Botetourt County WIND BRACING

The information herein provides guidelines for complying with the wall bracing provisions of the 2009 Virginia Residential Code so your new home or addition can adequately resist wind load.

Botetourt County Development Services

Development Services

5 West Main Street Suite 100

Fincastle, VA 24090

Phone
(540)473-8248
Fax
(540)473-2018

www.botetourtva.gov

Hours of Operation

Monday—Friday: 8:30 a.m.—5:00 p.m.

BOTETOURT
COUNTY OF VIRGINIA

RESISTING WIND LOAD

All buildings must be designed to resist wind load. Unlike snow load which acts vertically and downward only, wind load acts horizontally and in any direction.

The design wind load on a structure is based on the local wind speed which is 90 mph for Botetourt County. Due to the way wind is measured, this translates to a Category 1 hurricane.

The structural system of a house is designed to transfer wind load from where it is applied all the way to the ground. **Wind load is resisted by the walls parallel to the direction of the wind.** For example, in a simple one-story house, as shown in FIGURE 1, wind against the end wall would cause the roof to move in the direction of the wind, but the movement is resisted by the bracing in the side walls parallel to the wind.

This process is similar for houses with multiple floors. In such cases, the walls of the first floor have the added responsibility of resisting the forward movement of all the floors and the roof above.

The Virginia Residential Code accounts for the properties and characteristics of wind through the construction requirements in this publication.

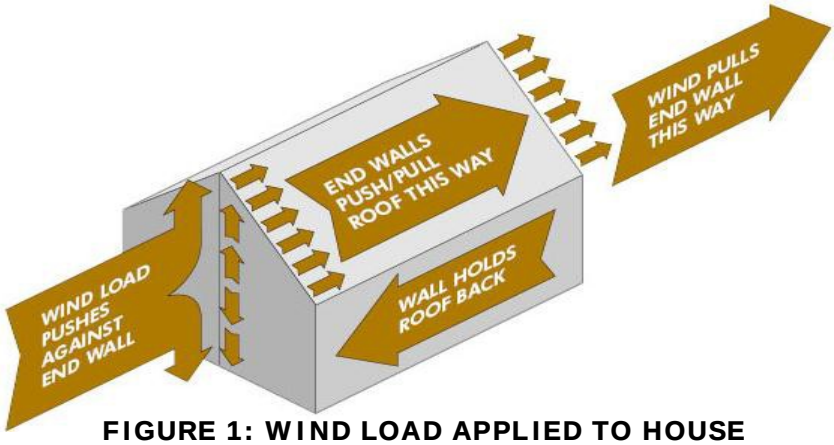


FIGURE 1: WIND LOAD APPLIED TO HOUSE

A special thanks to Fairfax County, Virginia for their preparation of this guideline.

A Fairfax County, Virginia Publication in conjuction with the County of Botetourt.

BRACED-WALL-PANELS

As shown in FIGURE 2, a typical wall will rack due to wind load if no bracing is provided. When installed in specified locations along a wall, usually in the form of sheathing, bracing prevents this lateral displacement, see FIGURE 3.

The code prescribes a –braced-wall-panel‖ as a sheathed, full-height section of wall that is placed in specified lengths and locations with a maximum height of 12 feet; see FIGURE 3. Sheathing, also called bracing method, is available in various materials and configurations; see Page 6.

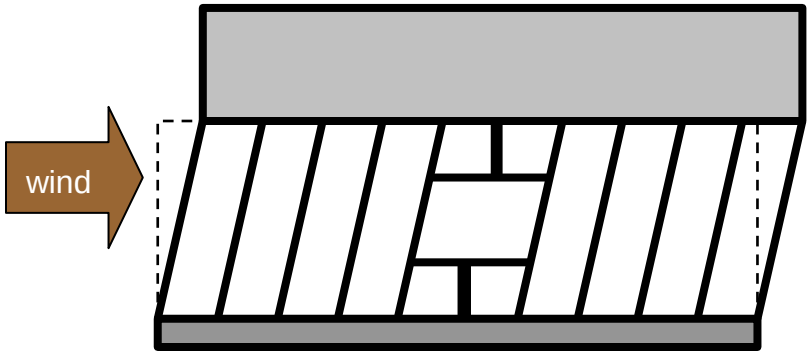


FIGURE 2: RACKING DUE TO WIND LOAD

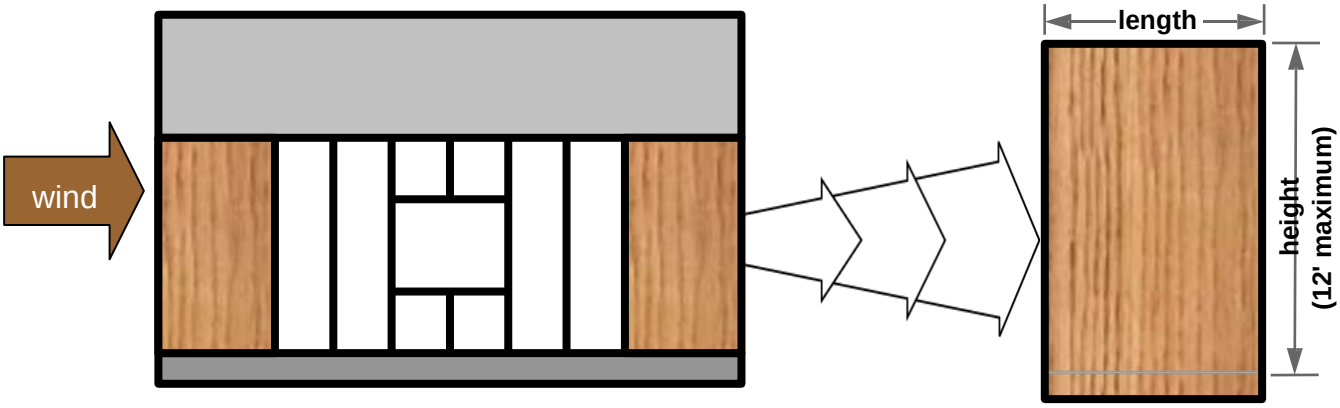


FIGURE 3: BRACED-WALL-PANELS

BRACED-WALL-LINES

"Braced-wall-lines," a building code concept, help to ensure proper distribution of bracing on the walls of your house or addition. Braced-wall-lines are –theoretical‖ straight lines that, as a designer, you draw through the house in the left-right and up-down plan direction. The amount and location of braced-wall-panels are derived from the characteristics of each braced-wall-line.

There are many "right answers" for the placement of a braced-wall-line, but you will want to place yours strategically and within the rules noted herein to minimize the amount of required bracing or maximize the number of openings for doors and windows.

SPACING

In most cases, braced-wall-lines will be located along all the exterior sides of your house or addition. However, braced-wall-lines may need to run through the interior of your house as the spacing between parallel braced-wall-lines cannot exceed 60 feet. For example, in FIGURE 4, BWL-2 is required if the distance between BWL-1 and BWL-3 is greater than 60 feet.

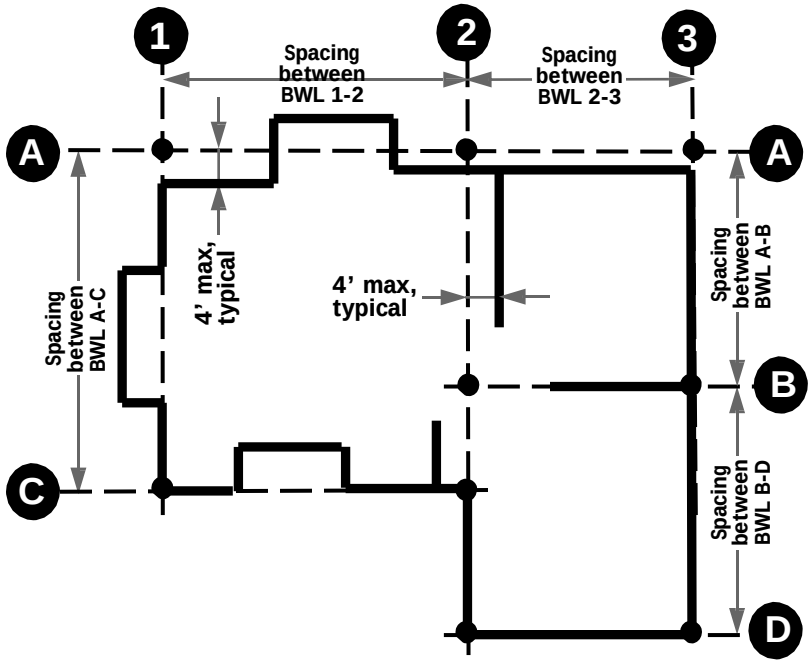


FIGURE 4: PLACEMENT OF BRACED-WALL-LINES

ENDS

Braced-wall-lines must terminate at the intersection with a perpendicular braced-wall-line at each end (See ANGLED WALLS for an exception). In FIGURE 4, the ends of a braced-wall-line are shown with a dot (●). Note that the ends of BWL-C are located at its perpendicular intersections with BWL-1 and BWL-2. Likewise, the ends of BWL-2 are located at the intersections with BWL-A and BWL-D.

