

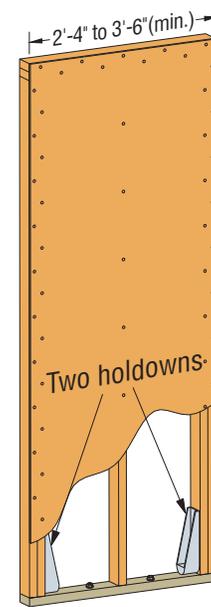
Connector Solutions to Meet the Wall Bracing Requirements of the International Residential Code®



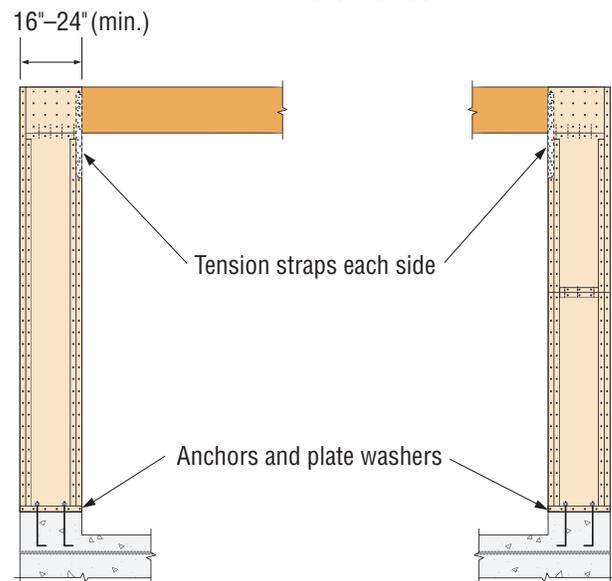
The International Residential Code (IRC) defines several different construction methods that may be used to build a braced wall panel. The methods include twelve intermittent bracing methods (occurring at isolated locations within a braced wall line) and four continuous sheathing bracing methods (requiring sheathing over the full wall surface of a braced wall line).

The required minimum length of an intermittent braced wall panel generally ranges from 4' to 8' of wall with no openings. In areas where window or door openings do not provide enough space to put a standard panel, the IRC allows for alternate braced wall panels and portal-frame applications to be site-built to fit a narrower wall space in some applications. To use these narrow alternatives, specific requirements for holdowns, mudsill anchors, header attachments, and minimum sheathing thickness and fastening must be followed. There are also narrow alternatives when using the continuous sheathing bracing methods, including a continuously sheathed portal frame that can have a panel length as narrow as 16" in some cases.

This technical bulletin is for use with the 2012, 2015 or 2018 International Residential Code (IRC). It provides information about the Simpson Strong-Tie products that meet the connector and anchorage requirements for braced wall panels constructed in accordance with IRC Section R602.10.4. Details for narrow intermittent and continuous sheathing methods are provided to highlight specific requirements for connectors and anchors. The designer is responsible for complying with the IRC wall bracing requirements as well as the local building code.



Alternate Braced Wall (ABW) Panel Method



Continuously Sheathed Portal Frame (CS-PF)

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Connector Solutions to Meet the Wall Bracing Requirements of the International Residential Code®

Simpson Strong-Tie® Connector and Anchorage Products for Wall Bracing

This section provides information about products that meet the IRC connector and anchorage requirements for braced wall panels. Refer to the current *Wood Construction Connectors* catalog for additional options and installation requirements.

Holdowns

Holdowns are used to tie down braced wall panels and prevent overturning. Holdowns are only required in the construction of braced wall panel methods ABW (Alternate Braced wall Panel), PFH (Portal Frame with Holdowns) and BV-WSP (wood structural panels with stone or masonry veneer in Seismic Design Category (SDC) D₀, D₁ and D₂). Holdowns may also be used with other bracing methods to reduce the amount of required bracing length, eliminate the requirement for a corner return or eliminate the need to have a panel located at the corner.

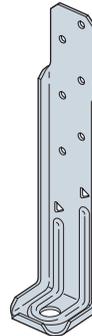
The holddown options listed in Table 1 are designed to be installed after the concrete has been placed and require attachment to anchor bolts (cast-in-place or post-installed)

with diameters as noted in the table. These holdowns may also be used to anchor the ends of braced wall panels on upper stories to the floor or wall framing below. The designer must specify the anchor bolt type, length and embedment (for attachment to foundations) to be used in conjunction with these holdowns. Refer to the details in Figures 1 and 2 on p. 3 for complete holddown solutions that meet the IRC provisions for a minimum 800 lb. holddown. Where higher capacity holdowns are required (i.e., IRC Table R602.10.6.1 Minimum Hold-Down Forces for Method ABW Braced Wall Panels), refer to the Post-to-Foundation Designer web application at strongtie.com/software for an online tool that helps design holddown and anchorage solutions for a given uplift load.

