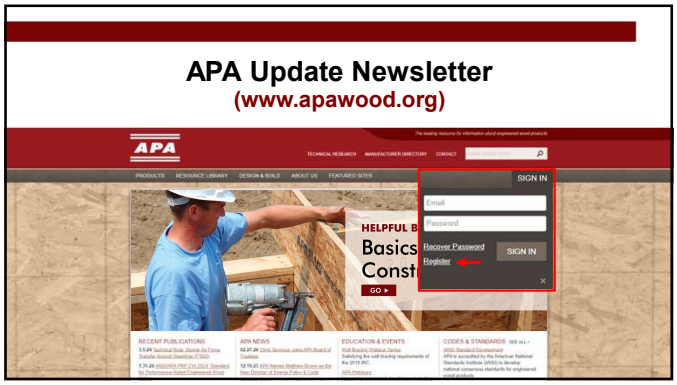
APA Update Newsletter
(www.apawood.org)



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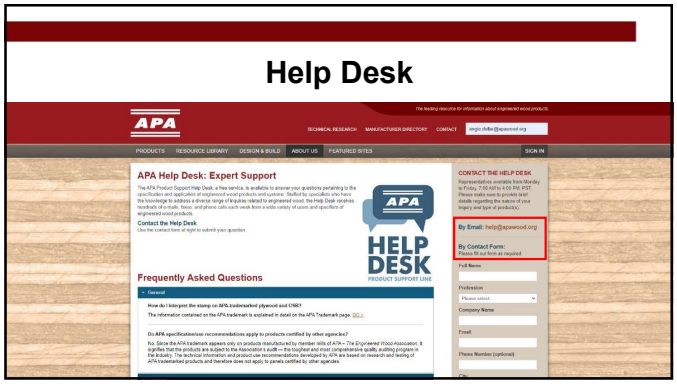
Help Desk



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Attendee Survey

Kyle Tilley
kyle.tilley@apawood.org

https://www.apawood.org/presentation-survey

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Thank you for attending.

APA – The Engineered Wood Association
7011 S. 19th Street
Tacoma, Washington 98466

www.apawood.org/contact-us

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