

Portal Frame Bracing Without Hold-Down Devices

FOR USE IN CONTINUOUSLY SHEATHED WALLS

Number J740

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BACKGROUND

Wall bracing is required by the International Residential Code (IRC) to resist wall racking due to wind or seismic forces. Historically, wall bracing segments had to be a minimum of 48 inches in width. With modern home designs maximizing windows and minimizing wall sections, finding 48 inches to count toward bracing can be a challenge. APA developed the portal frame for wall bracing to help provide a segment as narrow as 16 inches that can be counted toward the overall bracing amount required by the code. The portal frame design relies on additional nailing and a semi-rigid connection between the wall segment sheathing and header to improve performance in a narrow wall segment. For information on IRC wall bracing requirements, refer to APA's publication, *Introduction to Wall Bracing*, Form F430.

This portal frame without hold downs is also sometimes referred to as "6:1 aspect ratio segments used with continuous structural panel sheathing" and/or the "APA narrow wall bracing method." This portal frame design has been tested to show bracing performance comparable to existing code-permitted bracing for residential structures. APA and three other independent labs have conducted nearly 100 cyclic tests⁽¹⁾ showing that the 16-inch-wide portal frame design used in a continuously sheathed wood structural panel wall, with a 6:1 aspect ratio as measured at the vertical wall segment, performs comparably to wood structural panel wall bracing segments currently permitted in the IRC. The portal frame segment depicted in Figure 1 provides bracing performance that is comparable to other continuously sheathed wood structural panel bracing segments, on strength per foot of bracing basis.

This bracing method is recognized in the 2006 IRC Table R602.10.5 footnote c, where it is limited to installations next to garage doors only, with up to a story above, and only in Seismic Design Category A-C.

Significant expansion of the IRC provisions can be seen in the 2007 IRC Supplement where the bracing segment is listed in Section R602.10.4.6, and can be used anywhere in the dwelling (not just next to garage doors) and in any seismic design category.

The 2007 IRC Supplement also includes provisions for not only how this segment resists in-plane wall racking loads, but also how this segment resists out-of-plane wind loads (those acting perpendicular to the wall). This is a unique strength advantage over all other IRC bracing methods. Section R301.2.1 of the IRC requires that wall coverings and garage doors be able to resist the design wind pressures, and Section R601.2 of the IRC requires that wall construction be capable of accommodating all loads imposed. Garage doors, for example, collect a large area of wind pressure and impose large loads on the adjacent wall framing. For the portal frame to resist these loads perpendicular to the wall, provisions included in Table 1 and Figures 1–3 have been developed.

Current APA recommendations for using this bracing segment follow and closely reflect what is expected to appear in the 2009 IRC.⁽²⁾



APA RECOMMENDATIONS

Wall segments having a maximum 6:1 aspect ratio shall be permitted to be built in accordance with Figures 1–3 and Table 1. The maximum 6:1 aspect ratio is based on height being measured from the top of the header to the bottom of the wall segment bottom plate.

For purposes of calculating the percentage of bracing present in the braced wall line, i.e., per 2006 IRC Table R602.10.1, the width of the full height sheathing segment shall be equal to its measured width. For example, a portal frame without hold downs with a 16-inch-wide wall segment is counted as 16 inches of bracing.

If applicable, the bracing amount reduction factors (0.8 or 0.9 from 2006 IRC Section R602.105) for continuously sheathed braced walls next to given openings shall be applied when calculating the total amount of wall bracing required for the entire braced wall line.

