

# New to Truro and Provincetown

Changes in the 9<sup>th</sup> Edition of 780 CMR  
the 2015 International Residential Code (with MA amendments)

Prepared by:

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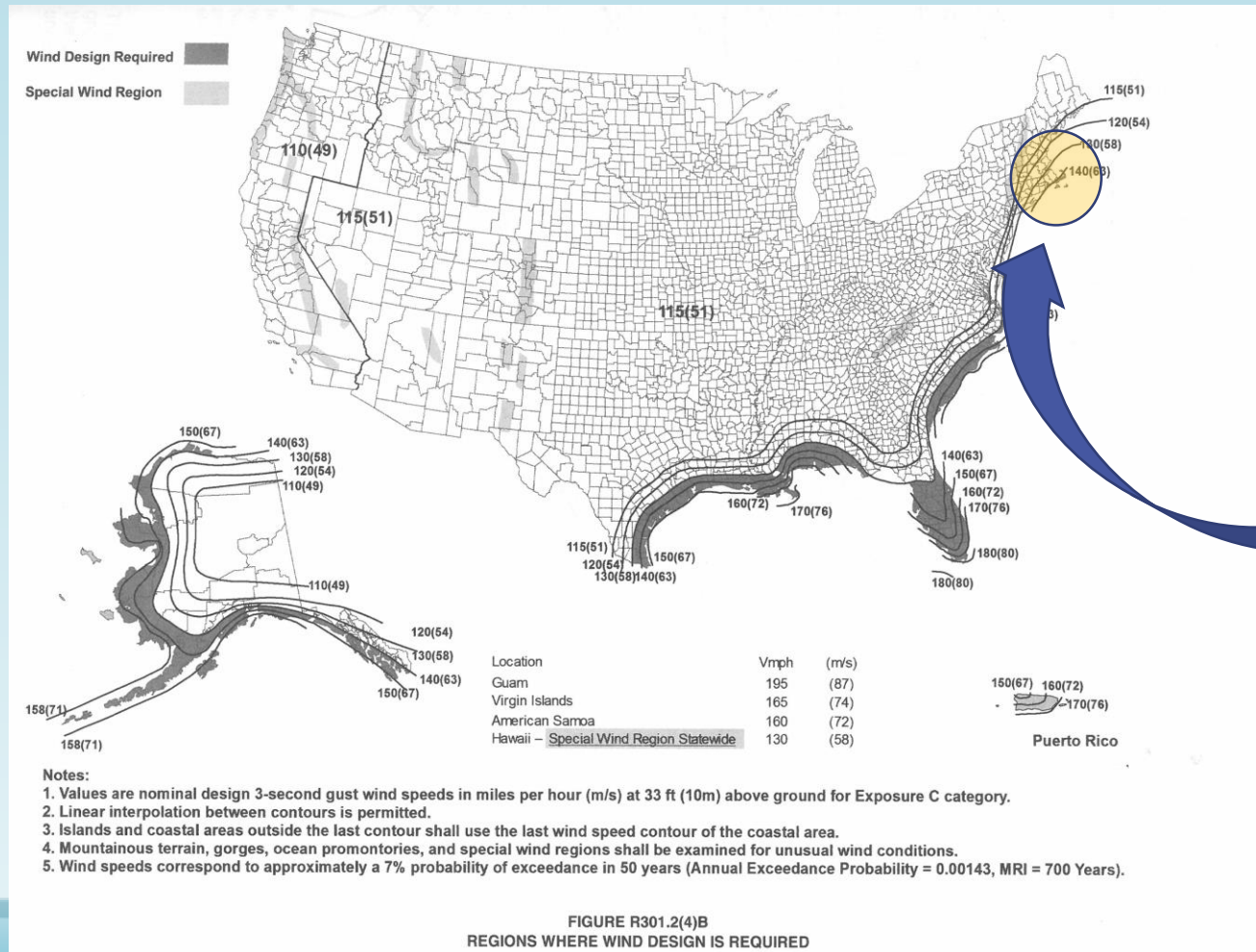
Building Commissioner

Town of Truro

Truro and Provincetown  
are no longer in the  
High Wind Zone

Huh?

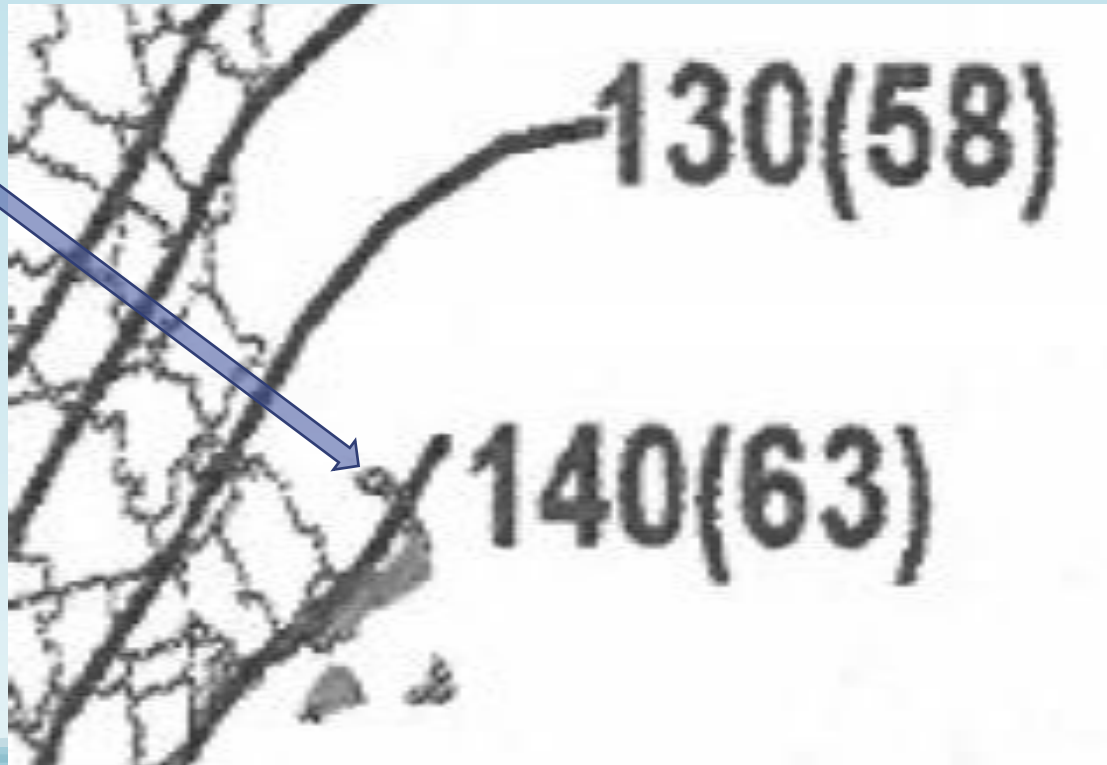
The new 2015 code book shows this -



How can  
anyone  
read that?

