



Slide 1



### Wall Bracing III: Simplified Wall Bracing & APA Wall Bracing Calculator for the 2018 IRC®



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Slide 2


The APA – The Engineered Wood Association is a Registered Provider with The American Institute of Architects Continuing Education Systems (AIA/CES), Provider #G023.

Credit(s) earned on completion of this course will be reported to AIA/CES for AIA members. Certificates of Completion for both AIA members and non-AIA members are available upon request.



This course is registered with 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.



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Slide 3

### Meet the Team




Warren Hamrick




2018 IRC Load Path, Lateral Forces and Limitations

Matt Brown



Meeting the IRC® Bracing Provisions for Wind and Seismic

Ron Nuttall



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Slide 4

### Learning Objectives

- Apply the IRC Wall Bracing provision to example plans
- Understand both the IRC and APA simplified methods
- Input plan information into the APA Wall Bracing Calculator



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Slide 5


### Resources

[www.iccsafe.org](http://www.iccsafe.org)  
▪ Item 7102S12



[www.apawood.org](http://www.apawood.org)  
▪ Form F430





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Slide 6

### Bracing Topics

Forces	Basics	Bracing
Load Path	Limits	Braced Wall Lines
Lateral Forces	Wind Exposure	Braced Wall Panels
Stiffened Walls		Required Length
		Simplified Wall Bracing
		APA Simplified Wall Bracing
		APA Wall Bracing Calculator



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Slide 7

Example #1

**Example:**

- SDC C, Single-family dwelling
- Wind 115 mph, Wind Exposure C
- Method WSP
- Upper floor of two-story home
- Story height is 9 ft.
- Roof eave-to-ridge height is 16 ft.

7

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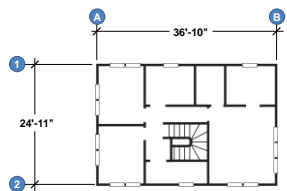
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Slide 8

Example #1



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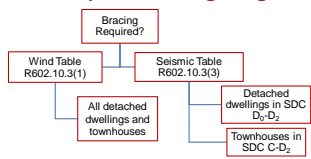
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Slide 9

Bracing: Required Length

**Decision Tree for Determining Required Bracing Length**



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Slide 10

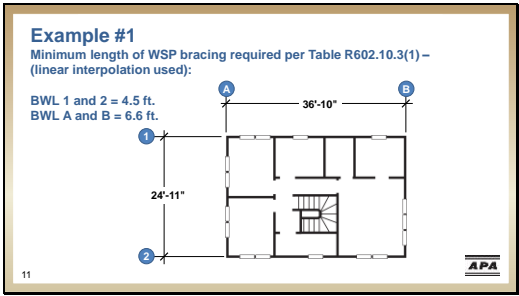
**Table R602.10.3(1) –  
Minimum Required Length of Bracing**

EXPOSURE CATEGORY B  
30-4 FOOT MEAN ROOF HEIGHT  
10-4 FOOT WALL HEIGHT  
2 BRACED WALL LINES

MINIMUM TOTAL LENGTH (FEET) OF BRACED WALL PANELS  
REQUIRED ALONG EACH BRACED WALL LINE<sup>a</sup>

Ultimate Design Wind Speed (mph)	Story Location	Braced Wall Type Spacing <sup>b</sup> (feet)	Method L <sup>b</sup>	Method U <sup>b</sup>	Methods CS, ASD, CS, P, CS, S <sup>c</sup>	Methods CS, ASD, CS, G, CS, P
25 ft. 127 ft.	1	10	3.5	3.5	2.0	2.0
		20	6.5	6.5	3.5	3.5
		30	9.5	9.5	5.0	5.0
		40	12.5	12.5	6.5	6.5
		50	15.5	15.5	8.0	8.0
	≤ 115	10	7.0	7.0	4.0	4.0
		20	12.5	12.5	7.0	7.0
		30	18.0	18.0	10.0	10.0
		40	23.5	23.5	13.0	13.0
		50	29.0	29.0	16.0	16.0
2	10	3.5	3.5	2.0	2.0	
	20	6.5	6.5	3.5	3.5	
	30	9.5	9.5	5.0	5.0	
	40	12.5	12.5	6.5	6.5	
	50	15.5	15.5	8.0	8.0	
3	10	3.5	3.5	2.0	2.0	
	20	6.5	6.5	3.5	3.5	
	30	9.5	9.5	5.0	5.0	
	40	12.5	12.5	6.5	6.5	
	50	15.5	15.5	8.0	8.0	
4	10	3.5	3.5	2.0	2.0	
	20	6.5	6.5	3.5	3.5	
	30	9.5	9.5	5.0	5.0	
	40	12.5	12.5	6.5	6.5	
	50	15.5	15.5	8.0	8.0	
5	10	3.5	3.5	2.0	2.0	
	20	6.5	6.5	3.5	3.5	
	30	9.5	9.5	5.0	5.0	
	40	12.5	12.5	6.5	6.5	
	50	15.5	15.5	8.0	8.0	

Slide 11



Slide 12

**Bracing: Required Length**

Adjustment Factor —  
Wind Exposure Category, Mean Roof Height

Table R602.10.3(2)

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

12

Slide 13

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

Eave-to-ridge height

Roof sail area that contributes to total structure sail area

13

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Slide 14

Bracing: Required Length

Adjustment Factor — Story Height

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

14

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Slide 15

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

Braced wall line spacing

15

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Slide 16

### Example #1

### Applicable Adjustment Factors, Table R602.10.3(2)

### #1 – Exposure category (C) – 1.3

#2 – Roof eave-to-ridge height (16 ft.) – 1.36

**#3 – Story height (9 ft.) – 0.95**

16



Slide 17

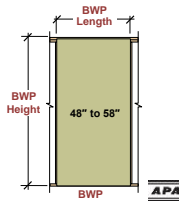
**Bracing: Panel Material – Intermittent**

### Minimum Length of BWPs

Table R602.10.5, Minimum length for braced wall panels

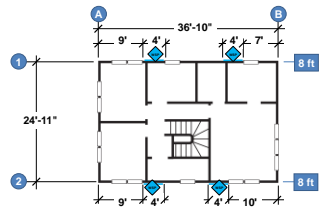
Method (See Table R602.10.4)	Minimum Length <sup>a</sup> (inches)					Contributing Length (inches)
	Wall Height					
	8 ft	9 ft	10 ft	11 ft	12 ft	
DWB (WSP)	48	48	48	53	58	Actual <sup>b</sup>
SFB, PSB, PCP, HPS, BV-WSP						Double sided = Actual Single sided = 0.5 x Actual
GB	48	48	48	53	58	
LJB	55	62	69	NP	NP	Actual <sup>c</sup>