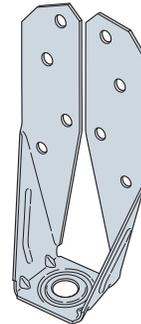
Table 1 — Holdowns That Attach to Anchor Bolts

Holdown	Anchor Bolt Diameter (in.)	Min. Wood Member Thickness (in.)	Allowable Tension (lb.) (160)	
			DF/SP	SPF/HF
DTT1Z	5/8	1 1/2	840	840
LTT19	1/2, 5/8 or 3/4	1 1/2	1,310	1,125
DTT2Z	1/2	1 1/2	1,825	1,800
DTT2Z-SDS2.5	1/2	3	2,145	2,105
HDU2-SDS2.5	5/8	3	3,075	2,215
HTT4	5/8	3	3,610	3,105
HTT5	5/8	3	4,350	3,740
HDU4-SDS2.5	5/8	3	4,565	3,285
HDU5-SDS2.5	5/8	3	5,645	

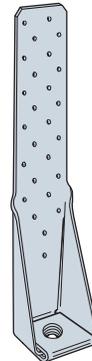
1. Allowable loads have been increased for wind or earthquake load durations with no further increase allowed.
2. Refer to the current *Wood Construction Connectors* catalog for holddown fasteners.
3. Designer must specify anchor bolt type, length and embedment.
4. Post may consist of multiple members provided they are connected independently of the holddown fasteners.