# Blown up, we see this

we are  
here



Fortunately, the MA Amendments to the 2015 IRC (you know, that other book you need to get) clarifies – there's a table

**TABLE R301.2(4) SNOW LOADS AND WIND SPEEDS**

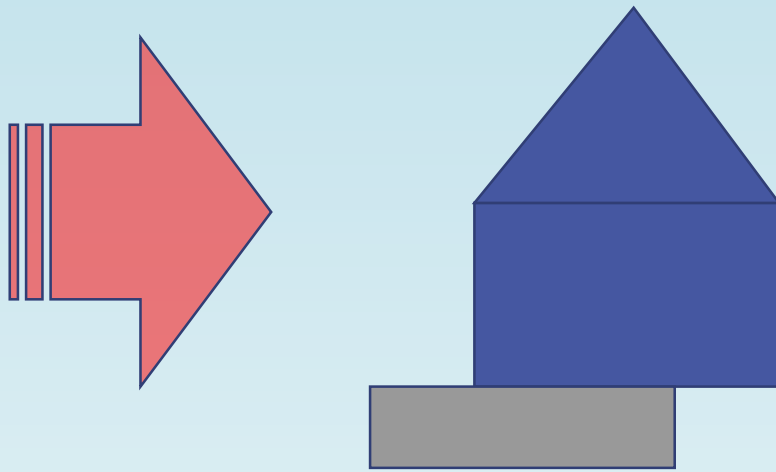
	SNOW LOADS		
City/Town	Ground Snow Load, $P_g$ (psf)	Minimum Flat Roof Snow Load, $P_f^1$ (psf)	BASIC WIND SPEED, $V_{ult}$ (mph)
Provincetown	25	25	138
Truro	25	25	139

#### **R301.2.1.1 Wind limitations and wind design required.**

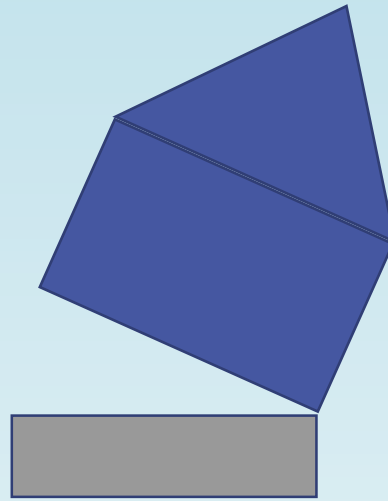
The wind provisions of this code shall not apply to the design of buildings where the ultimate wind speed,  $V_{ult}$  is **140 mph or greater**. See Table R301.2(4) for wind speeds by city or town.

# So, what are the wind forces acting on the structure?

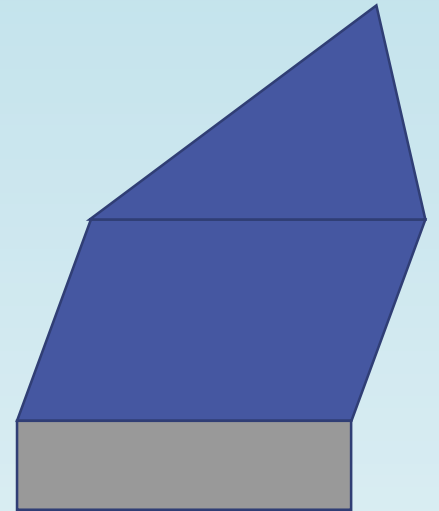
Sliding



Uplift/overturning



Racking



The racking forces are the  
focus of this presentation



This means that, **JUST SORTA LIKE OLD TIMES**, we can use the prescriptive design measures that are in the code book

For walls it's mostly like old times BUT with a wrinkle.....

[It's found in R602.10 – Wall Bracing](#)

**WHAT'S A BRACED WALL?**



**R602.10 – Wall Bracing.** Buildings shall be braced in accordance with section....Where a building, or portion thereof, does not comply with one or more of the bracing requirement in this section, those portions shall be designed and constructed in accordance with Section R301.1 (engineering, WFCM, etc.)

**Wall Bracing** consists of -

**R602.10.1 Braced wall lines.** - For the purpose of determining the amount and location of bracing required in each story level of a building,

**R602.10.2 Braced Wall Panels.** Braced wall panes shall be full-height sections of wall that shall not have vertical or horizontal offsets. Brace wall panels shall be constructed and placed along a braced wall line in accordance with section and the bracing methods specified in Section R602.10.4

simply put..... **Braced Walls** are shear walls.

# So, lets get started

## Disclaimer

This presentation is meant to be an intro- I'm going to try my best to stay out of weeds. Like many things the “devil is in the details” and it my intent to keep this simple. Here's hoping.