17



Slide 18

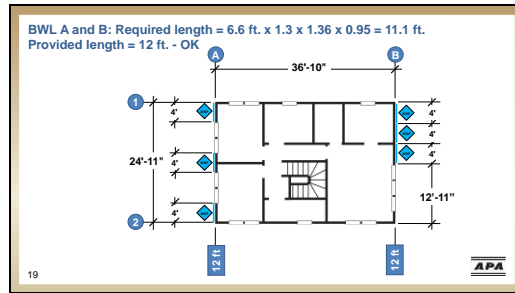
BWL 1 and 2: Required length = 4.5 ft. x 1.3 x 1.36 x 0.95 = 7.6 ft.  
Provided length = 8 ft. - OK



18



Slide 19



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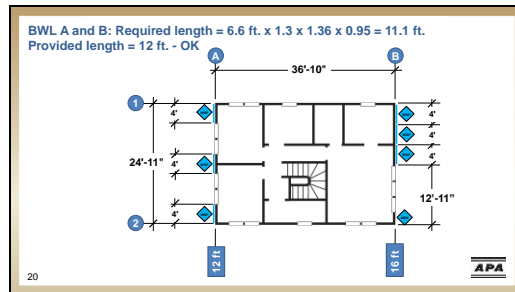
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Slide 20



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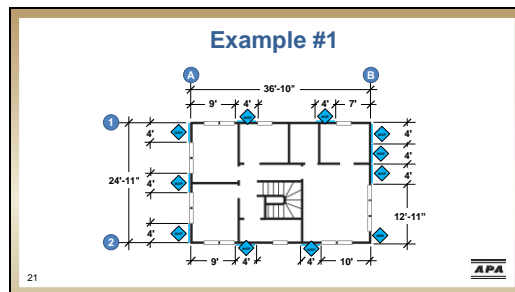
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Slide 21

[illegible]

Slide 22

Example #2

**Example:**

- SDC C, Single-family dwelling
- Wind 115 mph, Wind Exposure C
- Method CS-WSP
- Bottom floor of two-story home
- Story height is 10 ft.
- Roof eave-to-ridge height is 16 ft.

22

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Slide 23

Example #2

Minimum length of CS-WSP bracing required per Table R602.10.3(1) — (linear interpolation used):

36'-10"

24'-11"

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Slide 24

Bracing: Required Length

**Decision Tree for Determining Required Bracing Length**

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graph TD; A[Bracing Required?] --> B[Wind Table R602.10.3(1)]; A --> C[Seismic Table R602.10.3(3)]; B --> D[All detached dwellings and townhouses]; C --> E[Detached dwellings in SDC D1-D2]; C --> F[Townhouses in SDC C-D2];
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24