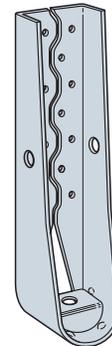
DTT1Z
US Patent Pending



DTT2Z
US Patent 8,555,580

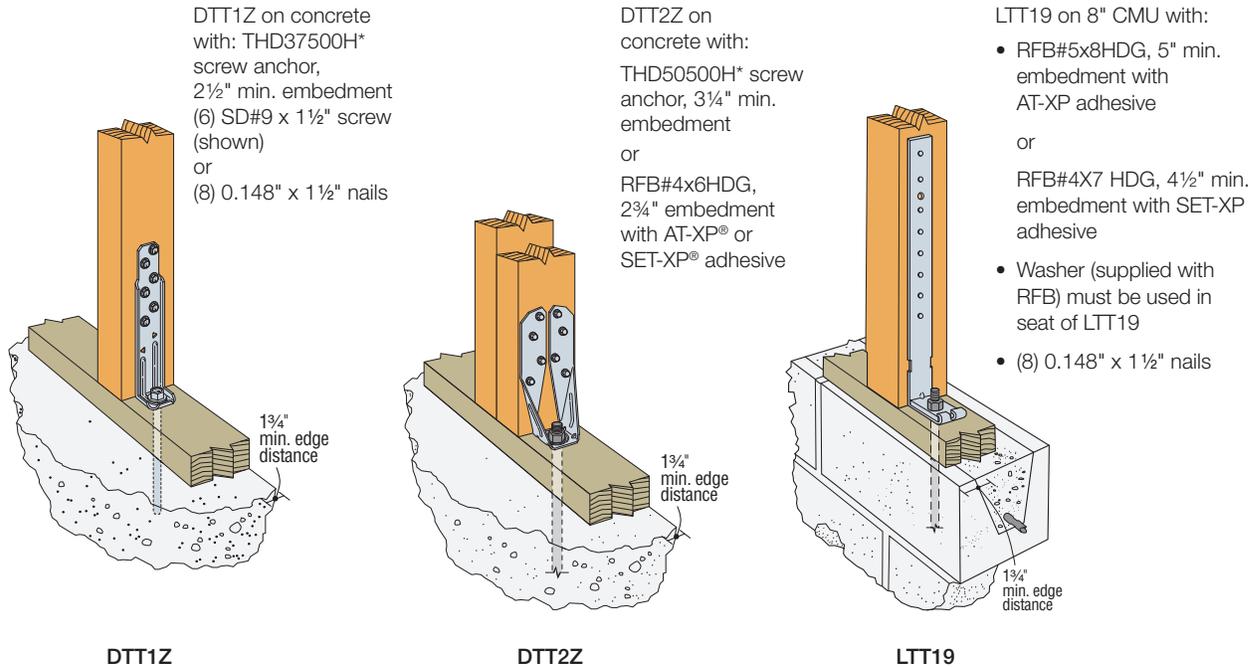


HTT4



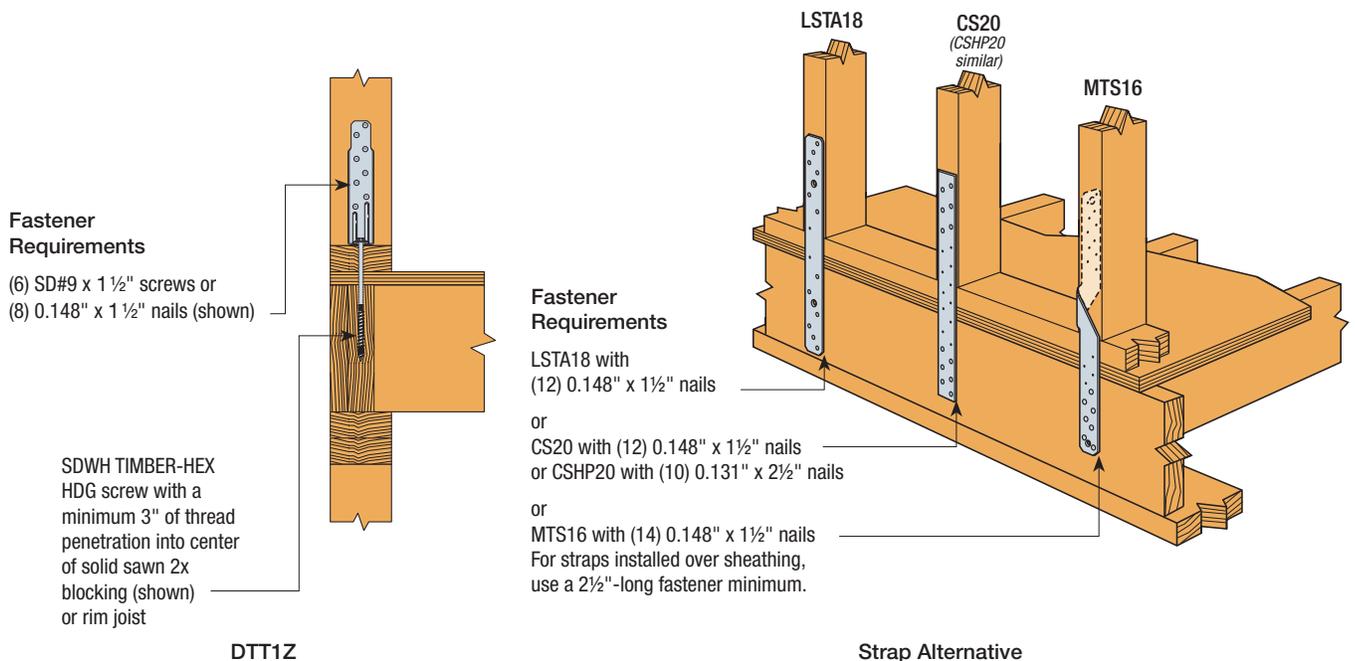
HDU5

Figure 1: Braced Wall Panel-to-Foundation Holddown Solutions for 800 lb. Capacity Holddown Requirement



*Note: Mechanically galvanized anchors may be required by code when used with preservative-treated wood. If required, add MG to Titen HD® model number (e.g., THD37500HMG).

Figure 2: Braced Wall Panel-to-Floor Framing Holddown Solutions for 800 lb. Capacity Holddown Requirement



Additional connectors not shown for clarity.



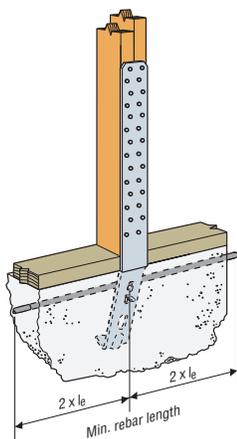
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The holddown options in Table 2 are embedded strap-type holddowns that are installed at the time of concrete placement and do not require anchor bolts. This type of holddown is specifically required in the construction of the Method PFH.

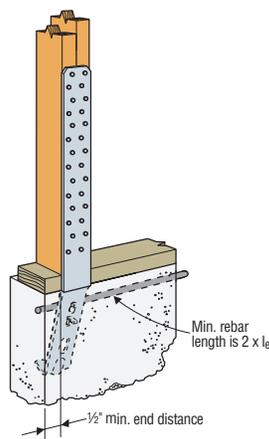
Table 2 — Embedded Strap-Type Holddowns

Holddown	Min. Wood Member Thickness (in.)	Allowable Tension (lb.) (DF/SP/SPF/HF)			
		Wind and SDC A&B		SDC C-F	
		Midwall/Corner	Endwall	Midwall/Corner	Endwall
LSTHD8/ LSTHD8RJ	3½	2,590	2,135	1,950	1,610
STHD10/ STHD10RJ	3½	4,075	3,015	2,940	2,175
STHD14/ STHD14RJ	3½	5,285	4,410	3,815	3,500

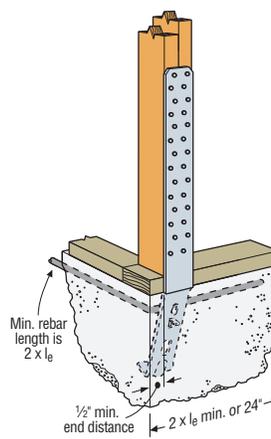
1. Allowable loads have been increased for wind or earthquake load durations with no further increase allowed.
2. Post may consist of multiple members provided they are connected independently of the holddown fasteners.
3. Tension values apply to minimum concrete strength, f'c of 2,500 psi, and minimum stemwall width of 8". For values with minimum stemwall width of 6", refer to the current *Wood Construction Connectors* catalog.
4. Tension values for wind and SDC A&B apply to uncracked concrete; tension values for SDC C-F apply to cracked concrete. For allowable load information for other applications, refer to the current *Wood Construction Connectors* catalog.
5. Refer to the current *Wood Construction Connectors* catalog for installation requirements.