# R602.10.1 Braced Wall Lines

....braced wall lines shall be designated as **straight lines** in the building plan placed in accordance with this section.

from R202 Definitions –

**Braced Wall Line.** A straight line through the building plan that represent the location of the lateral resistance provided by the wall bracing

**Properties** of Braced Wall Lines

- They are (imaginary) straight lines
- They have length
- They have spacing
- Offsets (within limits) are allowed

## R602.10.1.3 Spacing of braced wall lines

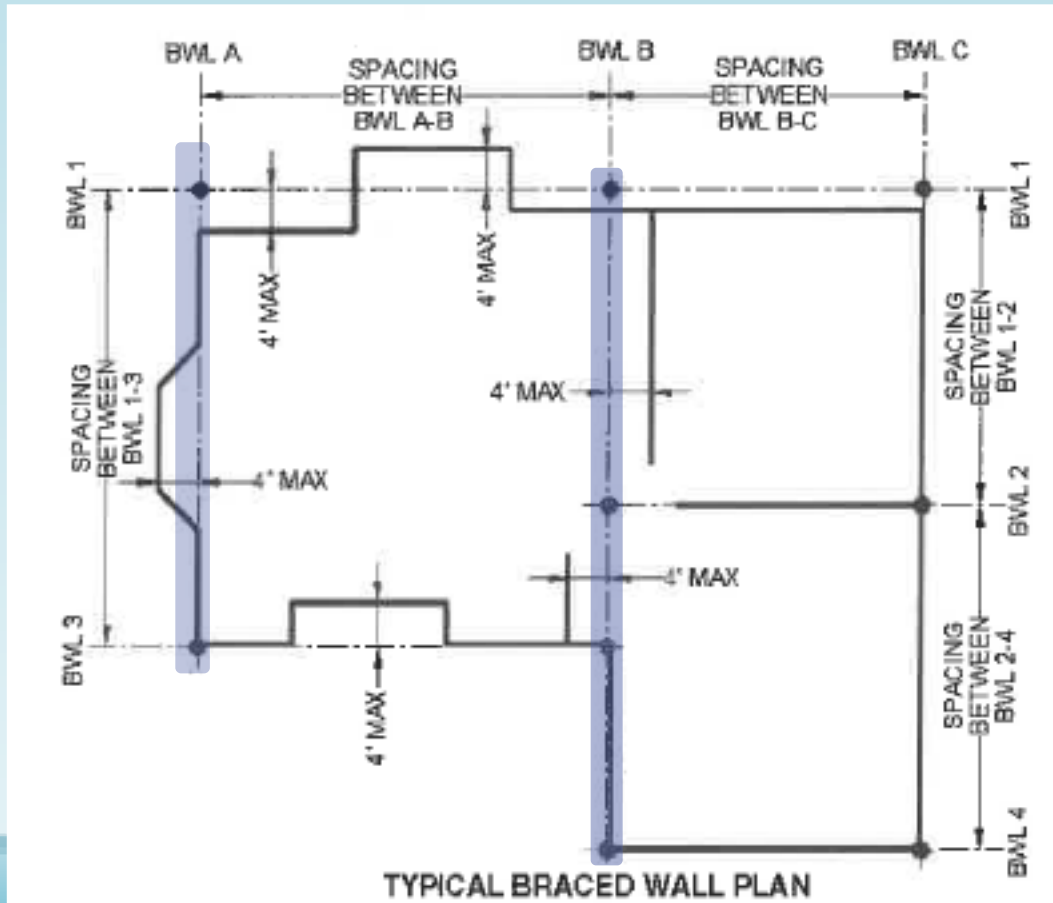
this one's simple -

Table R602.10.1.3 - **60' maximum**

# R602.10.1.1 Length of a Braced Wall Line

“The length of a braced wall line shall be the distance between its ends. The end of a braced wall line shall be the intersection with a perpendicular braced wall line ....or an exterior wall...

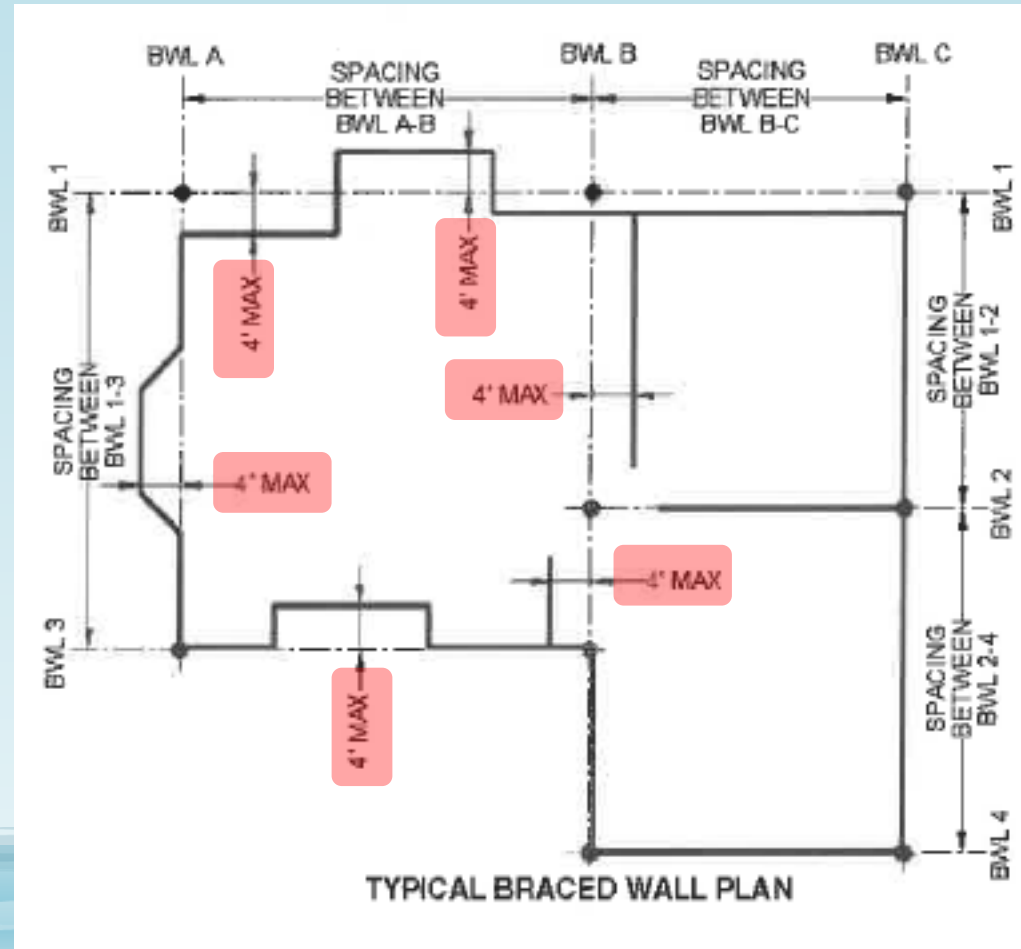
Two examples of braced wall lines



## R602.10.1.2 Offsets along & Spacing of a braced wall line

Exterior walls parallel to a braced wall line shall be offset not more than 4 feet from the designated braced wall line location.....