FIGURE 1

WALLS WITH 6:1 ASPECT RATIO USED WITH CONTINUOUS WOOD STRUCTURAL PANEL SHEATHING

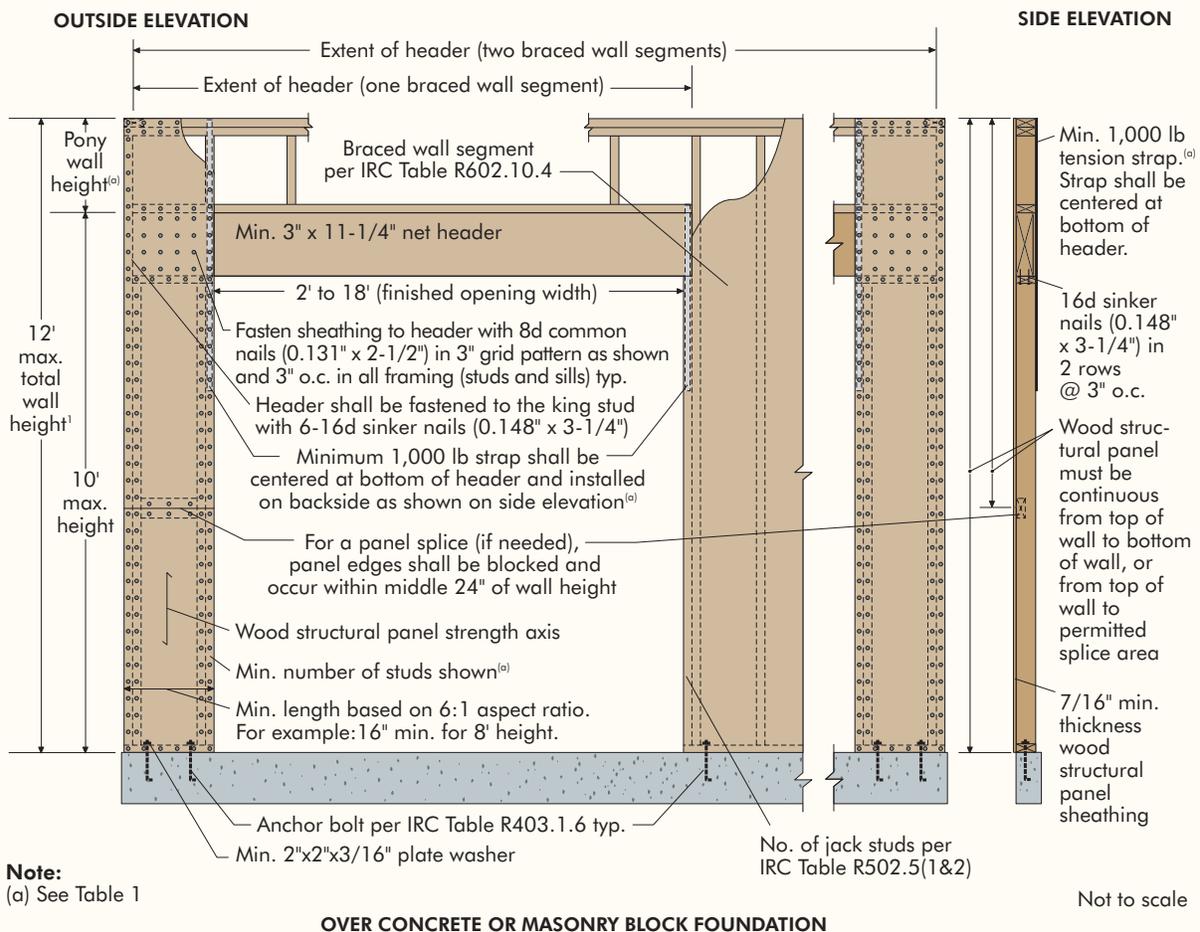


FIGURE 2

BRACING METHOD OVER RAISED WOOD FLOOR OR SECOND FLOOR – FRAMING ANCHOR OPTION^{(a)(b)}

Outside Elevation

Side Elevation

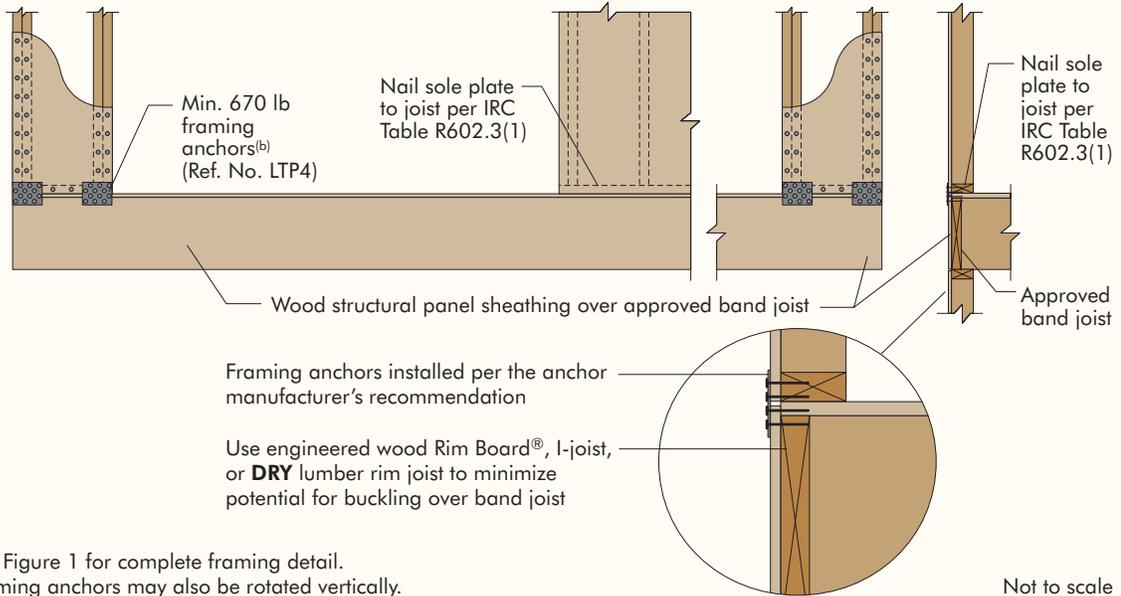


FIGURE 3

BRACING METHOD OVER RAISED WOOD FLOOR OR SECOND FLOOR – WOOD STRUCTURAL PANEL OVERLAP OPTION^(a)