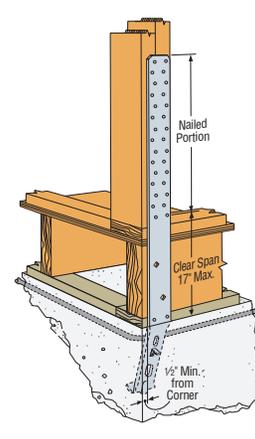
Typical STHD10 Midwall Installation



Typical STHD10 Endwall Installation



Typical STHD10 Corner Installation



Typical STHD14RJ Rim Joist Application

Tension Straps for Portal Frames

Tension straps, such as shown in Table 3, are required at the top of the portal frame bracing methods — PFH (Portal Frame with Holdowns), PFG (Portal Frame at Garage Door Openings) and CS-PF (Continuously Sheathed Portal Frame) — to tie the header to the stud on both sides of the opening and resist wind pressures acting perpendicular to the frames. The straps are also used to attach pony walls located directly above the portal frames to the portals. The amount of required tension strap capacity depends on the wall stud size, the wall and pony wall height, the width of the adjacent opening and the wind speed (see Table 6).

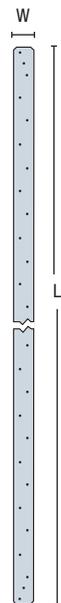
Table 3 — Tension Straps

Strap	Fasteners (Total)	Dimensions (in.)		Allowable Tension (lb.) (DF/SP/SPF/HF)
		W	L	
LSTA21	(16) 0.148" x 2½"	1¼	21	1,235
LSTA30	(22) 0.148" x 2½"	1¼	30	1,640
MSTA30	(22) 0.148" x 2½"	1¼	30	1,825
CS20	(14) 0.148" x 2½"	1¼	18	1,030
CSHP20	(12) 0.148" x 2½"	1¾	16	1,160
CSHP18	(16) 0.148" x 2½"	1¾	20	1,540
CS14	(26) 0.148" x 2½"	1¼	31	2,160

1. Allowable loads have been increased for wind or earthquake load durations with no further increase allowed.
2. The allowable tension may be doubled when a double jack is installed and two straps are installed (one per stud).
3. Use half the nails in each member being connected to achieve the listed loads, which assume no clear span between the members being connected. LSTA/MSTA straps require all of the nail holes to be filled. For CS/CSHP installations with clear spans, either use a longer strap to achieve the specified nailing or reduce the allowable load for a reduced number of nails as follows:

$$\text{Allowable Load} = \frac{\text{No. of Nails Used}}{\text{No. of Nails in Table}} \times \text{Table Load}$$

4. 0.148" x 1½" nails may be substituted for 0.148" x 2½" nails at 100% of the table loads, except where installed over sheathing.
5. Nail dimensions are listed diameter by length.



LSTA and MST A (pilot holes not shown)



Sill Plate Anchors

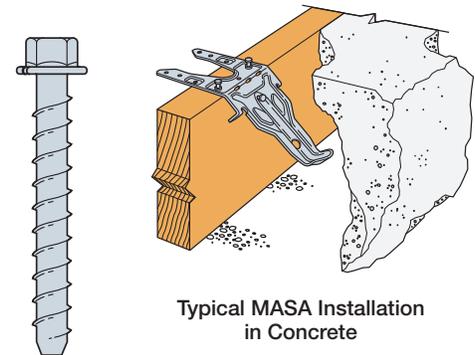
All wood sill plates, including braced wall line sills, are required to be anchored to the foundation to transfer shear loads between the wall framing and the foundation and prevent the building from sliding off of its foundation. The anchors in Table 4 provide alternatives to the code-specified

cast-in-place anchor bolts. The MASA/MASAP anchors offer a cast-in-place alternative to anchor bolts, and the Titen HD® screw anchors provide a post-installed anchorage option that may be used as a direct replacement for cast-in-place bolts.

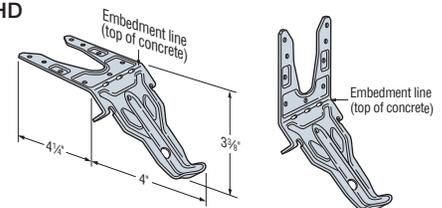
Table 4 — Sill Plate Anchors

Anchor Type	Model Number	Size (in.)	Sill Plate Size	Anchor Bolt Size to Replace ⁶
Post-Installed ¹	Titen HD ² THD50600H	½ x 6	Single 2x	½" diameter
	Titen HD ² THD50800H	½ x 8	Single 3x or Double 2x	½" diameter
	Titen HD ² THDB62800H	⅝ x 8	Single or Double 2x or 3x	⅝" diameter
Cast-in-Place	MASA/MASAP ⁴	—	Single 2x or 3x	½" diameter

1. Provide plate washers beneath the anchor head when required by code.
2. Mechanically galvanized anchors may be required by code when used with treated wood. Add "MG" to model number for mechanically galvanized Titen HD option. For additional information, visit strongtie.com.
3. Minimum concrete edge distance for the Titen HD is 1 ¾". Minimum concrete end distance is 6" for the Titen HD and 4" for the MASA/MASAP.
4. ZMAX® (galvanized G185) coating may be required by code when used with treated wood. Add "Z" to model number for ZMAX option (e.g., MASAZ).
5. Minimum concrete strength, f'c = 2,500 psi.
6. The anchors in this table may be used as a direct 1:1 replacement for the cast-in-place anchor bolt sizes shown. For additional code-compliant sill plate anchorage solutions and details, see technical bulletin T-A-SILPLANCH at strongtie.com.