Interior walls used as bracing shall be offset not more than 4 feet from a braced wall line through the interior of the building...



# R602.10.2 - Braced wall panels

Braced wall panels shall be **full-height section of wall**.... Braced wall panels shall be constructed and placed along a braced wall line in accordance with this section and the bracing method specified in Section R602.10.4

- Uplift load resistance must be in accordance with Section 602.3.5
- Panels shall begin with 10' from end of braced wall line.
- 20' maximum between panels.

We now have established some basis parameters. So the next question is.....

## HOW MUCH DO WE NEED?

# Table 602.10.3(1) is key

These represent typical wall construction methods. (see R602.10.4) Note that the code allows for different construction methods, unlike the WFCM.

These are the assumed design parameters. Later we will see how to modify these.

TABLE R602.10.3(1)—continued BRACING REQUIREMENTS BASED ON WIND SPEED						
EXPOSURE CATEGORY B 30-FOOT MEAN ROOF HEIGHT 10-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 Line Spacing (feet)	Method LIB <sup>b</sup>	Method GB	Methods DWB, WSP, SFB, PBS, PCP, HPS, BV-WSP, ABW, PFH, PFG, CS-SFB <sup>c</sup>	Methods CS-WSP, CS-G, CS-PF
≤ 140		10	5.5	5.5	3.0	2.5
		20	10.0	10.0	5.5	5.0
		30	14.0	14.0	8.0	7.0
		40	18.0	18.0	10.5	9.0
		50	22.5	22.5	13.0	11.0
		60	26.5	26.5	15.0	13.0
		10	10.0	10.0	6.0	5.0
		20	18.5	18.5	11.0	9.0
		30	27.0	27.0	15.5	13.0
		40	35.0	35.0	20.0	17.0
		50	43.0	43.0	24.5	21.0
		60	51.0	51.0	29.0	25.0
		10	NP	15.0	8.5	7.5
		20	NP	27.5	16.0	13.5
		30	NP	39.5	23.0	19.5
		40	NP	51.5	29.5	25.0
		50	NP	63.5	36.5	31.0
		60	NP	75.5	43.0	36.5

For SI: 1 inch = 25.4 mm, 1 foot = 304.8 mm, 1 mile per hour = 0.447 m/s.

a. Linear interpolation shall be permitted.

b. Method LIB shall have gypsum board fastened to not less than one side with nails or screws in accordance with Table R602.3(1) for exterior sheathing or Table R702.3.5 for interior gypsum board. Spacing of fasteners at panel edges shall not exceed 8 inches.

c. Where a braced wall line has parallel braced wall lines on one or both sides of differing dimensions, the average dimension shall be permitted to be used for braced wall line spacing.

This table recognizes that different wall construction methods create different shear resistance.



.....the numbers from the prior table get modified by this table based on:

- exposure
- roof height
- wall height
- number of braced wall lines

....and a few other minor things.....

TABLE R602.10.3(2)  
WIND ADJUSTMENT FACTORS TO THE REQUIRED LENGTH OF WALL BRACING

ITEM NUMBER	ADJUSTMENT BASED ON	STORY/SUPPORTING	CONDITION	ADJUSTMENT FACTOR <sup>a</sup> [multiply length from Table R602.10.3(1) by this factor]	APPLICABLE METHODS
1	Exposure category	One-story structure	B	1.00	All methods
			C	1.20	
			D	1.50	
		Two-story structure	B	1.00	
			C	1.30	
			D	1.60	
		Three-story structure	B	1.00	
			C	1.40	
			D	1.70	
2	Roof eave-to-ridge height	Roof only	≤ 5 feet	0.70	
			10 feet	1.00	
			15 feet	1.30	
			20 feet	1.60	
		Roof + 1 floor	≤ 5 feet	0.85	
			10 feet	1.00	
			15 feet	1.15	
			20 feet	1.30	
		Roof + 2 floors	≤ 5 feet	0.90	
			10 feet	1.00	
			15 feet	1.10	
			20 feet	Not permitted	
3	Wall height adjustment	Any story	8 feet	0.90	
			9 feet	0.95	
			10 feet	1.00	
			11 feet	1.05	
			12 feet	1.10	
4	Number of braced wall lines (per plan direction) <sup>c</sup>	Any story	2	1.00	
			3	1.30	
			4	1.45	
			≥ 5	1.60	
5	Additional 800-pound hold-down device	Top story only	Fastened to the end studs of each braced wall panel and to the foundation or framing below	0.80	DWB, WSP, SFB, PBS, PCP, HPS
6	Interior gypsum board finish (or equivalent)	Any story	Omitted from inside face of braced wall panels	1.40	DWB, WSP, SFB, PBS, PCP, HPS, CS-WSP, CS-G, CS-SFB
7	Gypsum board fastening	Any story	4 inches o.c. at panel edges, including top and bottom plates, and all horizontal joints blocked	0.7	GB