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Slide 25

**Table R602.10.3(1) – Minimum Required Length of Bracing**

EXPOSURE CATEGORY B 30-40 FT MEAN ROOF HEIGHT OR 4-6 FT WALL HEIGHT 2.2 BRACED WALL PANELS		MINIMUM TOTAL LENGTH (FEET) OF BRACED WALL PANELS REQUIRED ALONG EACH BRACED WALL LINE <sup>a</sup>			
Ultimate Design Wind Speed (mph)	Story Location Spacing <sup>b</sup> (feet)	Method L10 <sup>c</sup>	Method L2	Methods D10, WSP, SER, P10, P12, P15, P18, W10, W12, W15, W18, P10, CS, SER <sup>d</sup>	Methods CS, WSP, CS, G, CS, P1
10	10	3.5	3.5	2.5	2.0
20	10	6.5	6.5	3.5	3.0
30	10	9.5	9.5	5.5	4.5
40	10	12.5	12.5	7.0	6.0
50	10	15.0	15.0	8.0	7.0
60	10	17.5	17.5	9.0	8.0
70	10	20.0	20.0	10.0	9.0
80	10	22.5	22.5	11.0	10.0
90	10	25.0	25.0	12.0	11.0
100	10	27.5	27.5	13.0	12.0
110	10	30.0	30.0	14.0	13.0
120	10	32.5	32.5	15.0	14.0
130	10	35.0	35.0	16.0	15.0
140	10	37.5	37.5	17.0	16.0
150	10	40.0	40.0	18.0	17.0
160	10	42.5	42.5	19.0	18.0
170	10	45.0	45.0	20.0	19.0
180	10	47.5	47.5	21.0	20.0
190	10	50.0	50.0	22.0	21.0
200	10	52.5	52.5	23.0	22.0
210	10	55.0	55.0	24.0	23.0
220	10	57.5	57.5	25.0	24.0
230	10	60.0	60.0	26.0	25.0
240	10	62.5	62.5	27.0	26.0
250	10	65.0	65.0	28.0	27.0
260	10	67.5	67.5	29.0	28.0
270	10	70.0	70.0	30.0	29.0
280	10	72.5	72.5	31.0	30.0
290	10	75.0	75.0	32.0	31.0
300	10	77.5	77.5	33.0	32.0
310	10	80.0	80.0	34.0	33.0
320	10	82.5	82.5	35.0	34.0
330	10	85.0	85.0	36.0	35.0
340	10	87.5	87.5	37.0	36.0
350	10	90.0	90.0	38.0	37.0
360	10	92.5	92.5	39.0	38.0
370	10	95.0	95.0	40.0	39.0
380	10	97.5	97.5	41.0	40.0
390	10	100.0	100.0	42.0	41.0
400	10	102.5	102.5	43.0	42.0
410	10	105.0	105.0	44.0	43.0
420	10	107.5	107.5	45.0	44.0
430	10	110.0	110.0	46.0	45.0
440	10	112.5	112.5	47.0	46.0
450	10	115.0	115.0	48.0	47.0
460	10	117.5	117.5	49.0	48.0
470	10	120.0	120.0	50.0	49.0
480	10	122.5	122.5	51.0	50.0
490	10	125.0	125.0	52.0	51.0
500	10	127.5	127.5	53.0	52.0
510	10	130.0	130.0	54.0	53.0
520	10	132.5	132.5	55.0	54.0
530	10	135.0	135.0	56.0	55.0
540	10	137.5	137.5	57.0	56.0
550	10	140.0	140.0	58.0	57.0
560	10	142.5	142.5	59.0	58.0
570	10	145.0	145.0	60.0	59.0
580	10	147.5	147.5	61.0	60.0
590	10	150.0	150.0	62.0	61.0
600	10	152.5	152.5	63.0	62.0
610	10	155.0	155.0	64.0	63.0
620	10	157.5	157.5	65.0	64.0
630	10	160.0	160.0	66.0	65.0
640	10	162.5	162.5	67.0	66.0
650	10	165.0	165.0	68.0	67.0
660	10	167.5	167.5	69.0	68.0
670	10	170.0	170.0	70.0	69.0
680	10	172.5	172.5	71.0	70.0
690	10	175.0	175.0	72.0	71.0
700	10	177.5	177.5	73.0	72.0
710	10	180.0	180.0	74.0	73.0
720	10	182.5	182.5	75.0	74.0
730	10	185.0	185.0	76.0	75.0
740	10	187.5	187.5	77.0	76.0
750	10	190.0	190.0	78.0	77.0
760	10	192.5	192.5	79.0	78.0
770	10	195.0	195.0	80.0	79.0
780	10	197.5	197.5	81.0	80.0
790	10	200.0	200.0	82.0	81.0
800	10	202.5	202.5	83.0	82.0
810	10	205.0	205.0	84.0	83.0
820	10	207.5	207.5	85.0	84.0
830	10	210.0	210.0	86.0	85.0
840	10	212.5	212.5	87.0	86.0
850	10	215.0	215.0	88.0	87.0
860	10	217.5	217.5	89.0	88.0
870	10	220.0	220.0	90.0	89.0
880	10	222.5	222.5	91.0	90.0
890	10	225.0	225.0	92.0	91.0
900	10	227.5	227.5	93.0	92.0
910	10	230.0	230.0	94.0	93.0
920	10	232.5	232.5	95.0	94.0
930	10	235.0	235.0	96.0	95.0
940	10	237.5	237.5	97.0	96.0
950	10	240.0	240.0	98.0	97.0
960	10	242.5	242.5	99.0	98.0
970	10	245.0	245.0	100.0	99.0
980	10	247.5	247.5	101.0	100.0
990	10	250.0	250.0	102.0	101.0
1000	10	252.5	252.5	103.0	102.0
1010	10	255.0	255.0	104.0	103.0
1020	10	257.5	257.5	105.0	104.0
1030	10	260.0	260.0	106.0	105.0
1040	10	262.5	262.5	107.0	106.0
1050	10	265.0	265.0	108.0	107.0
1060	10	267.5	267.5	109.0	108.0
1070	10	270.0	270.0	110.0	109.0
1080	10	272.5	272.5	111.0	110.0
1090	10	275.0	275.0	112.0	111.0
1100	10	277.5	277.5	113.0	112.0
1110	10	280.0	280.0	114.0	113.0
1120	10	282.5	282.5	115.0	114.0
1130	10	285.0	285.0	116.0	115.0
1140	10	287.5	287.5	117.0	116.0
1150	10	290.0	290.0	118.0	117.0
1160	10	292.5	292.5	119.0	118.0
1170	10	295.0	295.0	120.0	119.0
1180	10	297.5	297.5	121.0	120.0
1190	10	300.0	300.0	122.0	121.0
1200	10	302.5	302.5	123.0	122.0
1210	10	305.0	305.0	124.0	123.0
1220	10	307.5	307.5	125.0	124.0
1230	10	310.0	310.0	126.0	125.0
1240	10	312.5	312.5	127.0	126.0
1250	10	315.0	315.0	128.0	127.0
1260	10	317.5	317.5	129.0	128.0
1270	10	320.0	320.0	130.0	129.0
1280	10	322.5	322.5	131.0	130.0
1290	10	325.0	325.0	132.0	131.0
1300	10	327.5	327.5	133.0	132.0
1310	10	330.0	330.0	134.0	133.0
1320	10	332.5	332.5	135.0	134.0
1330	10	335.0	335.0	136.0	135.0
1340	10	337.5	337.5	137.0	136.0
1350	10	340.0	340.0	138.0	137.0
1360	10	342.5	342.5	139.0	138.0
1370	10	345.0	345.0	140.0	139.0
1380	10	347.5	347.5	141.0	140.0
1390	10	350.0	350.0	142.0	141.0
1400	10	352.5	352.5	143.0	142.0
1410	10	355.0	355.0	144.0	143.0
1420	10	357.5	357.5	145.0	144.0
1430	10	360.0	360.0	146.0	145.0
1440	10	362.5	362.5	147.0	146.0
1450	10	365.0	365.0	148.0	147.0
1460	10	367.5	367.5	149.0	148.0
1470	10	370.0	370.0	150.0	149.0
1480	10	372.5	372.5	151.0	150.0
1490	10	375.0	375.0	152.0	151.0
1500	10	377.5	377.5	153.0	152.0
1510	10	380.0	380.0	154.0	153.0
1520	10	382.5	382.5	155.0	154.0
1530	10	385.0	385.0	156.0	155.0
1540	10	387.5	387.5	157.0	156.0
1550	10	390.0	390.0	158.0	157.0
1560	10	392.5	392.5	159.0	158.0
1570	10	395.0	395.0	160.0	159.0
1580	10	397.5	397.5	161.0	160.0
1590	10	400.0	400.0	162.0	161.0
1600	10	402.5	402.5	163.0	162.0
1610	10	405.0	405.0	164.0	163.0
1620	10	407.5	407.5	165.0	164.0
1630	10	410.0	410.0	166.0	165.0
1640	10	412.5	412.5	167.0	166.0
1650	10	415.0	415.0	168.0	167.0
1660	10	417.5	417.5	169.0	168.0
1670	10	420.0	420.0	170.0	169.0
1680	10	422.5	422.5	171.0	170.0
1690	10	425.0	425.0	172.0	171.0
1700	10	427.5	427.5	173.0	172.0
1710	10	430.0	430.0	174.0	173.0
1720	10	432.5	432.5	175.0	174.0
1730	10	435.0	435.0	176.0	175.0
1740	10	437.5	437.5	177.0	176.0
1750	10	440.0	440.0	178.0	177.0
1760	10	442.5	442.5	179.0	178.0
1770	10	445.0	445.0	180.0	179.0
1780	10	447.5	447.5	181.0	180.0
1790	10	450.0	450.0	182.0	181.0
1800	10	452.5	452.5	183.0	182.0
1810	10	455.0	455.0	184.0	183.0
1820	10	457.5	457.5	185.0	184.0
1830	10	460.0	460.0	186.0	185.0
1840	10	462.5	462.5	187.0	186.0
1850	10	465.0	465.0	188.0	187.0
1860	10	467.5	467.5	189.0	188.0
1870	10	470.0	470.0	190.0	189.0
1880	10	472.5	472.5	191.0	190.0
1890	10	475.0	475.0	192.0	191.0
1900	10	477.5	477.5	193.0	192.0
1910	10	480.0	480.0	194.0	193.0
1920	10	482.5	482.5	195.0	194.0
1930	10	485.0	485.0	196.0	195.0
1940	10	487.5	487.5	197.0	196.0
1950	10	490.0	490.0	198.0	197.0
1960	10	492.5	492.5	199.0	198.0
1970	10	495.0	495.0	200.0	199.0
1980	10	497.5	497.5	201.0	200.0
1990	10	500.0	500.0	202.0	201.0
2000	10	502.5	502.5	203.0	202.0
2010	10	505.0	505.0	204.0	203.0
2020	10	507.5	507.5	205.0	204.0
2030	10	510.0	510.0	206.0	205.0
2040	10	512.5	512.5	207.0	206.0
2050	10	515.0	515.0	208.0	207.0
2060	10	517.5	517.5	209.0	208.0
2070	10	520.0	520.		