Titen HD



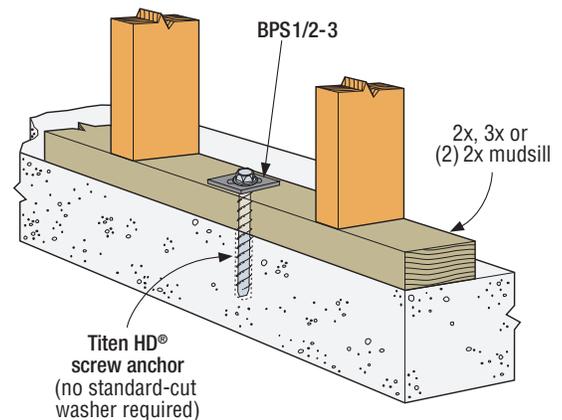
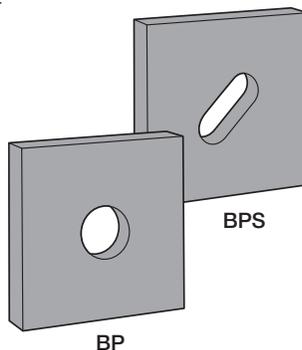
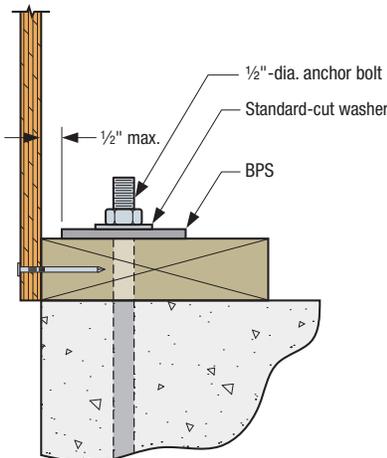
MASA
US Patents 8,484,917 and D656391S

MASAP
US Patents 8,484,917 and D656391S

Plate Washers

Braced wall panel methods PFH, PFG and CS-PF, and all panels in high seismic zones, require plate washers in addition to anchor bolts to provide a greater bearing surface and help distribute the load at these critical connections. BP1/2-3 and BP5/8-3 are 3"x3" bearing plates for ½" and ⅝"-diameter anchor bolts, respectively, that meet the requirements in IRC R602.11.1. BPS1/2-3 and BPS5/8-3

also meet these requirements and offer increased flexibility by having slotted holes that allow for adjustability to account for bolts that are not in the middle of the sill plate. A standard-cut washer is required between the slotted BPS bearing plate and anchor bolt nut. The additional cut washer is not required when the BPS bearing plates are used with the Titen HD screw anchors.





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Intermittent Bracing Methods Requiring Connectors and Anchors

Three of the twelve intermittent bracing methods outlined in R602.10.4 provide narrow bracing alternatives that require connectors and anchors. Details for these three narrow braced panel alternatives are shown in this section, and the connector and anchor requirements for each of these methods appear in **bold**.

Another intermittent bracing method that requires holdowns is BV-WSP, wood structural panels with stone or masonry veneer, but this is limited to SDC D₀, D₁ and D₂ and only applies when the veneer extends past the top plates of the first floor. The detail and corresponding holddown requirements for the BV-WSP method are not addressed in this document; refer to Section R602.10.6.5 for those requirements.

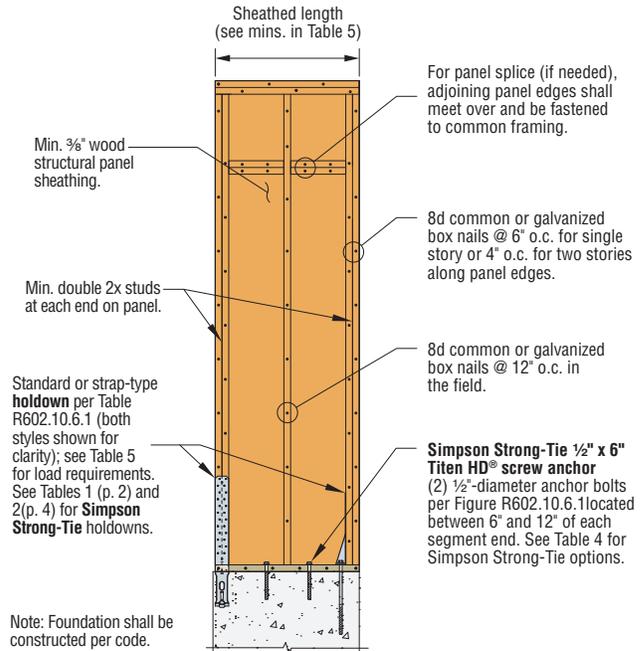
Method ABW: Alternate Braced Wall (R602.10.6.1)

This narrow alternative may be used when there is not enough space to fit a 4' braced wall panel. It requires a holddown at each end with a capacity per Table R602.10.6.1 (see Table 5 below).