BRACED-WALL-PANEL OFFSETS

To provide flexibility, the code allows braced-wall-panels up to 4 feet away from and parallel to the braced-wall-line to help it resist wind load. As shown in FIGURE 4, you may locate your braced-wall-lines to maximize the total amount of actual walls on or within 4 feet of it.

In FIGURE 4 notice BWL-A is located so that all wall segments of the house are within 4 feet of the braced-wall-line's location, even though it does not fall on any one actual wall. This minimizes the number of braced-wall-lines and maximizes the number of wall segments which contain bracing that is able to contribute to the strength requirements of BWL-A.

UNUSUAL DESIGN CONDITIONS

Some house designs may have conditions where a braced-wall-line does not have another braced-wall-line intersecting perpendicularly at one or both ends. This is often seen in the wood framed walls of a walk-out basement or the second floor walls of a cape cod-style house.

In these instances, the code allows you to end your braced-wall-line at the farthest exterior wall or end of the building.

ANGLED WALLS

Not all houses are designed with walls that are constructed at right angles. The code accounts for the many angled walls types commonly used in today's designs.

When an angled wall is greater than 8 feet in length, it is required to be its own separate braced-wall-line. See BWL-B in FIGURE 5.

When an angled wall less than 8 feet occurs at a building corner, the end of the intersecting braced-wall-lines are taken at the projected corner. See the intersection of BWL-A and BWL-1 in FIGURE 5.

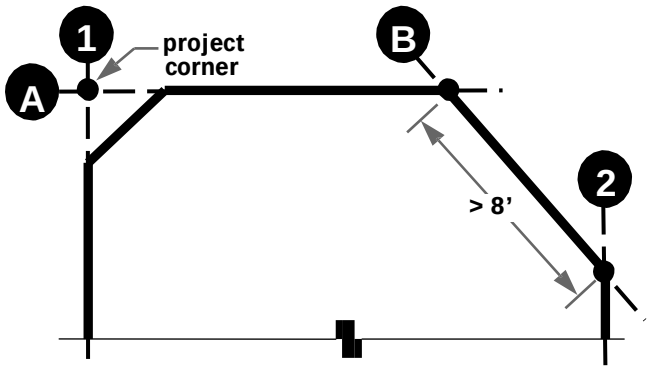


FIGURE 5: ANGLED WALLS

BRACING RULES

Braced-wall-panels are required to be placed along each braced-wall-line such that you meet all four of the following rules.

① LOCATION: A braced-wall-panel must be located at each end of a braced-wall-line or begin within 10 feet of the end.

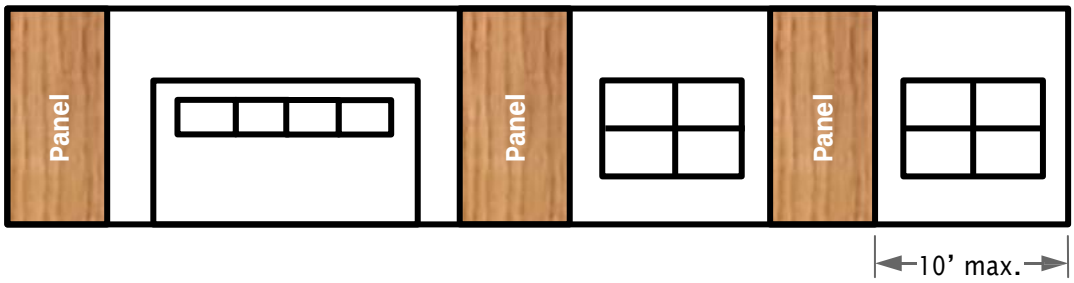


FIGURE 6: PANEL LOCATION

② SPACING: In each braced-wall-line, braced-wall-panels can be a maximum of 20 feet apart.

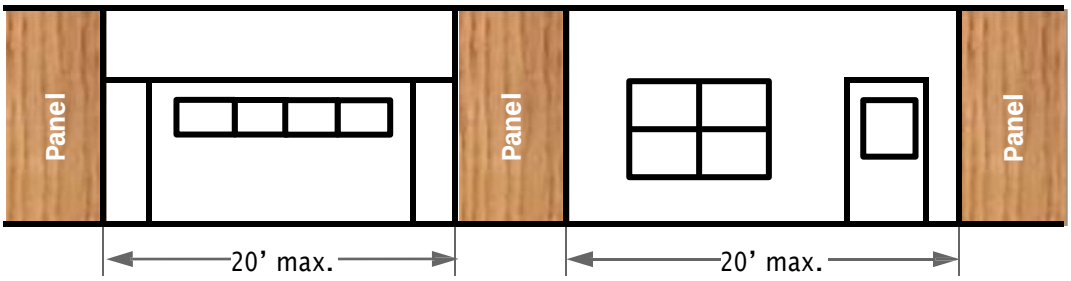


FIGURE 7: PANEL SPACING

③ NUMBER: Braced-wall-lines are required to have at least two braced-wall-panels.

Exception: one panel 48-inch or longer is permitted in braced-wall-lines 16 feet or less in length.

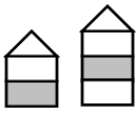
④ AMOUNT: The cumulative length of all braced-wall-panels must be greater than or equal to the minimum required length as calculated below.

Follow the instructions below for each braced-wall-line to determine its minimum required length of bracing.

Step 1) Determine the spacing from the braced-wall-line you are designing to the next adjacent braced-wall-line. In cases where it has parallel braced-wall-lines on one or both sides with differing distanced to each, the average spacing may be used.

Step 2) For the braced-wall-line being designed use the spacing as found in Step 1, the story in which the braced-wall-line is located and the intended bracing method (see Page 6), to determine its unadjusted required length of bracing from TABLE 1 below.

TABLE 1: MINIMUM REQUIRED LENGTH (FEET) OF BRACING[1]

Story Location	Spacing to adjacent braced-wall-line (feet)	Method LIB	Method GB	Methods DWB, WSP, SFB, PBS, PCP, HPS, CS-SFB	Methods CS-WSP, CS-G, CS-PF
	10	3.5	3.5	2.0	2.0
	20	7.0	7.0	4.0	3.5
	30	9.5	9.5	5.5	5.0
	40	12.5	12.5	7.5	6.0
	50	15.5	15.5	9.0	7.5
	60	18.5	18.5	10.5	9.0
	10	7.0	7.0	4.0	3.5
	20	13.0	13.0	7.5	6.5
	30	18.5	18.5	10.5	9.0
	40	24.0	24.0	14.0	12.0
	50	29.5	29.5	17.0	14.5
	60	35.0	35.0	20.0	17.0
	10	NP	10.5	6.0	5.0
	20	NP	19.0	11.0	9.5
	30	NP	27.5	15.5	13.5
	40	NP	35.5	20.5	17.5
	50	NP	44.0	25.0	21.5
	60	NP	52.0	30.0	25.5

[1] Interpolation is permitted.

Step 3) Use TABLE 2 to determine the adjustment factor for the eave-to-ridge height of the roof.

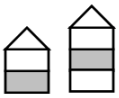
Step 4) use TABLE 2 to determine the adjustment factor for the wall height.

Step 5) Use TABLE 2 to determine the adjustment factor for the number of braced-wall-lines in each plan direction, i.e., left-right or up-down.

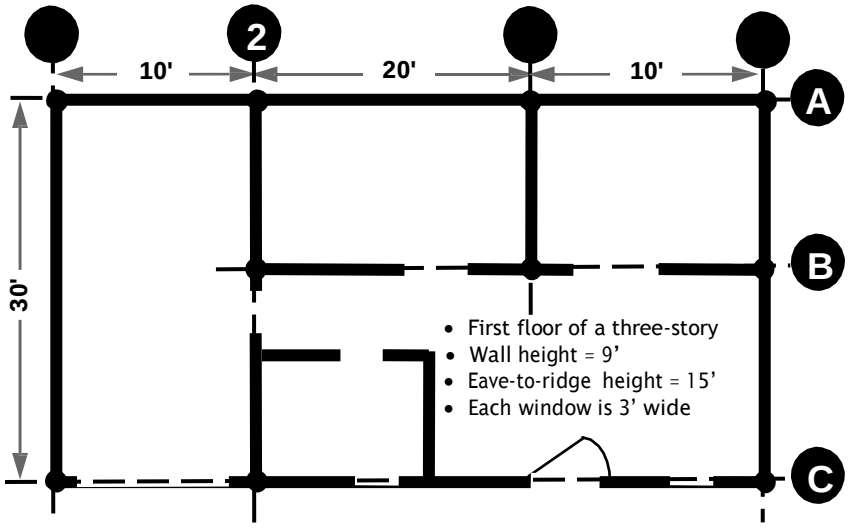
Step 6) Multiply the value from TABLE 1 by <u>all</u> of the adjustment factors to determine the final amount of required bracing.