Slide 28

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

Eave-to-ridge height

Roof sail area that contributes to total structure sail area

28

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Slide 29

Bracing: Required Length

Adjustment Factor — Story Height

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

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Slide 30

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

30

— Braced wall line

x — Braced wall line spacing

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Slide 31

### Example #2

### Applicable Adjustment Factors, Table R602.10.3(2)

### #1 – Exposure category (C) – 1.3

#2 – Roof eave-to-ridge height (16 ft.) – 1.18

31



Slide 32

### Minimum Length of BWP Table R602.10.5

CS-15			24	27	30	33	36		Actual?
CS-15P		2000, 1, 11 and 12	15	18	20	22	24		1, 1,

One mile = 1.61 km, 1 hour = 3600 sec, 1 meter per hour = 0.000278 m/s



Slide 33

### Example #2

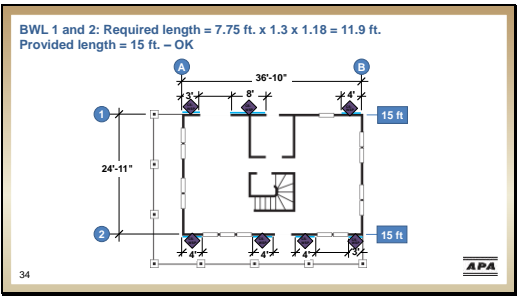
**Example:**

- **Clear opening height at doors = 8 ft.**
  - Minimum BWP length = 41" per Table R602.10.5
- **Clear opening height at windows = 5 ft.**
  - Minimum BWP length = 27" per Table R602.10.5

33



Slide 34



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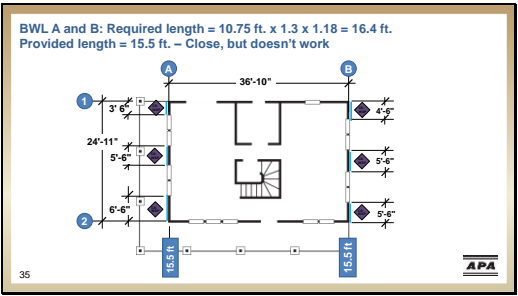
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Slide 35



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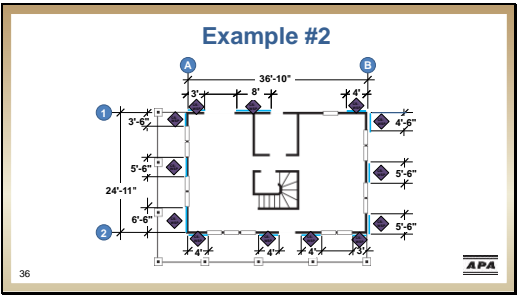
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Slide 36



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Slide 37

### Bracing Topics

Forces

Basics

Bracing

Braced Wall Lines

Braced Wall Panels

Required Length

Simplified Wall Bracing

APA Simplified Wall Bracing

APA Wall Bracing Calculator

37

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Slide 38

### IRC Simplified Wall Bracing (602.12)

**Prescriptive Limits**

- The structure must meet the following requirements:
  - Seismic Design Category (SDC) A, B, or C (SDC A or B for townhouses)
  - Ultimate Wind Speed of 130 mph or less with Wind Exposure Category B or C
  - One-, two-, or three-story structure
  - Wood structural panel (WSP) or structural fiberboard sheathing (WSP) is used to brace exterior walls with 1/2-in gypsum board fastened to the interior side of walls

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Slide 39

### IRC Simplified Wall Bracing

**Prescriptive Limits**

- The structure must meet the following requirements:
  - 60 ft maximum length and width of the building
  - Max eave-to-ridge height of 15 ft
  - Max story height of 10 ft
  - Max ratio between long and short side of building: 3 to 1
  - Max cantilever of 24 inches beyond foundation
  - No cripple walls in three story buildings

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Slide 40

### IRC Simplified Wall Bracing

**Advantages to the Simplified Method:**

- No seismic requirements
- Bracing only occurs on the perimeter (exterior walls)
  - (No braced wall line length or spacing)
- No additional adjustment factors to check
- No interpolation

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Slide 41

### IRC Simplified Wall Bracing

**Procedure:**

1. Draw a rectangle around the perimeter of the building.

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Slide 42

### Bracing: Simplified Wall Bracing

**Rectangle Circumscribing an Enclosed Building**

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Slide 43

### Bracing: Simplified Wall Bracing

**Procedure continued:**

2. Identify the number of bracing units required on each side of the rectangle.

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Slide 44



### IRC Simplified Wall Bracing

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

44

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Table R602.12.4

Story Level	Eave-to-Ridge Height (Feet)	Minimum Number of Bracing Units on Each Long Side <sup>a</sup>					Minimum Number of Bracing Units on Each Short Side <sup>a</sup>						
		Length of short side (ft) <sup>b</sup>					Length of long side (ft) <sup>b</sup>						
		10	20	30	40	50	60	10	20	30	40	50	60
	10	1	2	2	2	3	3	1	2	2	2	3	3
		2	3	3	4	5	6	2	3	3	4	5	6
		2	3	4	6	7	8	2	3	4	6	7	8
	15	1	2	2	3	3	4	1	2	2	3	3	4
		2	3	4	5	6	7	2	3	4	5	6	7
		2	4	5	6	7	9	2	4	5	6	7	9

a. Interpolation shall not be permitted.  
b. Cripple walls or wood-framed basement walls in a walk-out condition of a one-story structure shall be designed as the first floor of a two-story house.  
c. Actual lengths of the sides of the circumscribed rectangle shall be rounded to the next highest unit of 10 when using this table.