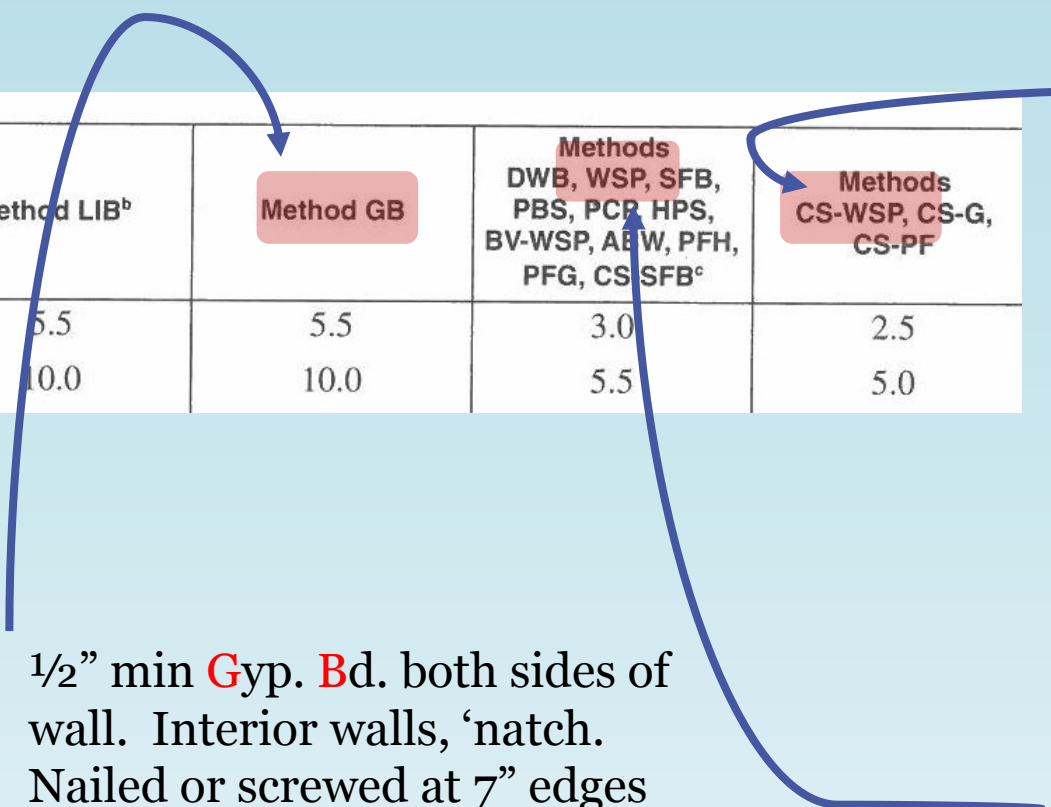
For SI: 1 inch = 25.4 mm, 1 foot = 304.8 mm, 1 pound = 4.48 N.

a. Linear interpolation shall be permitted.

b. The total adjustment factor is the product of all applicable adjustment factors.

c. The adjustment factor is permitted to be 1.0 when determining bracing amounts for intermediate braced wall lines provided the bracing amounts on adjacent braced wall lines are based on a spacing and number that neglects the intermediate braced wall line.

# our traditional wall construction methods....



Method LIB <sup>b</sup>	Method GB	Methods DWB, WSP, SFB, PBS, PCR, HPS, BV-WSP, ABW, PFH, PFG, CS SFB <sup>c</sup>	Methods CS-WSP, CS-G, CS-PF
5.5	5.5	3.0	2.5
10.0	10.0	5.5	5.0

## Continuously Sheathed – Wood Structural Panel

This is how we typically build. Sheathing continues under and over openings.

1/2" min Gyp. Bd. both sides of wall. Interior walls, 'natch. Nailed or screwed at 7" edges and field.

3/8" min. thickness Wood Structural Panel, full height only at location of required braced wall panel. Nailing 6" edges and 12" field. This means that if panels run horizontally edges must be blocked.

Areas not part of braced wall panel can be sheathed with anything that qualifies as wall sheathing

so... we now know the total amount of braced wall we need in a given braced wall line...  
...and how do we know which pieces of the wall contribute?

METHOD (See Table R602.10.4)	MINIMUM LENGTH* (Inches)					CONTRIBUTING LENGTH (inches)
	Wall Height					
	8 feet	9 feet	10 feet	11 feet	12 feet	
DWB, WSP, SFB, PBS, PCP, HPS, BV-WSP	48	48	48	53	58	Actual <sup>b</sup>
GB	48	48	48	53	58	Double sided = Actual Single sided = 0.5 × Actual

Yet another table!!

Using the previous wall construction methods...

METHOD (See Table R602.10.4)	MINIMUM LENGTH* (Inches)						CONTRIBUTING LENGTH (inches)
	Adjacent clear opening height (inches)	8 feet	9 feet	10 feet	11 feet	12 feet	
CS-WSP, CS-SFB	≤ 64	24	27	30	33	36	Actual <sup>b</sup>
	68	26	27	30	33	36	
	72	27	27	30	33	36	
	76	30	29	30	33	36	
	80	32	30	30	33	36	
	84	35	32	32	33	36	
	88	38	35	33	33	36	
	92	43	37	35	35	36	
	96	48	41	38	36	36	
	100	—	44	40	38	38	
	104	—	49	43	40	39	
	108	—	54	46	43	41	
	112	—	59	49	46	44	

It is clear that using the CS-WSP method allows for narrower contributing panels

Before we dive into an example, one more reason this is only sort of like old times:

**R107.1.3 Information on braced wall design.** For buildings and structures utilizing braced wall design, and **where required by the building official**, braced wall lines shall be identified on the construction documents. Pertinent information including, but not limited to, bracing methods, location and length of braced wall panels and foundation requirements of braced wall panels at top and bottom shall be provided.

## Here's a model that we will analyze -

- Appx 2,400 sf
- 3 bedrooms
- 2 ½ baths
- Vaulted great room/dining room/kitchen
- 1<sup>st</sup> floor master bedroom suite

### Note:

I've purposely employed somewhat conventional building forms and, in places, unconventional window geometry and placement.

This graphic is a video. It requires that you have QuickTime on your computer. Click on graphic and then the "Play" icon.