Step 7) Add all the contributing lengths (see Page 11 for an explanation) of each braced-wall-panel in the braced-wall-line and ensure the total is greater than the value calculated in Step 6.

TABLE 2: ADJUSTMENT FACTORS FOR LENGTH OF BRACING

ADJUSTMENT BASED ON...		CONDITION	ADJUSTMENT FACTOR [1]
Roof eave-to-ridge height		≤ 5 ft	0.70
		10 ft	1.00
		15 ft	1.30
		20 ft	1.60
		≤ 5 ft	0.85
		10 ft	1.00
		15 ft	1.15
		20 ft	1.30
		≤ 5 ft	0.90
		10 ft	1.00
		15 ft	1.10
		20 ft	Not permitted
Wall height adjustment		8 ft	0.90
		9 ft	0.95
		10 ft	1.00
		11 ft	1.05
		12 ft	1.10
Number of braced-wall-lines (per plan direction)		2	1.00
		3	1.30
		4	1.45
		≥ 5	1.60

[1] Interpolation is permitted.



FOR EXAMPLE: Using the floor plan above, find the minimum amount of required bracing for BWL-4 using bracing Method CS-WSP.

1. Find the average braced-wall-line spacing:
   - ✓ At the top of BWL-4, BWL-3 is the next parallel braced-wall-line at 10 feet away.
   - ✓ At the bottom of BWL-4, BWL-2 is the next parallel braced-wall-line at 30 feet way.
   - ✓ Therefore, the average spacing = (10 + 30) ÷ 2 = **20 feet**.
2. From TABLE 1, using the first of a three-story house, a 20-foot brace-wall-line spacing, and bracing Method CS-WSP, the pre-adjusted minimum required length of bracing is **9.5 feet**.
3. From TABLE 2, the adjustment factor for the first of a three-story house with a roof eave-to-ridge height of 15 feet is **1.10**.
4. From TABLE 2, the adjustment factor for a wall height of 9 feet is **0.95**.
5. Since BWL-4 runs up-down and there are a total of four braced-wall-lines in this direction, using TABLE 2, the adjustment is **1.45**.
6. The total minimum required amount of bracing for BWL-4 = 9.5 x 1.10 x 0.95 x 1.45 = **14.4 feet**.
7. The length of contributing bracing = 30' – 3' (width of window) = 27 feet > 14.4 feet.

BRACING METHODS

The type, material and configuration of sheathing methods vary. There are two types of bracing: intermittent (FIGURE 8) and continuous-sheathing (FIGURE 9).

Intermittent braced-wall-panels are placed at required locations only. The non-sheathed area between them is infilled with other material such as insulating foam. In continuous-sheathing the entire face of the wall is sheathed, including areas above and below openings.

In our region, continuous-sheathing is the predominant sheathing type for the exterior, while intermittent is most common for the interior.

TABLE 3 below lists the most common bracing methods and a description of each.

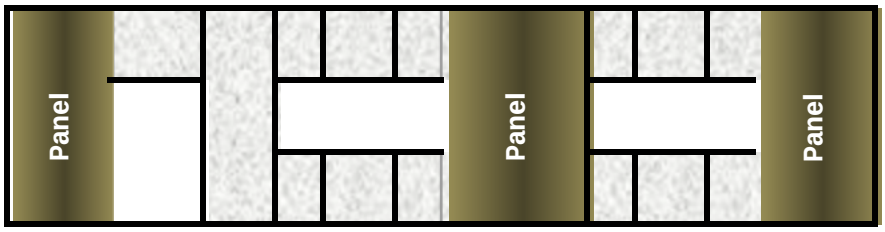


FIGURE 8: INTERMITTENT BRACING

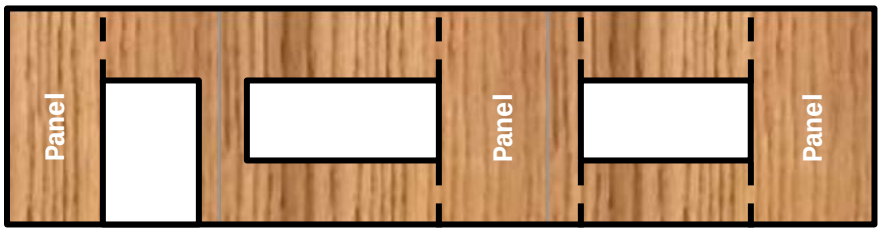
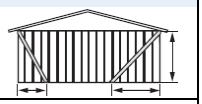
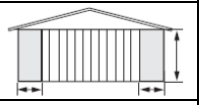
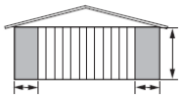
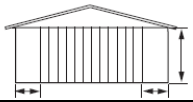
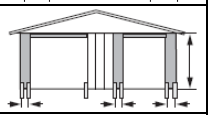
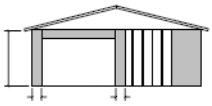
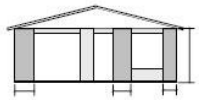
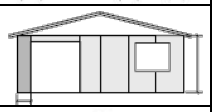
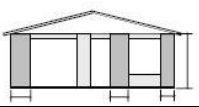
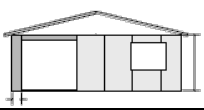


FIGURE 9: CONTINUOUS-SHEATING

TABLE 3: BRACING METHODS

Methods, Materials	Minimum Thickness	Connection Criteria	Figure
Intermittent Methods			
LIB Let-in-bracing	1x4 wood or metal straps, 45° to 60° angles	Wood: 2-8d common nails (2½‖ long x 0.113‖ dia.) at each stud Metal: per manufacturer	
WSP Wood structural panel (OSB or plywood)	⅜"	8d common nails (2 ½‖ long x 0.113‖ dia.) @ 6‖ edges, @ 12‖ field	
SFB Structural fiberboard sheathing	½" (maximum 16" stud spacing)	Galv. roofing nails (1½‖ long x 0.113‖ dia.) @3‖ edges, @ 6‖ field or 8d common nails (2 ½‖ long x 0.113‖ dia.) @ 6‖ edges, @ 12‖ field	
GB Gypsum board	½"	Nails: 13 gage x 1⅜‖ long, $^{19}/_{64}$‖ head or 0.098‖ dia., 1¼‖ long, annular-ringed or 5d cooler nails, 0.086‖ dia., 1⅝‖ long @ 7‖ Screws: Type W or S @ 7‖	
PFH Portal frame with hold-downs	⅜"	See Page 7 for portal frames.	
PFG Portal frame at garage	$^{7}/_{16}$"	See Page 7 for portal frames.	
Continuous-Sheathing Methods			
CS-WSP Continuous wood structural panel	⅜"	8d common nails (2 ½‖ long x 0.113‖ dia.) @ 6‖ edges, @ 12‖ field	
CS-G Continuous wood structural panel at garage door opening	⅜" (applies to one wall of one-story garages only)	8d common nails (2 ½‖ long x 0.113‖ dia.) @ 6‖ edges, @ 12‖ field	
CS-SFB Continuous structural fiberboard	½" (maximum 16" stud spacing)	Galv. roofing nails (1½‖ long x 0.113‖ dia.) @3‖ edges, @ 6‖ field 8d common nails (2 ½‖ long x 0.113‖ dia.) @ 6‖ edges, @ 12‖ field	
CS-PF Continuous-sheathing portal frame	$^{7}/_{16}$"	See Page 7 for portal frames.	

MIXING METHODS

Mixing different bracing methods in the same braced-wall-line is permitted provided the method which generates the highest required bracing per TABLE 1 governs the braced-wall-line design.

If you are mixing intermittent bracing methods along the interior portion of a braced-wall-line with continuous-sheathing methods along the exterior portion, the corners each end of the continuous-sheathing portion(s) of the braced-wall-line must meet the conditions listed below.

Method CS-SFB cannot be mixed with any other method in the same braced-wall-line.

CONTINUOUS-SHEATHING CORNERS

The corners at each end of a braced-wall-line with continuous-sheathing must be strengthened using the options described below.

The first option is to have a braced-wall-panel at each end and a return-panel on the intersecting braced-wall-line as shown in FIGURE 10. The minimum size of a return panel is 24 inches for wood structural panels and 32 inches for structural fiberboard.

A return panel may be omitted if the end-braced-wall-panel is 48 inches minimum as shown in FIGURE 12 or you install an 800 pound hold-down at the end-panel, as shown in FIGURE 11.

If your end-braced-wall-panel is offset from the corner, then you must install an 800 pound hold-down at the edge of the braced-wall-panel as shown in FIGURE 13.