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Slide 45

### IRC Simplified Wall Bracing

**Bracing Methods for Simplified Wall Bracing**

45

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R602.12.2, R602.12.3

Material	Stud Spacing & Fastener Criteria	Fastener Spacing Criteria	Bracing Unit Method	Minimum Bracing Unit Length (feet)
Wood Structural Panel	Table R602.3(3)	6" edge 12" field	Continuous	3
			Intermittent	4
Structural Fiberboard Sheathing	Max 16" spacing Table R602.3(1)	3" edge 6" field	Continuous	3
			Intermittent	4

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.

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Slide 46

IRC Simplified Wall Bracing

Narrow Bracing Methods  
for Simplified Wall Bracing

R602.12.6

Narrow Bracing Method	Equivalent Bracing Units
CS-G	0.50
CS-PF	0.75
PFH,ABW	1.00
PFG	0.75

Each narrow bracing method is worth one, or less than one, 3 ft or 4 ft bracing unit.

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Slide 47

IRC Simplified Wall Bracing

Procedure continued:

3. Stagger the required number of bracing units along the four wall lines.

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Slide 48

IRC Simplified Wall Bracing

Distribution Requirements (R602.12.5)

- Bracing unit shall begin no more than 12 feet from any corner
- Distance between adjacent edges shall be no more than 20 feet
- Walls longer than 8 feet require a minimum of one bracing unit

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Slide 49

### IRC Simplified Wall Bracing

**Example**

- SDC B
- Wind 115 mph, Wind Exposure B
- Method CS-WSP
- 1 Story
- Walls—9 ft
- Eave to ridge height—15 ft

49

APA

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Slide 50

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

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Slide 51

### IRC Simplified Wall Bracing

TABLE 702.2.2.1  
MINIMUM NUMBER OF BRACING UNITS ON EACH SIDE OF THE CIRCUMSCRIBED RECTANGLE

SDC CATEGORY	STORY LEVEL	EAVE TO RIDGE HEIGHT (ft)	MINIMUM NUMBER OF BRACING UNITS ON EACH SIDE OF THE CIRCUMSCRIBED RECTANGLE											
			Length of short side (feet)				Length of long side (feet)							
			10	20	30	40	50	60	70	80	90	100		
1	1	10	1	2	2	2	3	3	1	2	2	3	3	
		15	2	3	3	4	5	6	2	3	3	4	5	6
		20	2	3	4	5	7	8	2	3	4	5	7	8
	2	10	1	2	3	3	4	4	1	2	3	3	4	4
		15	2	3	4	5	6	7	2	3	4	5	6	7
		20	2	4	5	6	7	9	2	4	5	6	7	9

51

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Slide 52

**IRC Simplified Wall Bracing**

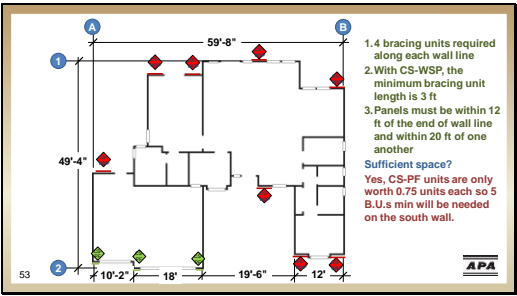
**TABLE BRG-1.2.1**  
MINIMUM NUMBER OF BRACING UNITS REQUIRED BY THE CIRCUMSCRIBED RECTANGLE  
CAN BE CALCULATED BY THE FOLLOWING TABLE

STORY LEVEL	EAVE TO RIDGE HEIGHT (feet)	LENGTH OF BRACING UNIT (feet)									
		10	20	30	40	50	60	70	80	90	100
10	10	1	2	2	2	3	3	3	2	2	3
	20	2	3	3	4	5	6	2	3	3	4
	30	2	3	4	5	7	8	2	3	4	5
	40	2	3	4	5	7	8	2	3	4	5
15	10	1	2	2	2	3	3	3	2	2	3
	20	2	3	4	5	7	8	2	3	4	5
	30	2	3	4	5	7	8	2	3	4	5
	40	2	3	4	5	7	8	2	3	4	5
20	10	1	2	2	2	3	3	3	2	2	3
	20	2	3	4	5	7	8	2	3	4	5
	30	2	3	4	5	7	8	2	3	4	5
	40	2	3	4	5	7	8	2	3	4	5

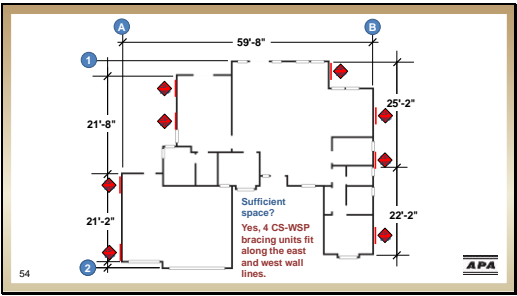
52

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Slide 53



Slide 54



Slide 55

### Bracing Topics

Forces

Basics

Bracing

Braced Wall Lines

Braced Wall Panels

Required Length

Simplified Wall Bracing

APA Simplified Wall Bracing

APA Wall Bracing Calculator

55

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Slide 56

### Wall Bracing

What if...  
There was a simpler way to brace house designs?

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#### System Report

16-102E

APRIL 2020

APA Simplified Wall Bracing Method Using Wood Structural Panel Continuous Sheathing

56

1. Basis of the System Report  
© 2006, 2010 and 2012 International Residential Code (IRC) Section R602.13 Alternative Sheathing, Design and Methods of Construction and Assembly. © APA - The Engineered Wood Association

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Slide 57

### What is it?

#### APA Simplified Wall Bracing Method

- It is prescriptive, not engineered
- It takes advantage of the full strength of OSB and plywood
- It recognizes the strength found in shorter bracing panels
- It greatly reduces the complexity in designing bracing in single family houses
- It is based on the "simplified bracing" concept found in the IRC (R602.12)
- Its foundation is in years of testing and experience in the design of shear walls and diaphragms by APA

57

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Slide 58

What is it?