# 1<sup>st</sup> Floor

4 braced wall lines  
in this direction

C

D

E

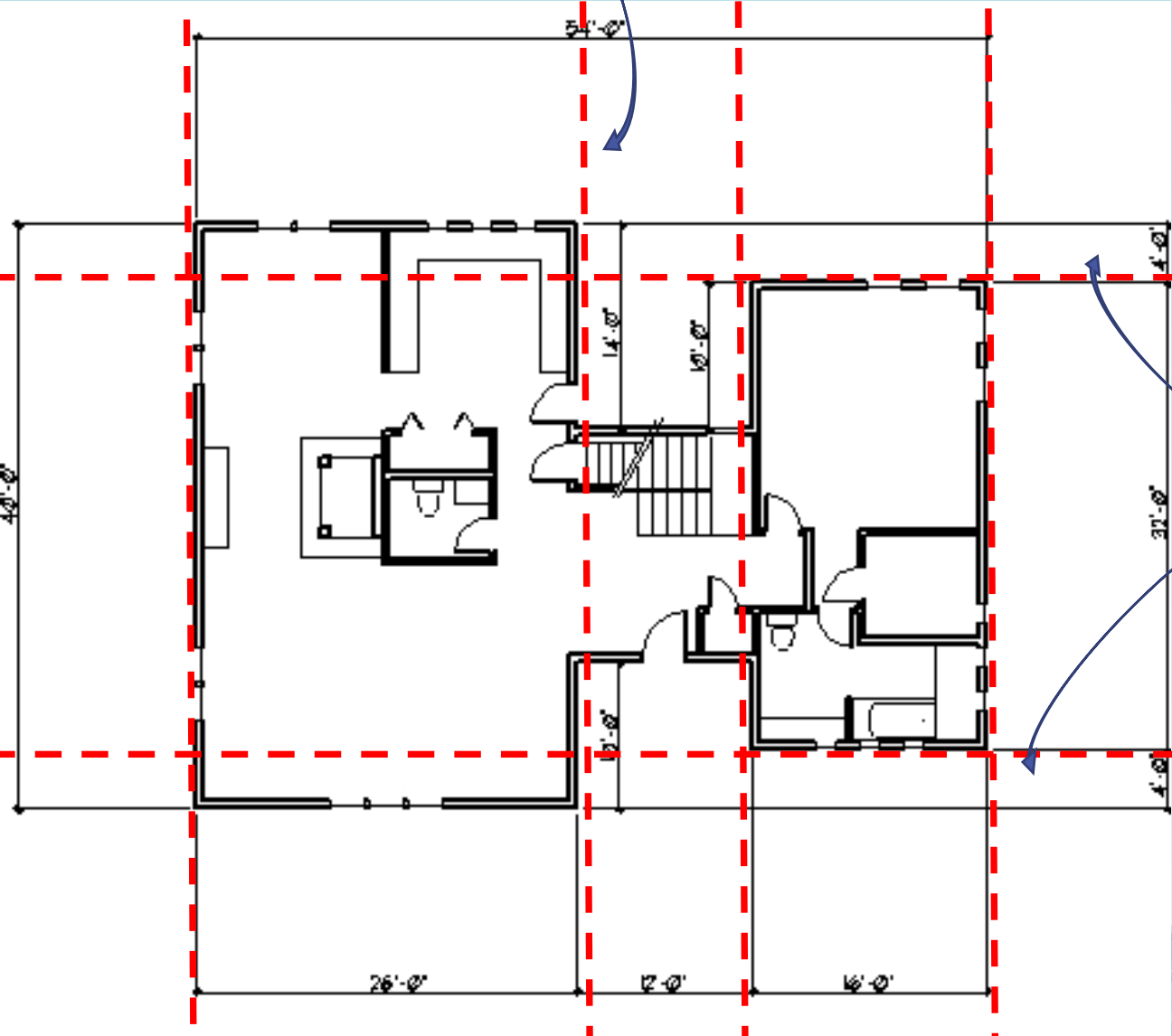
F

A

2 braced wall  
lines

B

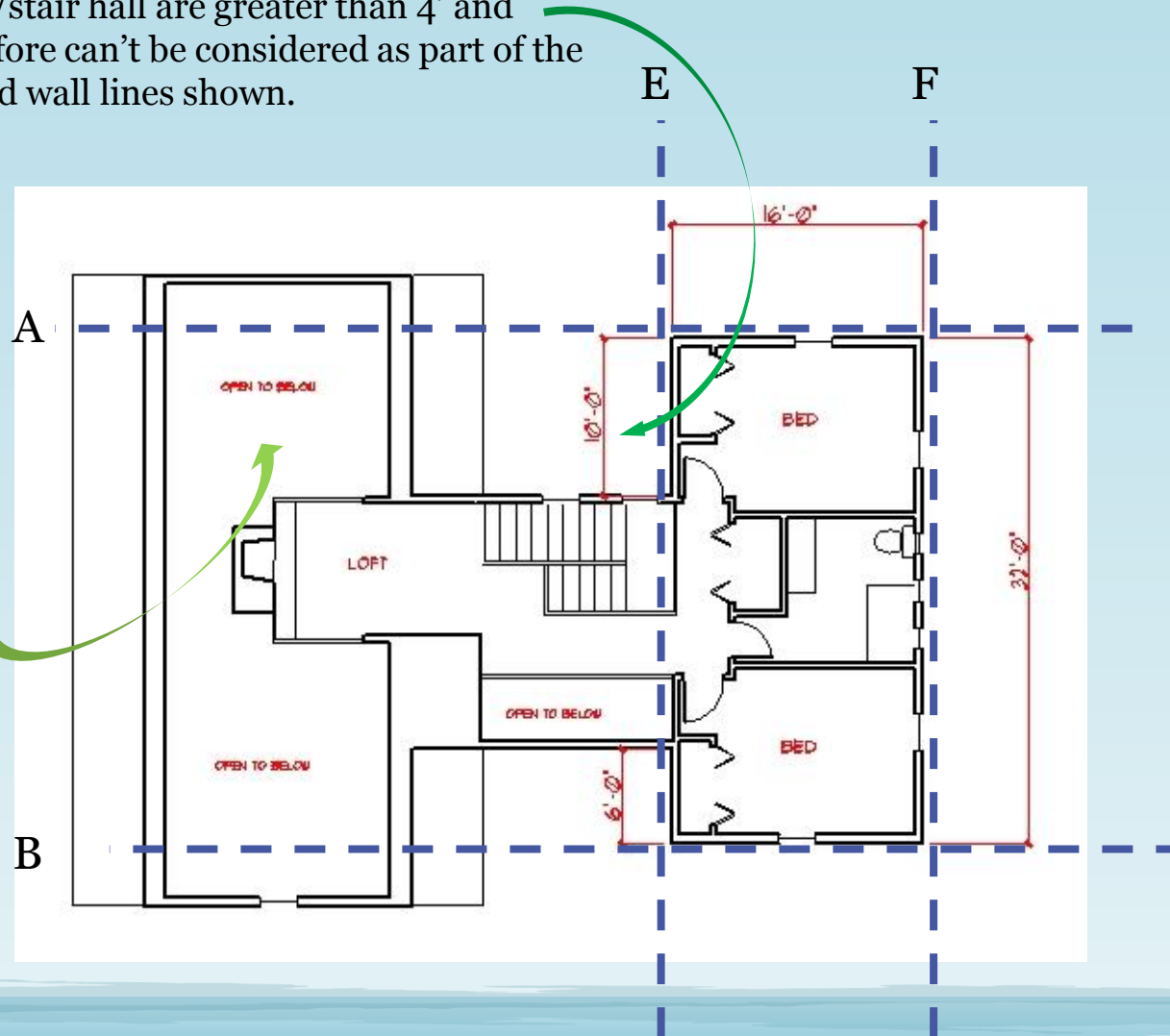
notice 4'  
offsets – that's  
o.k.