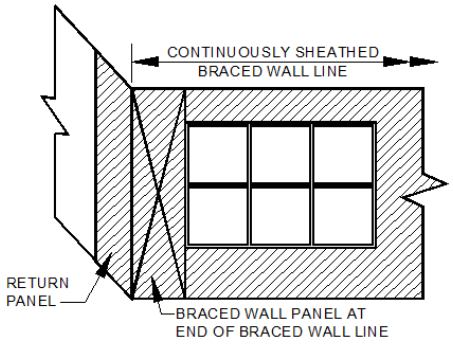


FIGURE 10: RETURN PANEL

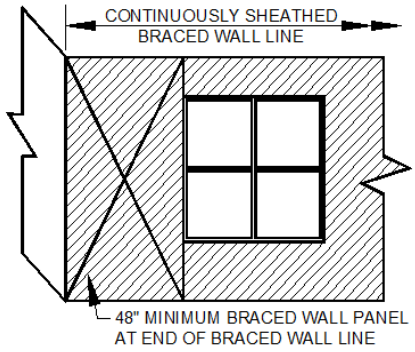


FIGURE 12: 48-INCH END-BRACED-WALL-PANEL

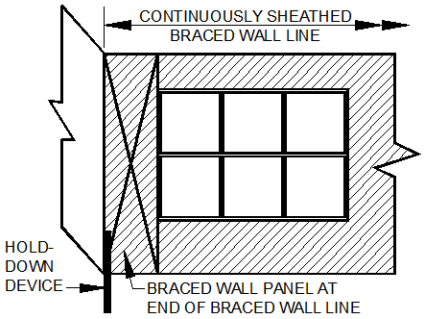


FIGURE 11: HOLD-DOWN

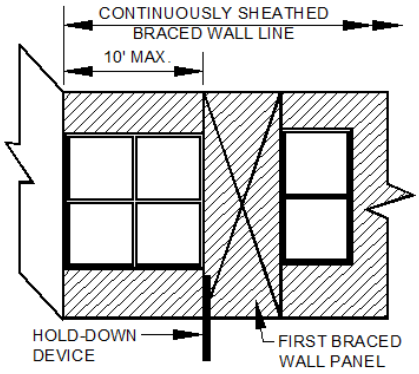


FIGURE 13: OFFSET HOLD-DOWN

PORTAL FRAMES

For those applications where it is difficult to place a full-length braced-wall-panel, portal frames are easy, narrow options that can be constructed with common building materials. The code provides three different portal frames. Methods PFH and PFG are intermittent methods, and Method CS-PF is a continuous-sheathing method.

Portal frames are tested assemblies equivalent to a standard braced-wall-panel. Their strength is derived from the stiffness created by the connection of the wood sheathing to the header which must span over the panel. Therefore, it is essential these braced-wall-panels are constructed properly. See FIGURE 14.

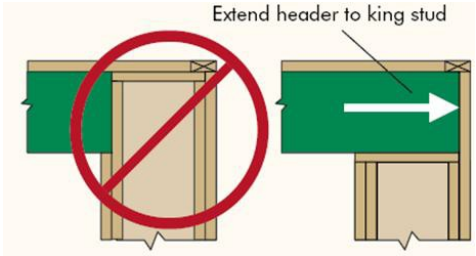
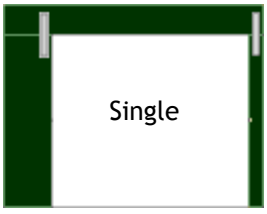


FIGURE 14: PORTAL FRAME HEADER

Portal frames can be constructed as a single portal or double portal. A single portal includes the braced-wall-panel and header spanning over the opening to a jack stud.



A double portal includes a braced-wall-panel at each side of the opening with a shared continuous header spanning over each panel.

Single and double portals can be used together to frame numerous openings, such as garage doors or windows in sunrooms, and still comply with wall bracing requirements. See FIGURE 15.

METHOD PFH

Method PFH is an intermittent portal frame with hold-downs per FIGURE 16. PFH panels must be constructed atop a concrete foundation with cast-in-place hold-downs.

METHOD PFG

Method PFG is an intermittent portal frame with anchor bolts per FIGURE 17. Permitted only at garage openings, PFG panels can be constructed atop a concrete or masonry foundation.

METHOD CS-PF

Method CS-PF, per FIGURE 18, is a portal frame used with continuous-sheathing. CS-PF panels can be constructed atop concrete or masonry foundations or a raised wood floor as shown in FIGURE 18. A maximum of four Method CS-PF panels can be constructed in each braced-wall-line.

PORTAL FRAME PONY WALLS

Portal frames are permitted to be constructed up to 10 feet tall with an optional pony wall atop up to 2 feet tall. The inclusion of a pony wall does have limitations and requires specific material strengths as listed in TABLE 4.

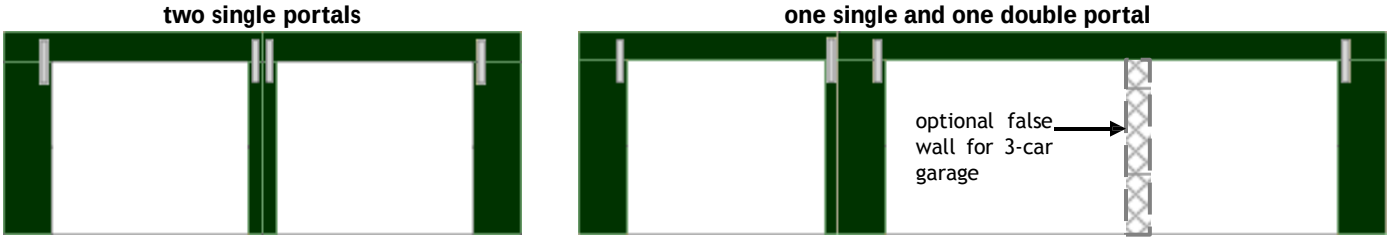


FIGURE 15: PORTAL FRAME OPENING OPTIONS

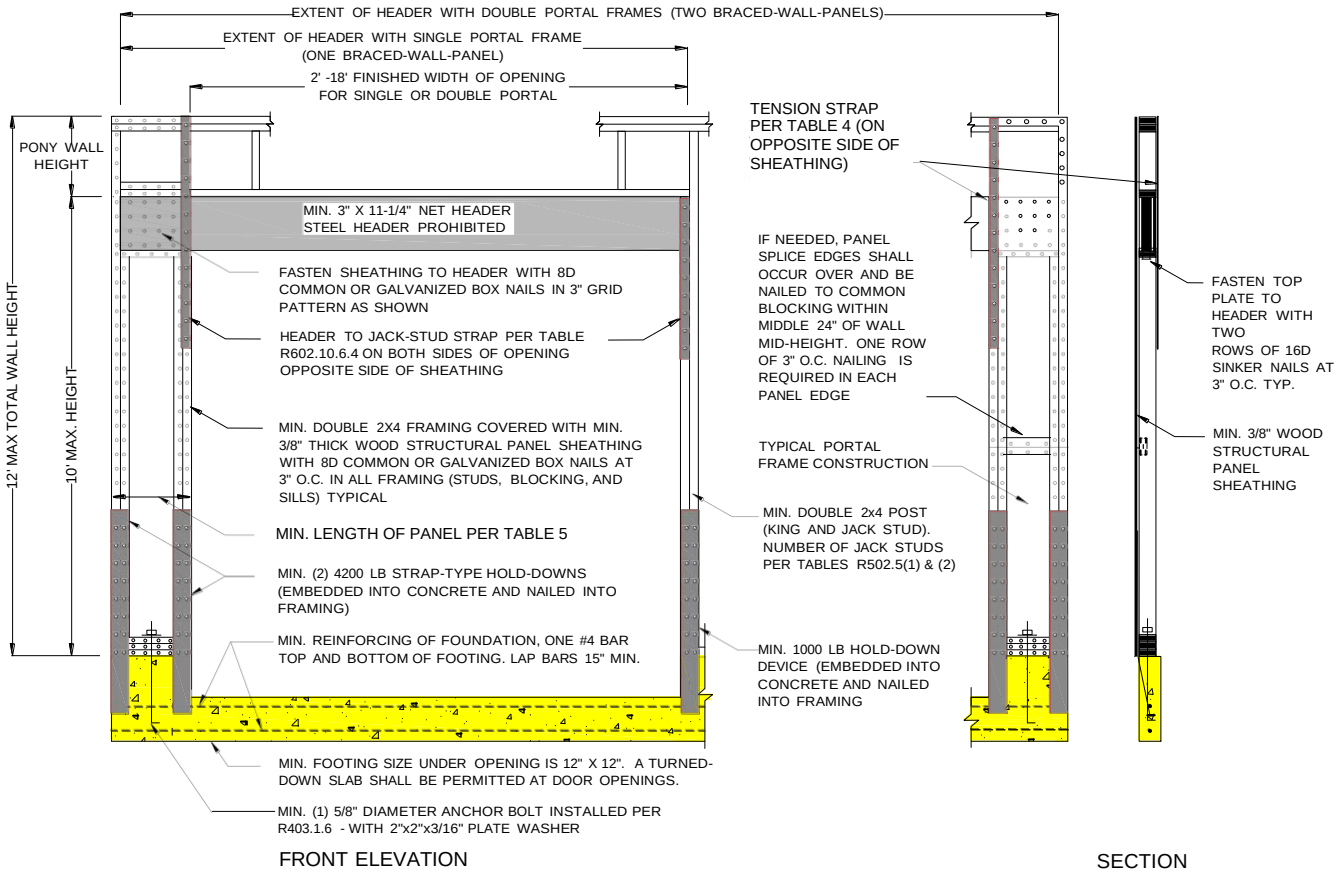


FIGURE 16: METHOD PFH

Please note: All code references in the figure above are to the 2009 Virginia Residential Code.