Outside Elevation

Side Elevation

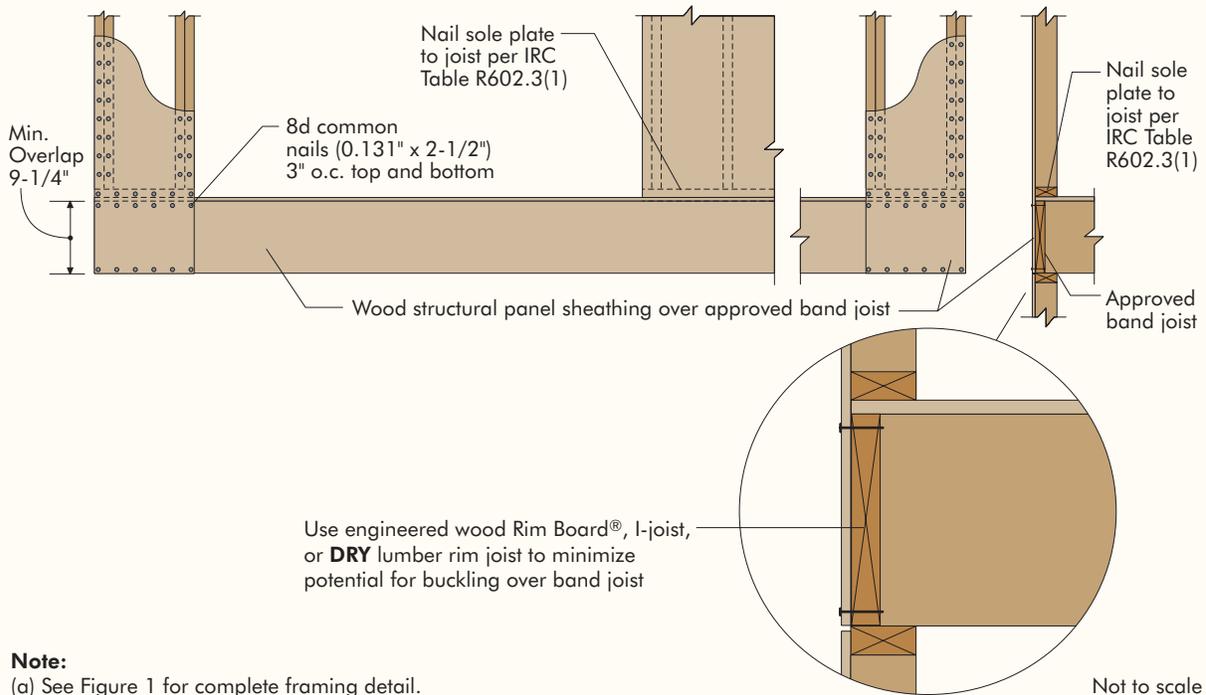


TABLE 1

TENSION STRAP CAPACITY REQUIRED FOR RESISTING WIND PRESSURES PERPENDICULAR TO 6:1 ASPECT RATIO WALLS^{(a)(b)}

Minimum Wall Stud Framing Size and Grade (Nominal)	Maximum Pony Wall Height (ft)	Maximum Total Wall Height (ft)	Maximum Opening Width (ft)	Basic Wind Speed (mph)								
				85			90			100		
				Exposure B			Exposure C					
				Tension strap capacity required (lbf) ^{(a)(b)}								
2x4 No. 2 Grade	0	10	18	1000	1000	1000	1000	1000	1000	1000		
			9	1000	1000	1000	1000	1000	1275			
	1	10	16	1000	1000	1750	1800	2325	3500			
			9	1000	1000	1025	1075	1550	2500			
	2	10	16	1525	2025	3125	3200	3900	NP			
			9	1000	1200	2075	2125	2750	4000			
		12	16	2600	3200	NP	NP	NP	NP			
			9	1775	2350	3500	3550	NP	NP			
4	12	16	4175	NP	NP	NP	NP	NP				
		9	1000	1000	1325	1375	1750	2550				
	2	12	16	1650	2050	2925	3000	3550	NP			
			9	1125	1500	2225	2275	2775	3800			
4	12	16	2650	3150	NP	NP	NP	NP				

(a) NP = not permitted

(b) Strap shall be installed in accordance with manufacturer's recommendations.

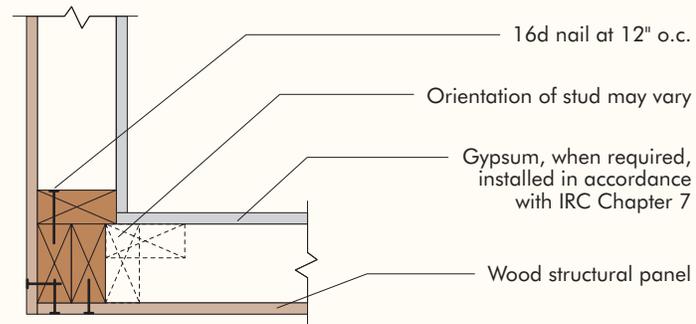
Corners at ends of continuously sheathed braced walls shall be constructed in accordance with 2006 IRC Figure R602.10.5, shown in Figure 4 in this document.

The total number of braced wall segments having a maximum 6:1 aspect ratio in any individual braced wall line shall not exceed four.

For purposes of resisting wind pressures acting perpendicular to the wall, as described above, the requirements of Figures 1, 2 or 3, and Table 1 shall be met. There shall be a maximum of two braced wall segments per header and header length shall not exceed 22 feet. Tension straps shall be installed in accordance with the manufacturer's recommendations.

FIGURE 4

**EXAMPLE OF REQUIRED OUTSIDE CORNER DETAIL
(IRC FIGURE R602.10.5)**



At corners, connect the two walls together as outlined in this detail to provide overturning restraint.