Basis of design

- The components that control the performance of bracing are panel thickness and fasteners.
- Since the 3/8" code minimum panel thickness is relatively seldom used, the APA method is based on the more commonly used 7/16" thickness.
- Fasteners aren't very expensive, so the APA method increases the frequency of the fastening along panel edges.
- All exterior wall areas sheathed with wood structural panels.

- When APA put the three together, we discovered another level of performance in CS-WSP.

58

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Slide 59

Comparison of Simplified Methods

IRC Simplified vs. APA Simplified

Comparison Table		
	IRC	APA
Minimum thickness WSP	3/8"	7/16"
Nailing at panel edges	6" o.c.	4" o.c.
Required bracing	Number of units	Total length of bracing
Minimum Length bracing unit	36"	Same as CS-WSP
Narrow bracing	Portal frames only	Can be as narrow as 20" without portal frame
Portal Frames	CS-G = 1/2 unit CS-PF and PFG = 3/4 unit	CS-PF 1.5 x actual length
Partial length bracing	Not allowed	Allowed in 8' & 9' walls

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Slide 60

APA Simplified Wall Bracing Method

What is this method based on?

CS-PF resists 174% more load than WSP bracing

CS-WSP resists 88% more load than WSP bracing

WSP wall bracing – Base case

Diagonal bracing resists 31% of WSP load

60

APA Full-Scale 3D Wall Bracing Tests, Form T2007-73

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Slide 61

### APA Simplified Wall Bracing Method

**Streamlining the process**

▪ **Four steps:**

1. Check the system criteria, lateral support and limitations.
2. Determine required bracing length from Table 3 and apply wall height multiplier.
3. Identify full height wall sections and whether they meet the minimum lengths per Tables 1 and 2 and the distribution requirements.
4. Add all qualifying bracing panels from step 3 on each side of the home and compare to step 2.

61

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Slide 62

### Bracing Calculation Example

**1. The house must meet the system criteria**

- ✓ No side longer than 60 feet
- ✓ Three stories or less
- ✓ Wall heights  $\leq 12$  feet
- ✓ Roof to eave to ridge height  $\leq 15$  feet
- ✓ Ultimate wind speeds  $\leq 130$  mph
- ✓ Check lateral support and foundations
- ✓ Single family must be in SDC A, B or C

62

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Slide 63

### Bracing Calculation Example

**1. The design parameters**

House depth—40 feet  
Roof height  $\leq 15$  feet  
9' first floor height  
8' second floor height  
Wind Exposure Category—B  
115 mph ultimate wind zone  
2nd Floor above garage  
Drywall inside of exterior walls

63

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Slide 64

### Bracing Calculation Example

2. Draw a rectangle around the house; measure each side.

64

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Slide 65

### Bracing Calculation Example

2. Draw a rectangle around the house; measure each side  
— Go to Table 3 and determine amount of bracing

Wind Speed	Story Level	Eave-to-Ridge Height (ft)	Minimum Required Bracing Length on Each Short Side (ft)					Minimum Required Bracing Length on Each Long Side (ft)						
			10	20	30	40	50	60	10	20	30	40	50	60
90 mph required for the 2012 IRC	10	10	2.0	3.5	5.0	6.0	7.5	9.0	2.0	3.5	5.0	6.0	7.5	9.0
			2.9	5.4	7.4	9.9	12.0	14.0	2.9	5.4	7.4	9.9	12.0	14.0
			4.1	7.9	11.2	14.5	17.8	21.0	4.1	7.9	11.2	14.5	17.8	21.0
115 mph ultimate for the 2018 and 2015 IRC	15	15	2.6	4.6	6.5	7.8	9.8	11.7	2.6	4.6	6.5	7.8	9.8	11.7
			3.3	6.2	8.5	11.4	13.8	16.1	3.3	6.2	8.5	11.4	13.8	16.1
			4.5	8.7	12.3	16.0	19.6	23.1	4.5	8.7	12.3	16.0	19.6	23.1

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Slide 66

### Bracing Calculation Example

2. Draw a rectangle around the house; measure each side  
— Go to Table 3 and determine amount of bracing  
— Apply the wall height adjustment factor

11.4' x .95 = 10.83' required bracing

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

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Slide 67

### Bracing Calculation Example

3. Identify full-height sections on sides of house

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Slide 68

### Bracing Calculation Example

3. Determine if segments meet minimum bracing length

TABLE 1  
MINIMUM LENGTH OF BRACED WALL PANELS  
(Range from the 2015, 2017 and 2019 IRC Table R602.10.3, modified in accordance with R602.10.3, Item 1)

Method	Additional clear opening height (in.)	Minimum Length (in.)			Contributing Length (in.)
		8 ft	9 ft	10 ft	
CS-PF	0	17	20	23	1.5 x Actual Length
	14	14	17	20	
	28	14	17	20	
	42	14	17	20	
	56	14	17	20	
CS-WSP	60	17	20	23	Actual Length
	74	17	20	23	
	88	17	20	23	
	102	17	20	23	
	116	17	20	23	
	130	17	20	23	
	144	17	20	23	
	158	17	20	23	
	172	17	20	23	
	186	17	20	23	

6. Use the actual length when it greater than or equal to the minimum length.

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68

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Slide 69

### Bracing Calculation Example

3. Determine if segments meet minimum bracing length

TABLE 1  
MINIMUM LENGTH OF BRACED WALL PANELS

Method	Opening Height	Wall Height	Minimum Length	Actual Length	Bracing Length
CS-PF	84"	9'	16"	16"	24"
CS-WSP	80"	9'	30"	32"	32"

\*Height to top of header

69

69

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Slide 70

## Bracing Calculation Example

3. Determine if segments meet minimum bracing length  
 — If walls are 8' or 9', there is partial credit for short lengths

TABLE 2  
 PARTIAL CREDIT FOR CS-WSP LESS THAN FULL LENGTH WITH 8'- AND 9'-FOOT TALL WALLS<sup>1</sup>

Wall height (ft)	Length of Full Segment Required CS-WSP Panel (ft)	Adjusted Segment Length (ft) at Level (ft)	Contributing Length of Braced Wall Panel (ft)
8	8.5	8.00	2.0
		8.1	2.0
		7.2	1.8
		7.5	1.6
		8.0	1.4
		8.4	1.4
9	9.0	8.5	2.0
		8.6	1.6
		7.2	1.3
		7.5	1.3
		7.8	1.3
		8.0	1.1

<sup>1</sup> Under interpretation shall be provided.