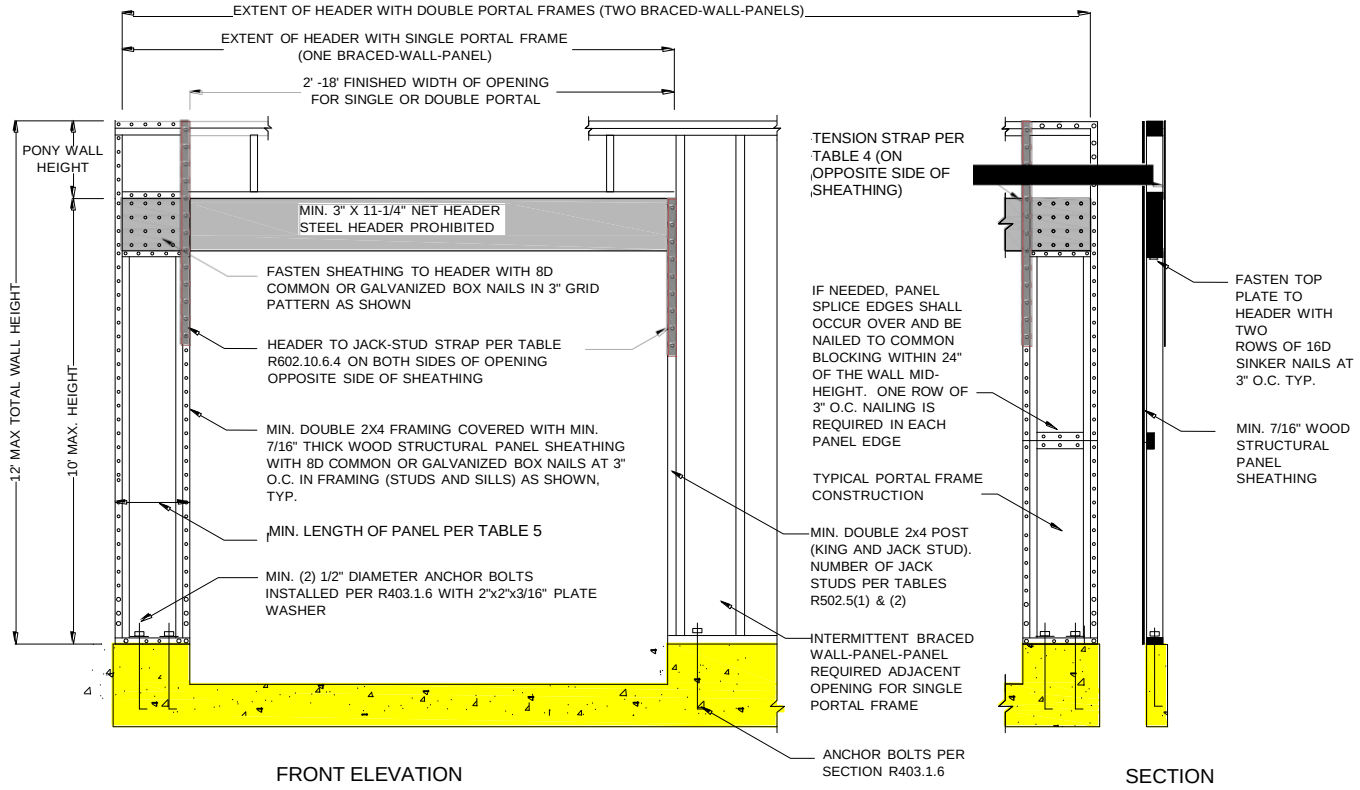


FIGURE 17: METHOD PFG

Please note: All code references in the figure above are to the 2009 Virginia Residential Code.

TABLE 4: PORTAL FRAME REQUIREMENTS

MINIMUM WALL STUD FRAMING NOMINAL SIZE AND GRADE	MAXIMUM PONY WALL HEIGHT (ft)	MAXIMUM TOTAL WALL HEIGHT (ft)	MAXIMUM OPENING WIDTH (ft)	TENSION STRAP CAPACITY REQUIRED (lbs)[1]
2x4 No. 2 Grade	0	10	18	1000
	1	10	9	1000
			16	1000
			18	1200
	2	10	9	1000
			16	2025
			18	2400
	2	12	9	1200
			16	3200
			18	3850
	4	12	9	2350
			16	design required
2x6 Stud Grade	2	12	9	1000
			16	2050
			18	2450
	4	12	9	1500
			16	3150
			18	3675

[1] Strap shall be installed in accordance with manufacturer's recommendations.

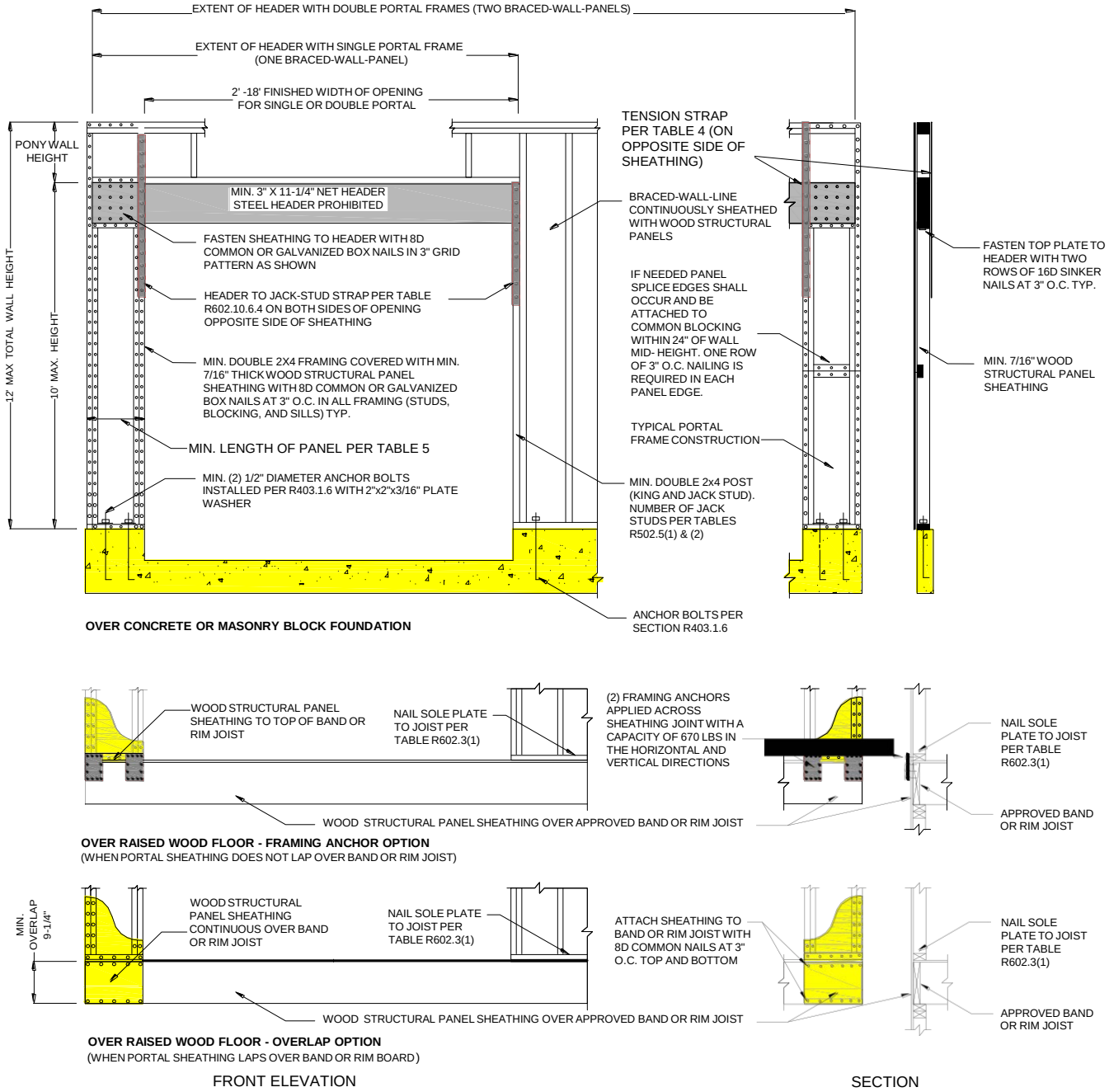


FIGURE 18: METHOD CS-PF

Please note: All code references in the figure above are to the 2009 Virginia Residential Code.