For sizing the header to resist gravity loads (snow, live, or dead), the following resources are available:

- 2006 IRC Section R502.5
- The Wood Frame Construction Manual (WFCM) Tables 3.22A-3.22E
- APA publication, *Glulam Garage Door Headers Offer Design Options*, Form C410.
- APA publication, *Glued Laminated Beam Design Tables*, Form S475.

The minimum header size of 3" x 11-1/4" is required for in-plane lateral load resistance. A deeper, thicker header may be required for gravity load resistance depending on building geometry, framing layout, and number of stories above. Like all header sizing, the proper size shall be determined by the design professional responsible for the particular project.

PORTAL FRAME WITH HOLD DOWNS

Additional information is also available on the portal frame with hold downs for use as a wall bracing segment in APA Technical Topic, *A Portal Frame With Hold Downs for Wall Bracing or Engineered Applications*, Form TT-100. The portal frame bracing segment with hold downs is described in 2006 IRC Section R602.10.6.2 and has limitations for stories constructed above the portal frame. It also has additional foundation size and reinforcement requirements, but the 16-inch wall length of a portal frame with hold downs counts as 48 inches of bracing.

- (1) *Cyclic Response of Narrow Wall Bracing for Seismic Design*, <http://www.apawood.org/docs/NarrowWallBracingAndSeismicDesign.pdf>
- (2) International Code Council 2007/2008 code development cycle result of the public hearings in Palm Beach, CA, February 2008.

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7011 So. 19th St. ■ Tacoma, Washington 98466 ■ (253) 565-6600 ■ Fax: (253) 565-7265

www.apawood.org



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(253) 620-7400 ■ E-mail Address: help@apawood.org

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