Table 5 — Holddown Forces for Alternate Braced Wall Panels (lb.) (Based on IRC Table R602.10.6.1)

Alternate Braced Wall Panel Location	Height of Braced Wall Panel ¹				
	8'	9'	10'	11'	12'
	Minimum Sheathed Length				
	2'-4"	2'-8"	2'-10"	3'-2"	3'-6"
One Story	1,800	1,800	1,800	2,000	2,200
First Story of Two Story	3,000	3,000	3,000	3,300	3,600

- Alternate braced wall panels in Seismic Design Categories D₀, D₁ and D₂ are limited to a maximum height of 10'.
- The minimum length for alternate braced wall panels up to 9' in height in Seismic Design Categories D₀, D₁ and D₂ is 2'-8".



Method ABW: Alternate Braced Wall Panels

Table 6 — Tension Strap Capacity Required for Resisting Wind Pressures Perpendicular to Methods PFH, PFG and CS-PF Braced Wall Panels (Based on IRC Table R602.10.6.4)

Min. Wall Stud Framing Nominal Size and Grade	Max. Pony Wall Height (ft.)	Max. Total Wall Height (ft.)	Max. Opening Width (ft.)	Tension Strap Capacity Required (lb.)					
				Exposure B			Exposure C		
				Ult. Design Wind Speed V _{ult} (mph)			Ult. Design Wind Speed V _{ult} (mph)		
				110	115	130	110	115	130
2x4 No. 2 Grade	0	10	18	1,000	1,000	1,000	1,000	1,000	1,050
			9	1,000	1,000	1,000	1,000	1,000	1,750
	1	10	16	1,000	1,025	2,050	2,075	2,500	3,950
			18	1,000	1,275	2,375	2,400	2,850	DR
	2	10	9	1,000	1,000	1,475	1,500	1,875	3,125
			16	1,775	2,175	3,525	3,550	4,125	DR
			18	2,075	2,500	3,950	3,975	DR	DR
	2	12	9	1,150	1,500	2,650	2,675	3,175	DR
			16	2,875	3,375	DR	DR	DR	DR
	18	12	9	3,425	3,975	DR	DR	DR	DR
			12	2,275	2,750	DR	DR	DR	DR
	4	12	9	3,225	3,775	DR	DR	DR	DR
12			3,225	3,775	DR	DR	DR	DR	

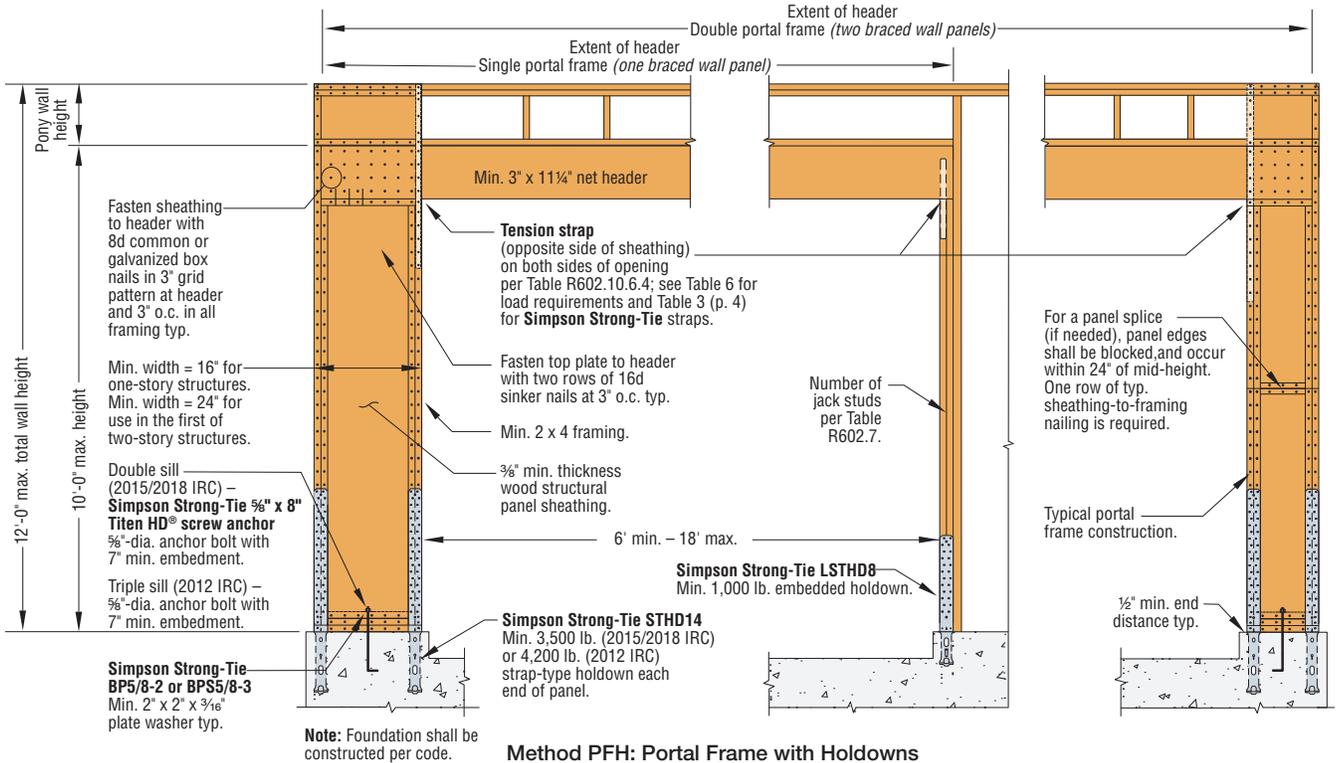
- See pp. 7–8 for details of Methods PFH, PFG and CS-PF, which require straps with capacities as noted in this table. Select a strap from Table 3 based on these requirements.
- DR = Design Required.