BRACED-WALL-PANELS REQUIREMENTS

For braced segments of walls to be considered braced-wall-panels, they must meet the minimum requirements noted herein.

INTERIOR FINISH MATERIAL

With the exception of Methods GB, PFH, PFG and CS-PF, the interior side of a braced-wall-panel must be finished with ½-inch gypsum board or an equivalent material such as paneling.

For all methods except Method LIB, you may eliminate the interior finish material if you multiply the bracing determined in TABLE 1 by a factor of 1.40.

JOINTS

A braced-wall-panel is not required to be constructed with a single sheet of OSB, plywood, fiberboard or gypsum board. Vertical and horizontal joints are permitted. Joints must be fastened using edge nailing requirements. Vertical joints must occur at a stud.

Except for portal frames, horizontal joints must have 2x blocking and may occur anywhere along the height of the braced-wall-panel.

Horizontal blocking is not required when the amount of actual bracing provided in the braced-wall-line is at least double that required by TABLE 1

or, for Method GB only, the sheets of gypsum board are applied horizontally.

MINIMUM LENGTH

A braced-wall-panel must meet a specific length based on its method and height. That dimension is called **minimum length** and is listed in TABLE 5.

For Methods CS-WSP and CS-SFB, minimum length is also based on the vertical dimension of the adjacent opening as shown in FIGURE 20. When a panel has an opening on each side of differing heights, the taller opening governs the panel length chosen from TABLE 5. See example below.

Any panels less than the lengths determined from TABLE 5 are NOT considered braced-wall-panels, but by definition of continuous-sheathing, they must still be sheathed.

CONTRIBUTING LENGTH

Contributing length, as shown in TABLE 5, is the value in which the panels can contribute to the minimum required length of bracing. Certain methods contribute more than their actual length, and some contribute less. See example below.

Angled braced-wall-panels within 4 feet of the braced-wall-line contribute only their projected length towards braced-wall-line's required bracing. Angled braced-wall-panels at the corner of a building can contribute to either of the intersecting braced-wall-lines, but not both. See FIGURE 19.

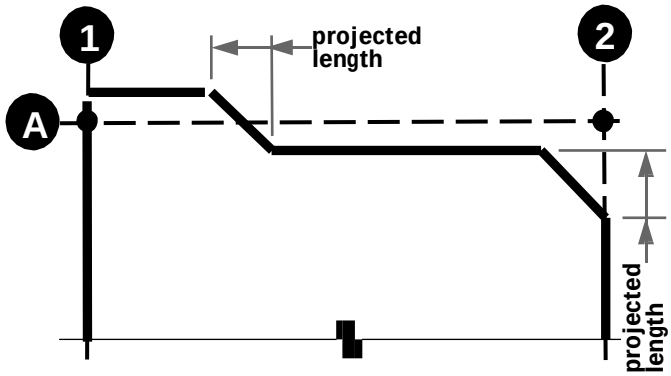
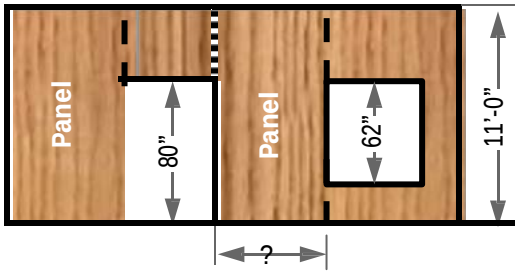
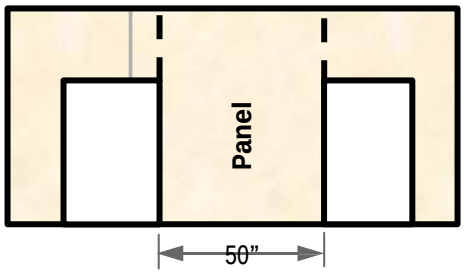


FIGURE 19: ANGLED BRACED-WALL-PANELS



FOR EXAMPLE: In the braced-wall-line above with continuous-sheathing, find the minimum length of the panel between the window and the door.

1. The governing opening is the taller of the two; therefore, in TABLE 5, use 80 inches as the opening's vertical dimension.
2. Use 11 feet as the wall height.
3. Using the two criteria from above, the minimum length of the panel is 33 inches.
4. If the panel is less than 33 inches, it cannot be considered a braced-wall-panel, but that area of the wall must still be sheathed.



FOR EXAMPLE: In the braced-wall-line above, calculate the contributing length of the 50 inch, single sided, Method GB panel.

1. Find the formula for contributing length of Method GB. In this case the formula is *0.5 x actual length* for a singled sided application.
2. Therefore the contributing length is equal to 50 x 0.5 which equals 25 inches.

Likewise, if you have a Method PFG panel, the contributing length formula is *1.5 x actual length*. Therefore if you construct a 30 inch panel, it would have a contributing length of 45 inches (1.5 x 30).

TABLE 5: MINIMUM LENGTH OF BRACED WALL PANELS

METHOD		MINIMUM LENGTH [1] (in) Wall Height					CONTRIBUTING LENGTH (in)
		8 ft	9 ft	10 ft	11 ft	12 ft	
WSP, SFB		48	48	48	53	58	Actual [2]
GB		48	48	48	53	58	Double sided = Actual Single sided = 0.5 x Actual
LIB		55	62	69	NP	NP	Actual [2]
ABW		28	32	34	38	42	48
PFH	Supporting roof only	16	16	16	18 [3]	20 [3]	48
	Supporting one story and roof	24	24	24	27 [3]	29 [3]	48
PFG		24	27	30	33 [3]	36 [3]	1.5 x Actual [2]
CS-G		24	27	30	33	36	Actual [2]
CS-PF		16	18	20	22 [3]	24 [3]	Actual [2]
CS-WSP CS-SFB	**Adjacent opening vertical dimension (in)**						
	≤ 64	24	27	30	33	36	Actual [2]
	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			50	45	43	
	116			55	48	45	
	120			60	52	48	
	124				56	51	
	128				61	54	
	132				66	58	
	136					62	
	140					66	
	144					72	

NP = Not permitted

[1] Linear interpolation is permitted.

[2] Use the actual length provided it is greater than or equal to the minimum length.

[3] Maximum header height for is 10'; however, wall height may be increased to 12' with a pony wall per TABLE 4.

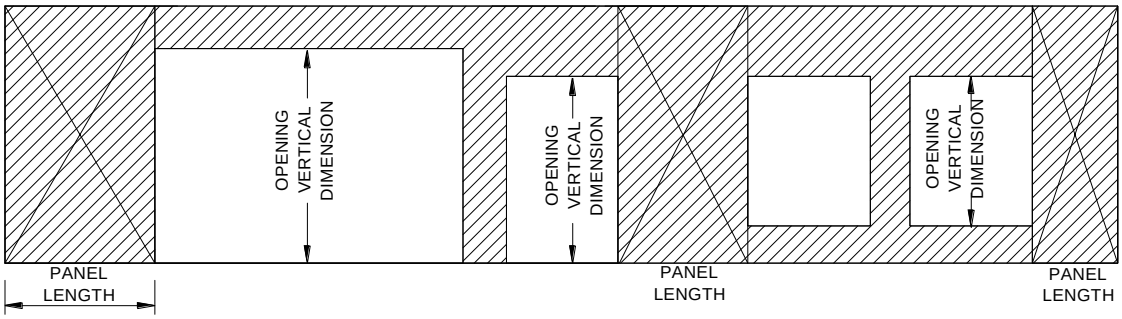
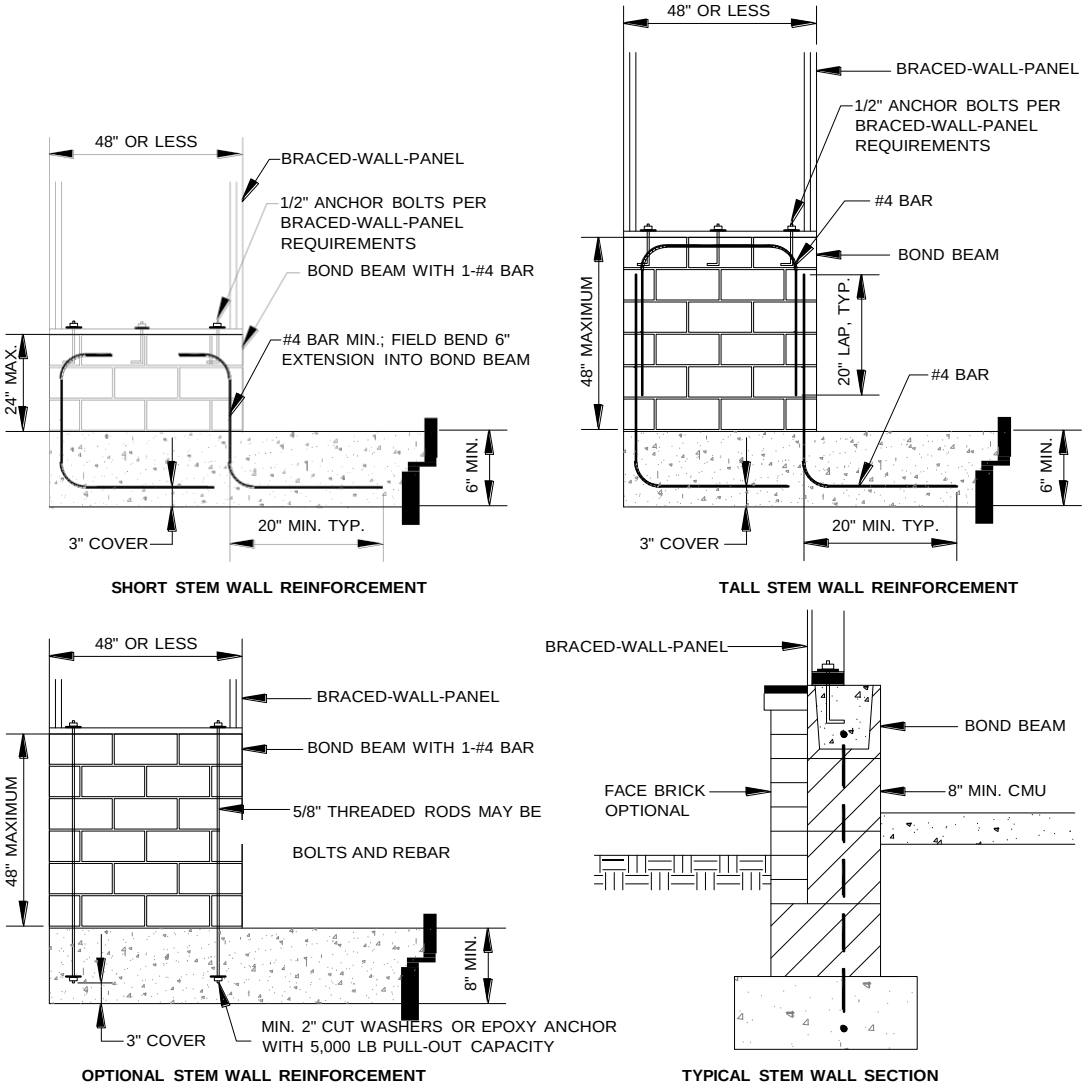