# 2<sup>nd</sup> Floor

The offsets of the exterior walls of the foyer/stair hall are greater than 4' and therefore can't be considered as part of the braced wall lines shown.

Note that when we get to the building elevations and braced wall calculations in later slides, the triangular roof spaces (in this case the entire vaulted area) are not considered in the calculation. These roof spaces are inherently stable geometries and transfer the wind shear loads to the braced walls below.



It is only necessary to look at the braced wall panels along the established braced wall line. As you can see from our example, the braced panels are often separated by many feet.

Braced wall panels can be separated by no more than 20' along the braced wall line (in the weeds, now).

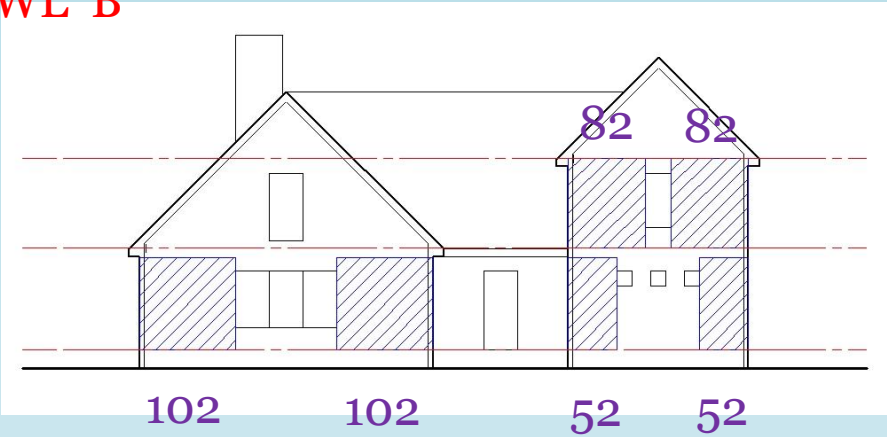
Looking at the elevations (next slide) it is clear that we are well within the 20' limit.



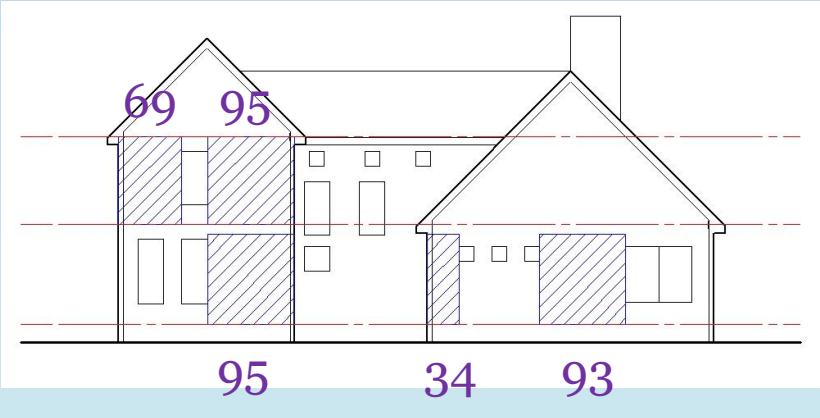
# Braced Wall Panel Lengths (in inches)

(BWL's 'D' & 'E' not shown)

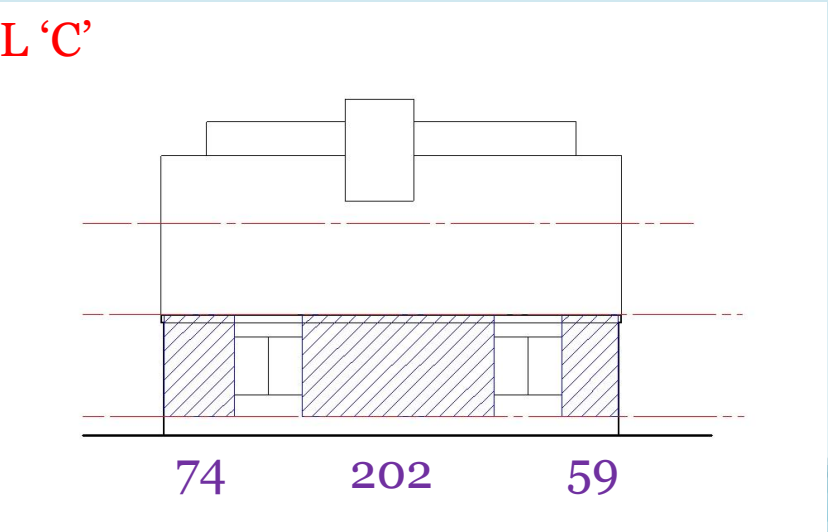
BWL 'B'



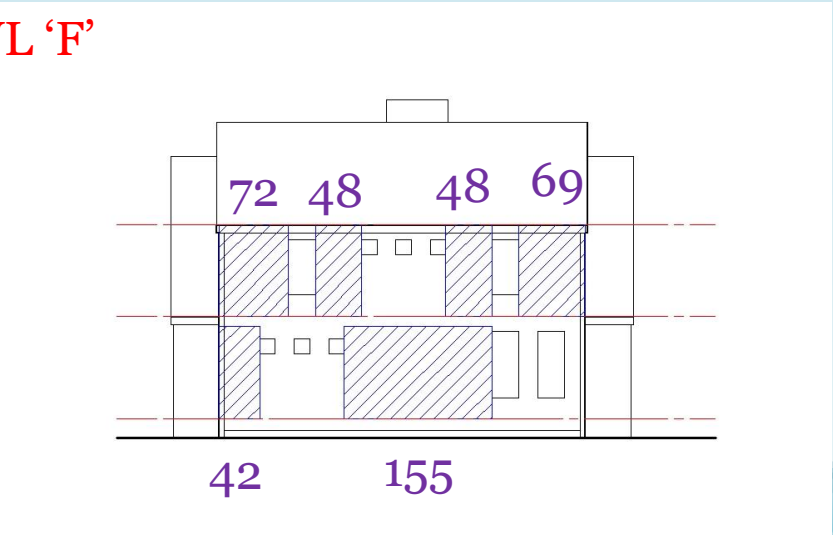
BWL 'A'