Connector Solutions to Meet the Wall Bracing Requirements of the International Residential Code®



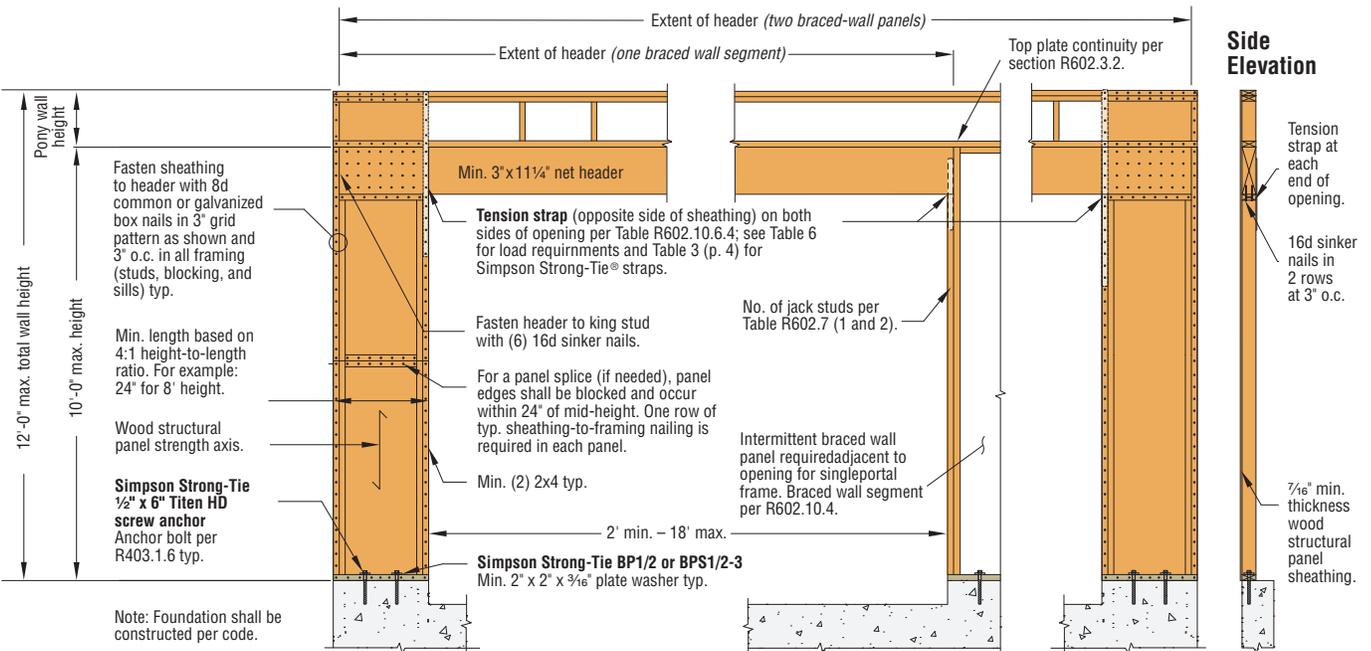
Method PFH: Portal Frame with Holdowns (R602.10.6.2)

This narrow alternative may be used adjacent to door or window openings and requires tension straps on each side, plus three holdowns for a single portal frame application or four holdowns for a double portal frame.



Method PFG: Portal Frame at Garage Door Openings in Seismic Design Categories A, B and C (R602.10.6.3)

This narrow alternative is similar to the PFH, but it is restricted to SDC A, B and C and may only be used where supporting a roof or one story and a roof. Unlike the PFH, this method does not require holdowns.