**APA**  
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 Tacoma, WA 98401  
 206.462.2000  
[www.apa-plywood.com](http://www.apa-plywood.com)

Slide 71

### Bracing Calculation Example

3. Determine if segments meet minimum bracing length  
—If walls are 8' or 9', there is partial credit for short lengths

**TABLE 2**  
**PARTIAL CREDIT FOR BRACED WALL PANELS**

Method	Opening Height	Wall Height	Minimum Length	Actual Length	Bracing Length
CS-WSP	6'-4"	9'	24'	24'	24'
CS-WSP	6'-4"	9'	20'	22'	18'

The diagram shows a building facade with a green section and a red section. A measurement scale at the bottom indicates various lengths: 16', 16', 16', 21', 12', 20', 32', 32', 32', 32', 16', 9', 9'. Red circles highlight the 12', 20', 32', and 9' measurements, which correspond to the values in the table. Arrows point from the table to the building facade, indicating the application of the bracing calculations.

71

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Slide 72

## Bracing Calculation Example

4. Compile the amount of bracing on each side of house

$24' + 24' + 22' + 18' + 32' + 32' + 18' + 22' = 166.0'$  eligible for bracing

Legend:

- Full height segment/too short
- Actual Length
- Qualified Bracing Unit
- # Contributing Length

House dimensions (feet): 16', 16', 16', 24', 10', 32'-32', 10', 22', 18', 22'

Bracing units (circled numbers): 1, 1, 1, 1, 1, 2, 1, 1, 1, 1

APA logo



Slide 73

Bracing Calculation Example

16.0' > 10.83'

Bracing checked!

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Slide 74

Multiple Rectangles

FIGURE A1  
FLOOR PLAN

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Slide 75

Multiple Rectangles

FIGURE A2 - STEP 1  
DIVIDE STRUCTURE INTO RECTANGULAR ELEMENTS

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Slide 76

### Multiple Rectangles

FIGURE A3 - STEP 2  
DETERMINING BRACING REQUIREMENTS FOR EACH RECTANGULAR ELEMENT SEPARATELY

Rectangle A

Bracing requirement for Rectangle A  
■ Bracing panel for Rectangle A

Rectangle B

Bracing requirement for Rectangle B  
■ Bracing panel for Rectangle B

76

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Slide 77

### Multiple Rectangles

FIGURE A4 - STEP 3  
REJOIN RECTANGLES WITH BRACING PROVIDED

Rectangle A

Bracing requirement for Rectangle A  
■ Bracing panel for Rectangle A

+

Rectangle B

Bracing requirement for Rectangle B  
■ Bracing panel for Rectangle B

=

Rectangle A

Bracing requirement for Rectangle A  
■ Bracing panel for Rectangle A

Rectangle B

Bracing requirement for Rectangle B  
■ Bracing panel for Rectangle B

77

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Slide 78

### Multiple Rectangles

DETAIL A  
EXPANDED VIEW OF COMMON SIDE BRACING

Rectangle A

Bracing requirement for Rectangle A  
■ Bracing panel for Rectangle A

Rectangle B

Bracing requirement for Rectangle B  
■ Bracing panel for Rectangle B

78

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Slide 79


[illegible]

Slide 80

# Bracing Topics

Forces	Basics	Bracing
		<ul style="list-style-type: none"><li>Braced Wall Lines</li><li>Braced Wall Panels</li><li>Required Length</li><li>Simplified Wall Bracing</li><li>APA Simplified Wall Bracing</li><li>APA Wall Bracing Calculator</li></ul>

80


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Slide 81


# APA Wall Bracing Calculator

[www.apawall-bracing-calculator.com](http://www.apawall-bracing-calculator.com)

Download the APA Wall Bracing Calculator (Quick Start Guide for a hint)



This video walks users through the basics of the APA Wall Bracing Calculator, a free tool that creates printable reports showing 2009, 2012, 2015, or 2018 IRC wall bracing combinations. The reports are exported to most local destinations. Running time: 1:45.



Slide 82

## APA Wall Bracing Calculator

**Benefits:**

- The user locates the bracing segments, which offers user creativity while automating the code check, highlighting incorrect or insufficient design.
- The output makes plan review clear and concise, and implementation into the construction plans straightforward.

WALL LINE ELEVATION VIEW

001 002 003

22'-0"  
Total Line Length of 22'-0"

WALL LINE PLAN VIEW

001 002 003

Project Results

RESULTS

DETAILS

WALL TYPE: CMU

WALL THICKNESS: 12"

WALL HEIGHT: 10'-0"

WALL WEIGHT: 120 lb/ft²


WALL STRENGTH: 4.0

WALL STIFFNESS: 1.0

APA

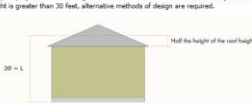
Slide 83

# APA Wall Bracing Calculator


 85 mph

**Mean Roof Height Less Than 30 Ft:** Mean roof height is prescribed in IRC Table R602.10.4.2(1). Footcra is an not more than 30 feet. The mean roof height of a building is located at the midpoint of the roof (the average height of the roof eave and to the tallest roof peak). Click yes or no to indicate whether your project mean roof height is less than 30 feet: the default answer is yes. If this mean roof height is greater than 30 feet, alternative methods of design are required.

YES ☐ NO ☒



Half the height of the roof height

30' = L'

83

Slide 84

# APA Wall Bracing Calculator

**Step 1**

- **Design Criteria**
  - Code
  - SDC
  - Wind Speed
  - Number of Stories

**Project Information**

Building Designer:

House/Shop Plan Name:

Development Address:

Code:

Residential (RHS 2006 Ed.) Residential (RHS 2012 Ed.) Residential (RHS 2015 Ed.) Residential (RHS 2018 Ed.)

SDC (Seismic Design Category)

1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39 40 41 42 43 44 45 46 47 48 49 50 51 52 53 54 55 56 57 58 59 60 61 62 63 64 65 66 67 68 69 70 71 72 73 74 75 76 77 78 79 80 81 82 83 84 85 86 87 88 89 90 91 92 93 94 95 96 97 98 99 100

Design Wind Speed

Select

Wind Exposure Category

1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39 40 41 42 43 44 45 46 47 48 49 50 51 52 53 54 55 56 57 58 59 60 61 62 63 64 65 66 67 68 69 70 71 72 73 74 75 76 77 78 79 80 81 82 83 84 85 86 87 88 89 90 91 92 93 94 95 96 97 98 99 100

Total Number of Stories

1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39 40 41 42 43 44 45 46 47 48 49 50 51 52 53 54 55 56 57 58 59 60 61 62 63 64 65 66 67 68 69 70 71 72 73 74 75 76 77 78 79 80 81 82 83 84 85 86 87 88 89 90 91 92 93 94 95 96 97 98 99 100

Cripple Wall

Yes No

Main Roof Height less than 30 ft.

