New to Truro and Provincetown

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

Prepared by:
Russell Braun RA CBO
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**

<table>
<thead>
<tr>
<th>City/Town</th>
<th>SNOW LOADS</th>
<th>BASIC WIND SPEED, $V_{ult}$ (mph)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Ground Snow Load, $P_g$ (psf)</td>
<td>Minimum Flat Roof Snow Load, $P_f$ (psf)</td>
</tr>
<tr>
<td>Provincetown</td>
<td>25</td>
<td>25</td>
</tr>
<tr>
<td>Truro</td>
<td>25</td>
<td>25</td>
</tr>
</tbody>
</table>

**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.

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

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

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

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

<table>
<thead>
<tr>
<th>Method LIB</th>
<th>Method GB</th>
<th>Methods DWB, WSP, SFB, PBS, PCR, HPS, BV-WSP, ALW, PFH, PFG, CS SFB²</th>
<th>Methods CS-WSP, CS-G, CS-PF</th>
</tr>
</thead>
<tbody>
<tr>
<td>5.5</td>
<td>5.5</td>
<td>3.0</td>
<td>2.5</td>
</tr>
<tr>
<td>10.0</td>
<td>10.0</td>
<td>5.5</td>
<td>5.0</td>
</tr>
</tbody>
</table>

Continuously Sheathed – Wood Structural Panel

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

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

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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?

Yet another table!!

Using the previous wall construction methods...

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
- 1st 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.
1st Floor

4 braced wall lines in this direction

2 braced wall lines

notice 4' offsets – that’s o.k.
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’

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

<table>
<thead>
<tr>
<th>Braced Wall Line</th>
<th>Notes</th>
<th>Spacing (feet)</th>
<th>Bracing Length (feet)</th>
<th>Using CS-WSP wall type</th>
<th>Bracing Length (feet)</th>
<th>Adjustments</th>
<th>Req'd BWP length</th>
<th>Actual</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>A</td>
<td>1 floor plus roof</td>
<td>32</td>
<td>7.4</td>
<td></td>
<td>1.00</td>
<td>1.05</td>
<td>0.9</td>
<td>1.00</td>
</tr>
<tr>
<td>A</td>
<td>2 floors plus roof</td>
<td>32</td>
<td>13.8</td>
<td></td>
<td>1.00</td>
<td>1.00</td>
<td>0.9</td>
<td>1.00</td>
</tr>
<tr>
<td>B</td>
<td>1 floor plus roof</td>
<td>32</td>
<td>7.4</td>
<td></td>
<td>1.00</td>
<td>1.05</td>
<td>0.9</td>
<td>1.00</td>
</tr>
<tr>
<td>B</td>
<td>2 floors plus roof</td>
<td>32</td>
<td>13.8</td>
<td></td>
<td>1.00</td>
<td>1.00</td>
<td>0.9</td>
<td>1.00</td>
</tr>
<tr>
<td>C</td>
<td>1 floor plus roof</td>
<td>26</td>
<td>6</td>
<td></td>
<td>1.00</td>
<td>1.00</td>
<td>0.9</td>
<td>1.45</td>
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<tr>
<td>D</td>
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<td>18</td>
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<td>1.00</td>
<td>1.00</td>
<td>0.9</td>
<td>1.45</td>
</tr>
<tr>
<td>E</td>
<td>1 floor plus roof</td>
<td>16</td>
<td>3.8</td>
<td></td>
<td>1.00</td>
<td>1.00</td>
<td>0.9</td>
<td>1.00</td>
</tr>
<tr>
<td>E</td>
<td>2 floors plus roof</td>
<td>13</td>
<td>6.2</td>
<td></td>
<td>1.00</td>
<td>1.00</td>
<td>0.9</td>
<td>1.45</td>
</tr>
<tr>
<td>F</td>
<td>1 floor plus roof</td>
<td>16</td>
<td>3.8</td>
<td></td>
<td>1.00</td>
<td>1.00</td>
<td>0.9</td>
<td>1.00</td>
</tr>
<tr>
<td>F</td>
<td>2 floors plus roof</td>
<td>16</td>
<td>7.4</td>
<td></td>
<td>1.00</td>
<td>1.00</td>
<td>0.9</td>
<td>1.45</td>
</tr>
</tbody>
</table>

as you can see, our actual braced panels way exceed what is required.
Proprietary software is out there as well......

an example from a local project
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...............
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
Questions?
Comments?

thanks for coming!!