FIGURE 20: BRACED-WALL-PANELS WITH METHODS CS-WSP AND CS-SFB

MASONRY STEMWALL SUPPORT

When a braced-wall-panel with a length 48 inches or less is supported by a masonry stemwall, the masonry must be reinforced in accordance with FIGURE 21.



NOTE: GROUT BOND BEAMS AND ALL CELLS WHICH CONTAIN REBAR, THREADED RODS AND ANCHOR BOLTS.

FIGURE 21: MASONRY STEM WALLS SUPPORTING BRACED-WALL-PANELS

FLOOR/CEILING CONNECTION

Where framing is perpendicular to a braced-wall-panel, a rim joist or blocking must be provided along its length as shown in FIGURE 22. Where framing is parallel to a braced-wall-panel, a rim joist, framing member or blocking must be provided along its length as shown in FIGURE 23.

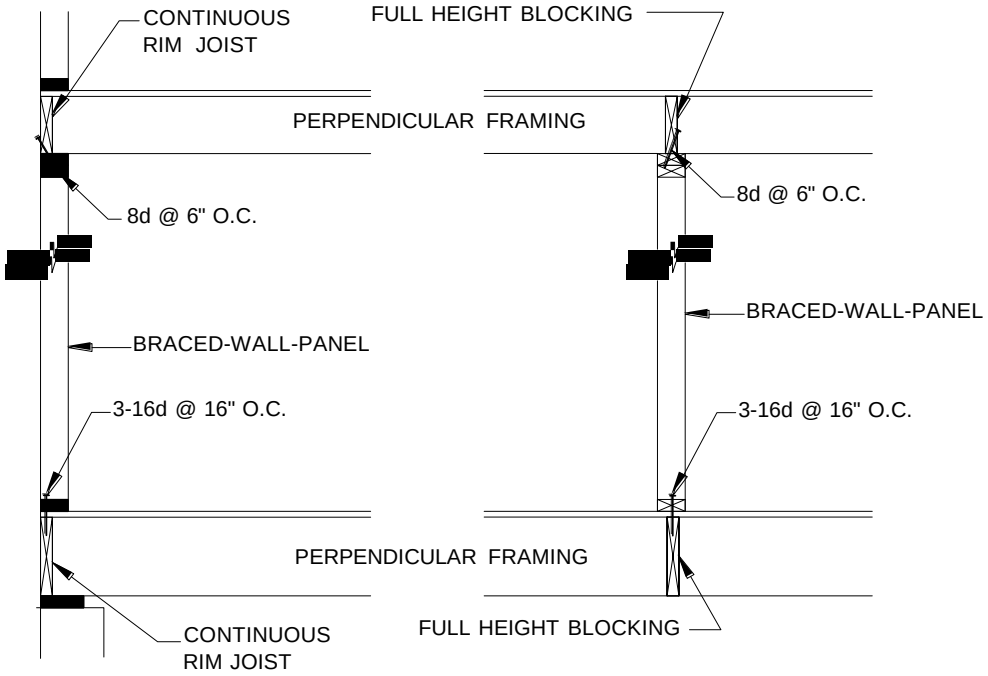


FIGURE 22: BRACED-WALL-PANEL CONNECTION WHEN PERPENDICULAR TO FLOOR/CEILING FRAMING

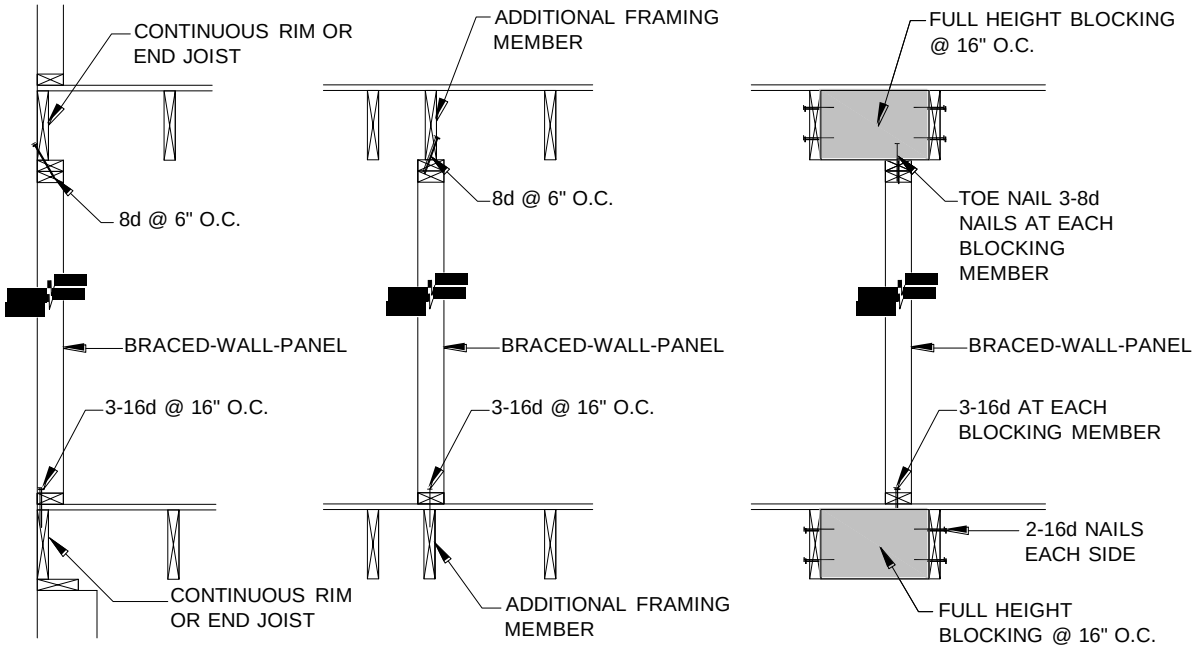


FIGURE 23: BRACED-WALL-PANEL CONNECTION WHEN PARALLEL TO FLOOR/CEILING FRAMING

ROOF CONNECTION

At the roof eave, blocking between the rafter or truss framing is required at braced-wall-panel locations when dimension D, as shown in FIGURE 24, is greater than 9.25 inches. The blocking must be constructed in accordance with TABLE 6 and the referenced figures. In the figures below all code references are to the 2009 Virginia Residential Code.