Yes No

Slide 85

**APA Wall Bracing Calculator**

**Step 2**

- **Wall Line Details**
  - Distance to adjacent BWL
  - Line Length
  - Wall Height
  - Gypsum, Blocking

85

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Slide 86

**APA Wall Bracing Calculator**

**Step 3**

- **Wall Line Segment Details**
  - Length BWPs
  - BWP material
  - BWP spacing
  - Total Compliant Bracing: Wind/Seismic

86

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Slide 87

**APA Wall Bracing Calculator**

**Step 4**

- **Producing a Project Report**
  - PDF or Print
  - Summary Elevations
  - Wind & Seismic factors
  - Qualified Bracing vs. Required Bracing

87

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Slide 88

Example

Example:

- SDC A, Single-family dwelling
- Wind 115 mph, Wind Exposure C
- Method CS-WSP
- One-story home
- Wall height is 9 ft.
- Roof eave-to-ridge height is 16 ft.

88

APA

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Slide 89

A floor plan diagram of a house. The overall dimensions are 36'-10" wide by 24'-11" deep. The plan shows a central staircase, a kitchen area, and a living area. Dimensions for various sections are provided: 3'-0", 6'-0", 8'-0", 3'-0", 7'-10", 3'-0", 6'-0" along the top; 2'-3" along the bottom left; 12'-6", 2'-3", 4'-0", 3'-0", 4'-6", 6'-0", 2'-4" along the bottom right. Labels A and B are at the top corners, and 1 and 2 are on the left side. The APA logo is in the bottom right corner.

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Slide 90

APA Wall Bracing Calculator

Step 1

Entering Project Information

- New Project
- Import Existing Project

APA WALL BRACING CALCULATOR

Wall Bracing Calculator

Enter data manually or import existing data

Enter data manually

Import existing data

90

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Slide 91

APA Wall Bracing Calculator

Step 1

Design Criteria

- Code
- SDC
- Wind Speed
- Exposure
- Number of Stories

Project Information

Builder/Designer

House/Big Plan Name

Development Address

Code

SDC (Seismic Design Category)

Ultimate Design Wind Speed

Wind Exposure Category

Total Number of Stories

Cripple Wall

Mean Roof Height less than 30 ft

91

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Slide 92

APA Wall Bracing Calculator

Step 2

Wall Line Details

- Distance to adjacent BWL
- Eave to Ridge
- Line Length
- Wall Height
- Gypsum, Blocking

Wall Line Details

Wall Line Segment Details

92

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Slide 93

APA Wall Bracing Calculator

Step 3

Wall Line Segment Details

- Length BWPs
- BWP material
- BWP spacing
- Total Compliant Bracing: Wind/Seismic

Wall Line Details

Wall Line Segment Details

93

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Slide 94

### APA Wall Bracing Calculator

**Step 3**

- Wall Line Segment Details
- 1. Length BWPs
- 2. BWP material
- 3. BWP spacing
- 4. Total Compliant Bracing: Wind/Seismic

Slide 95

### APA Wall Bracing Calculator

**Step 4**

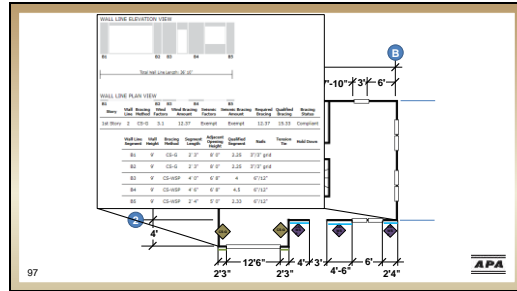
- Producing a Project Report
- PDF or Print
- Summary Elevations
- Wind & Seismic factors
- Qualified Bracing vs. Required Bracing

Slide 96

Segment Type	Segment Length	Bracing Type	Bracing Material	Bracing Spacing	Total Compliant Bracing
1	3'	CS-WSP	CS	12.00"	12.00
2	6'	CS-WSP	CS	12.00"	12.00
3	3'	CS-WSP	CS	12.00"	12.00
4	7'-10"	CS-WSP	CS	12.00"	12.00
5	3'	CS-WSP	CS	12.00"	12.00
6	6'	CS-WSP	CS	12.00"	12.00




Slide 97



Slide 98

2018 IRC Wall Bracing

**Questions?**



Find your Local Field Services Representative  
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[help@apawood.org](mailto:help@apawood.org)  
[www.apawood.org](http://www.apawood.org)



Slide 99

# APA Update Newsletter

(www.apawood.org)

April 2020



Visit [www.apawood.org](http://www.apawood.org) for current resources, or are unable to visit, visit us at [youtube.com/apawood](https://youtube.com/apawood) and [facebook.com/apawood](https://facebook.com/apawood). Please email your questions to [info@apawood.org](mailto:info@apawood.org)

**APA Performance Rated Units**  
After decades of research and testing, insulation details, installation specifications and engineering design details are now available. These updates will expedite the selection and installation of insulation in new building applications.

[APU1](#)



[APU2](#)



[APU3](#)



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APA System Report BR-102: APA® Embedded Wall Bracing Method

The Embedded Wall Bracing method has been accepted by the International Building Code and

[APU4](#)



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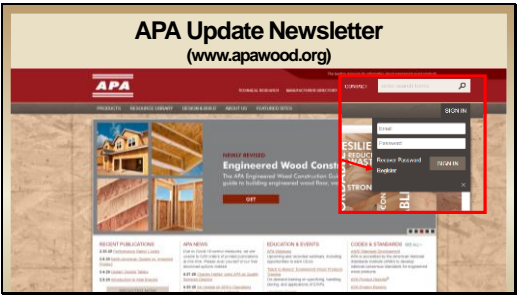
APA System Report BR-102: APA® Embedded Wall Bracing Method

The Embedded Wall Bracing method has been accepted by the International Building

Slide 100



Slide 101



Slide 102



Slide 103

Thank you!



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