BWL 'C'



BWL 'F'





# Spreadsheet format is convenient to do the calculations and to present the results :

using CS-WSP wall type



multipliers



as you can see, our actual braced panels way exceed what is required

Braced Wall Line	Notes	Spacing (feet)	table R602.10.3(1) Bracing Length (feet)	table R602.10.3(2) Adjustments					Req'd BWP length		Actual
				Exposure	Eave/Ridge	Wall Height	# BWL's	Other	Feet	Inches	
A	1 floor plus roof	32	7.4	1.00	1.05	0.9	1.00		7.0	84	164
A	2 floors plus roof	32	13.8	1.00	1.00	0.9	1.00		12.4	149	232
B	1 floor plus roof	32	7.4	1.00	1.05	0.9	1.00		7.0	84	164
B	2 floors plus roof	32	13.8	1.00	1.00	0.9	1.00		12.4	149	308
C	1 floor plus roof	26	6	1.00	1.00	0.9	1.45		7.8	94	335
D	1 floor plus roof	18	6	1.00	1.00	0.9	1.45		7.8	94	240
E	1 floor plus roof	16	3.8	1.00	1.00	0.9	1.00		3.4	41	164
E	2 floors plus roof	13	6.2	1.00	1.00	0.9	1.45		8.1	97	192
F	1 floor plus roof	16	3.8	1.00	1.00	0.9	1.00		3.4	41	237
F	2 floors plus roof	16	7.4	1.00	1.00	0.9	1.45		9.7	116	197

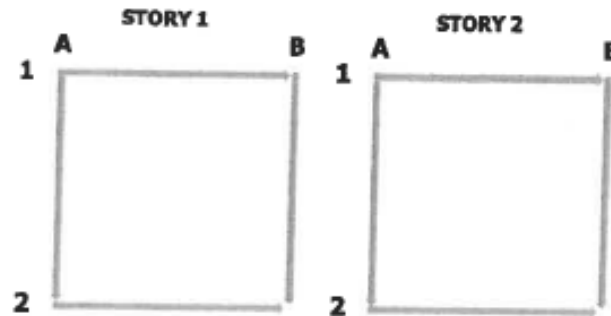
Proprietary software is out there  
as well.....

an example from a local project

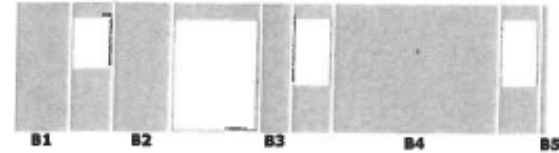
### APA Wall Bracing Calculator Project Report

Builder/Designer  
Home/Building Plan Name  
Development Address  
Code  
SDC (Seismic Design Category)  
Wind Speed  
Wind Exposure Category  
Total Number of Stories  
Cripple Wall  
Mean Roof Height less than 30 ft.

RCWA  
Fisher Road / Truro, MA  
BASED ON 2015 IRC  
1-2 FAMILY A-C  
< 140 mph  
EXPOSURE B  
2 STORY  
NO  
YES



WALL LINE ELEVATION VIEW



WALL LINE PLAN VIEW



Story	Wall Line	Bracing Method	Wind Factors	Wind Bracing Amount	Seismic Factors	Seismic Bracing Amount	Required Bracing	Qualified Bracing	Bracing Status
1st Story	A	CS-WSP	0.85	6.29	Exempt	Exempt	6.29	16.92	Compliant

Wall Line Segment	Bracing Method	Segment Length	Adjacent Opening Height	Qualified Segment	Nails	Tension Tie	Hold Down
B1	CS-WSP	3' 3"	3' 0"	3.25	6"/12"		
B2	CS-WSP	3' 6"	6' 8"	3.5	6"/12"		
B3	CS-WSP	1' 10"	6' 8"	0	6"/12"		
B4	CS-WSP	10' 2"	4' 0"	10.17	6"/12"		800
B5	CS-WSP	0' 5"	4' 0"	0	6"/12"		

Include proper 800lb HD details for IRC placement rules on the plans.

**To repeat** – this presentation meant only to be an intro. Other issues to consider (but not limited to:

- Maximum distances between braced wall panels
- Hold down requirements for continuous sheathing braced wall panels at or near corners
- How walls are connected to floor and ceiling/roof construction
- Portal frames
- How and when different construction methods can be mixed

Now that you are thoroughly confused, I suggest some stirring bedtime reading:

R 403.1.6 – Foundation anchorage

R 502.2.1 – Floor framing at braced wall lines

R 602.3.4 – Brace wall panel uplift load path

R 602.10 – Wall Bracing (skip the parts on seismic design and the simplified method)

R 802.11.1 – (Roof) Uplift resistance

Questions?  
Suggestions?

Thank you for your indulgence.

Oh, one more thing.....

You've heard that windborne debris  
protection requirements are no more?

you're  
right!

So you want to find where this is found in the code?

guess what?

....you  
won't !!

..but here's how you do it.....

start with

R301.2.1.2 – Protection of openings. Exterior glazing in buildings located in **windborne debris regions** shall be protected....

what they don't tell you about the term “**windborne debris regions**” is.....

# .....they changed the definition!

**WINDBORNE DEBRIS REGION.** Areas within hurricane-prone regions located in accordance with one of the following:

1. Within one mile (1.61 km) of the coastal mean high water line where the nominal design wind speed,  $V_{asd}$ , is 130 mph (58 m/s) or greater.
2. In areas where the nominal design wind speed,  $V_{asd}$ , is 140 mph (63.6 m/s) or greater.

NOTE: Values of  $V_{ult}$  are found in Table R301.2(4). To **convert**  $V_{ult}$  to  $V_{asd}$ , refer to Table R301.2.1.3.

as you can see  $V_{asd} < 108$  mph for our zones and  
< 130 mph requirement for the 1 mile coastal zone

**TABLE R301.2.1.3  
WIND SPEED CONVERSIONS\***

$V_{abr}$	110	115	120	130	140	150	160	170	180	190	200
$V_{asd}$	85	89	93	101	108	116	124	132	139	147	155

For SI: 1 mile per hour = 0.447 m/s.

a. Linear interpolation is permitted.



Questions?

Comments?

thanks for coming!!