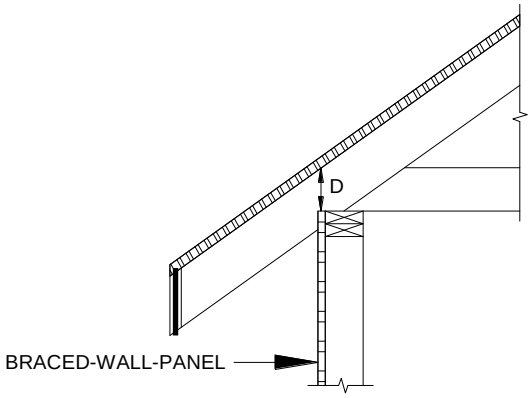


FIGURE 24: DISTANCE, D

TABLE 6: ROOF FRAMING BLOCKING

Distance, D	Requirement	Referenced Figure
0 – 9.25"	No blocking required	none
9.25" – 11.25"	Solid 2x blocking between rafters or trusses	FIGURE 25
11.25" – 48"	Soffit blocking or Vertical blocking panel	FIGURE 26 or FIGURE 27
over 48"	Engineered design required	none

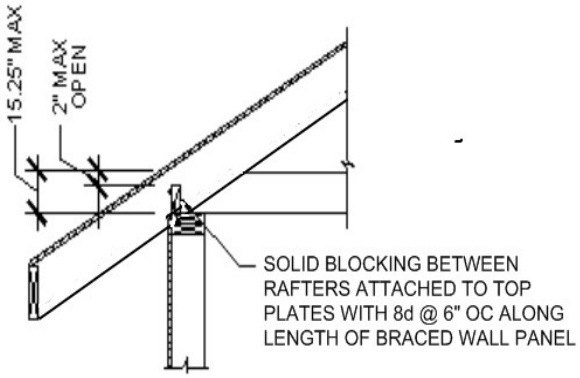


FIGURE 25: SOLID 2x BLOCKING (D = 9.25" – 11.25")

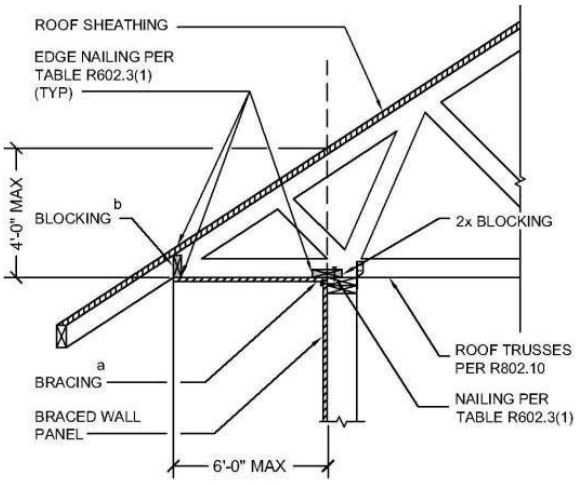


FIGURE 26: SOFFIT BLOCKING PANELS (D = 11.25" – 48")

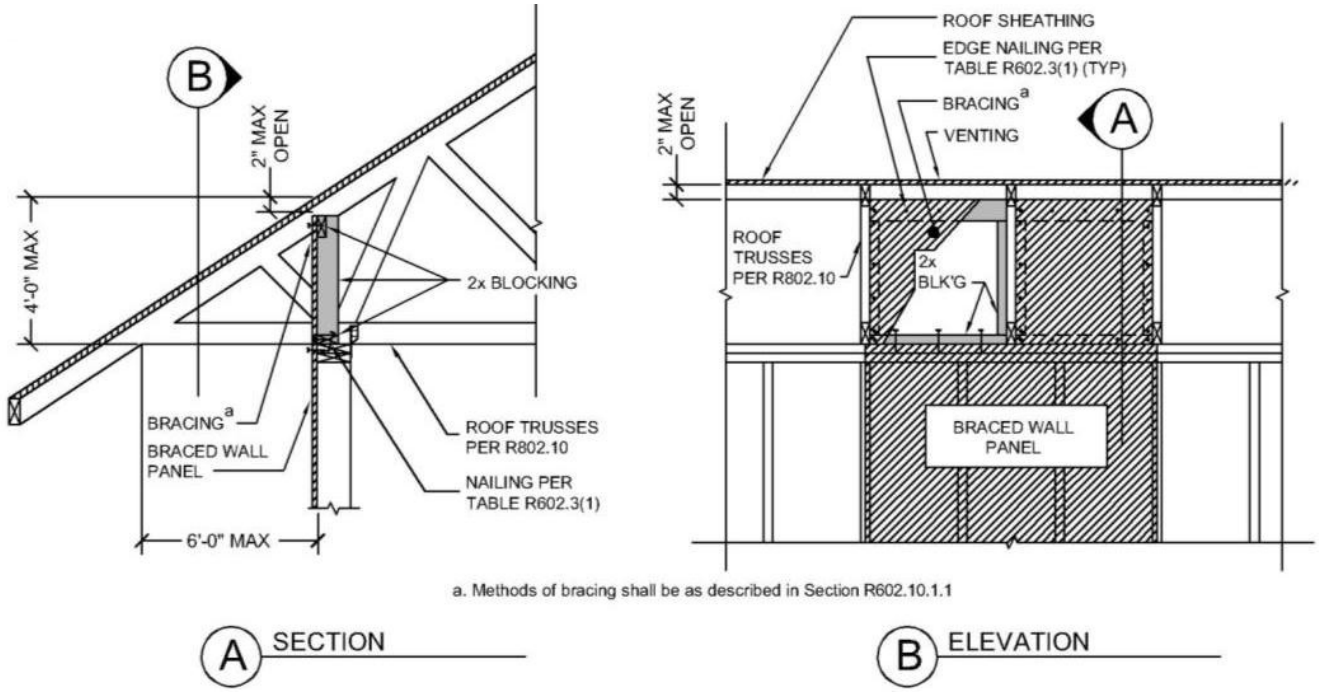


FIGURE 27: VERTICAL BLOCKING PANELS (D = 11.25" – 48")

PROPRIETARY SYSTEMS

There are two types of proprietary systems, code-equivalents and pre-engineered.

Code-equivalents are products that fit within your braced-wall-lines and are considered equal to the code-prescribed braced-wall-panels. For instance, a 12-inch wide proprietary panel can be placed in your braced-wall-line and be considered the same as a 48-inch WSP panel. This can be quite useful if you need a lot of bracing, but have little wall length in which to place it.

Code-equivalent panels are manufactured by companies such as Simpson Strong-Tie, i-Level and Hardy Frame and can be composed of wood and/or steel. Acceptable products must be listed by a product evaluating agency with a code evaluation report.

The International Code Council-Evaluation Service currently has several products listed. Go to *icc-es.org* to obtain product evaluation reports which will list manufacturer contact information, limitations for use, design loads and equivalent lengths.

Pre-engineered products are cost-effective alternatives to the full design of an engineered solution for resisting wind load. Considered –moment frames,‖ each are pre-engineered with a maximum load capacity outlined in the manufacturer's catalog.

While you will still need to employ an licensed engineer, he or she will simply need to calculate the amount of wind load delivered to the frame and then choose the correct size from the manufacturer based on its capacity.

Pre-engineered moment frames are particularly useful for lengths of wall with large openings and high amounts of load, such as the first floor of a three-story townhouse.

ENGINEERED DESIGN

If you wish to deviate from the prescriptive code requirements, then your house, or a portion thereof, must be designed by a Virginia licensed professional engineer. Use the criteria below to ensure a successful submission during permit application and plan review.

LOAD DETERMINATION

Determine the wind load on your house or addition using Section 1609 of the 2009 International Building Code (IBC) or the 2005 edition of the ASCE-7 standard. In Botetourt County, the basic wind speed is 90 mph with an Exposure B.

DESIGN METHOD AND CALCULATIONS

IBC Section 2305, –General Design Requirements for Lateral-Force-Resisting Systems,‖ the 2008 edition of the –Special Design Provisions for Wind and Seismic‖ (SDPWS) standard, and accepted engineering practice shall be employed in the submission package which must include the following:

- ✓ A detailed analysis of the wind load determination.
- ✓ A detailed design of the building diaphragms (IBC Section 2306.2) and shear walls (IBC Section 2306.3).
- ✓ Minimum aspect ratio of shear walls (SDPWS Table 4.3.4) and diaphragm (SDPWS Table 4.2.4).
- ✓ Specification of the sheathing thickness, nail sizes and nailing pattern for diaphragms and shear walls.
- ✓ Adequate load path to the foundation.
- ✓ A detailed analysis of all connections along the lateral load path.
- ✓ An analysis of the existing house shear walls when resisting the applied loads of an addition.
- ✓ Proper design of cross bracing and connections when constructing an addition on posts.
- ✓ The original signature and seal of the professional engineer.

Calculations which do not meet these requirements will not be approved during the permit application and plan review process.

SUBMISSION REQUIREMENTS

All building plans submitted for permit application and plan review must have all braced-wall-lines, braced-wall-panels and method(s) clearly identified. Plans will not be approved otherwise.

When submitting plans for a building that utilizes a proprietary system or an engineered design, the related evaluation report, manufacturer's catalog and/or calculations must be attached to the plans. The drawings must also include comprehensive details outlining the construction requirements of the diaphragms and shear walls. These detail sheets must also bear the original signature and seal of the responsible professional engineer.