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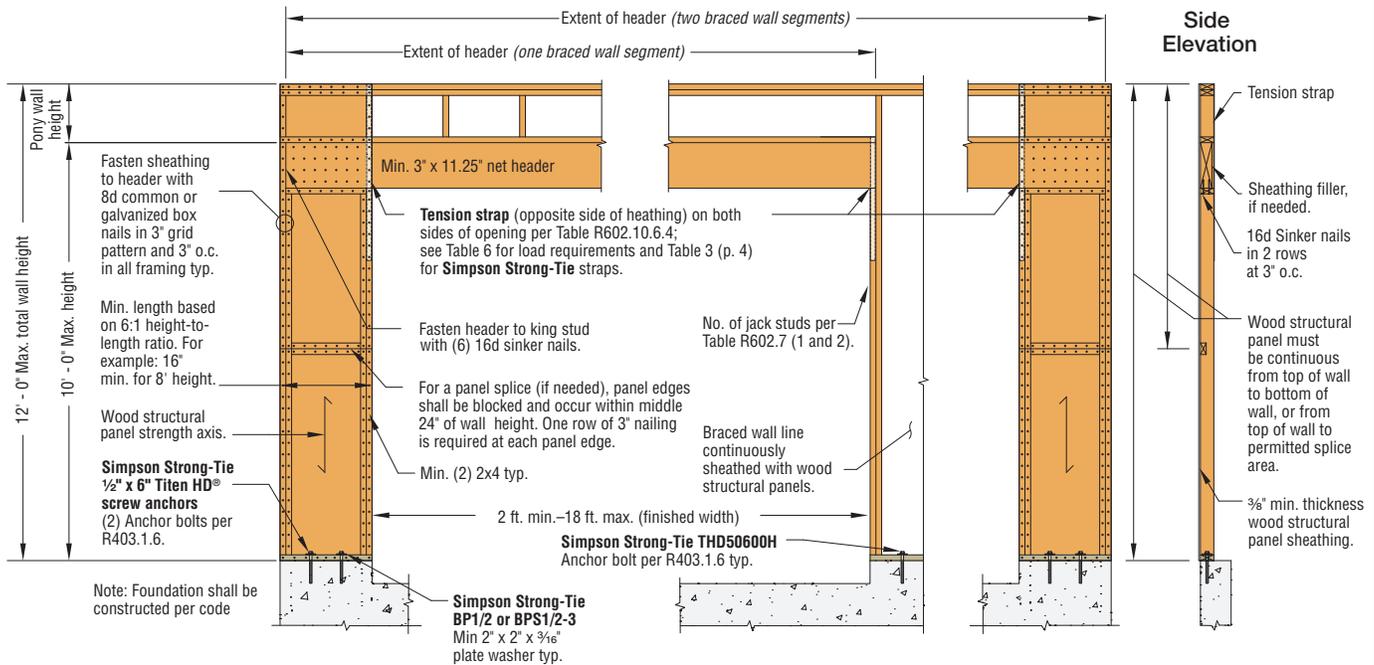
Continuous Sheathing Bracing Methods Requiring Connectors and Anchors

Like the intermittent portal frame methods, the continuously sheathed portal frame (CS-PF) method has specific construction requirements that include connectors and anchors (see detail below). Although the other continuously sheathed methods in R602.10.4 don't require connectors as part of their construction requirements, holdowns may be required at the ends of continuously sheathed braced wall lines per section R602.10.7 (see p. 11).

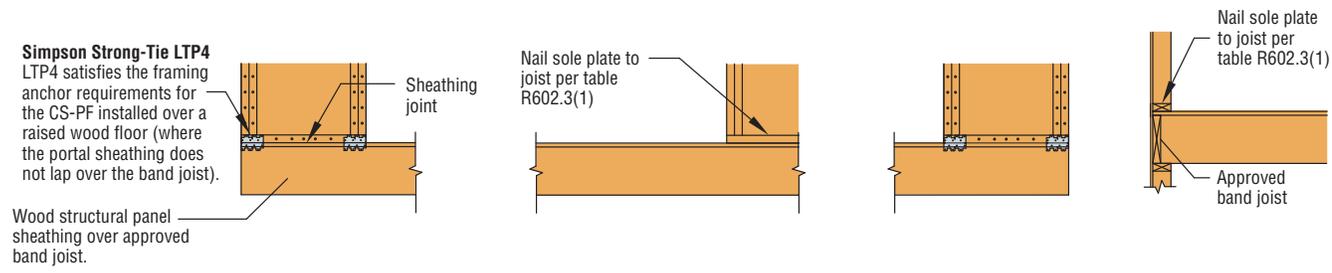
Method CS-PF: Continuously Sheathed Portal Frame (R602.10.6.4)

The CS-PF portal frame does not require holdowns, and it may be used on a raised wood floor or upper floor using alternative attachment details (see the Framing Anchor Option). Like the intermittent portal frame methods, the CS-PF requires tension straps on each side of the opening.

Over Concrete or Masonry Block Foundation



Over Raised Wood Floor or Second Floor – Framing Anchor Option



Method CS-PF: Continuously Sheathed Portal Frame



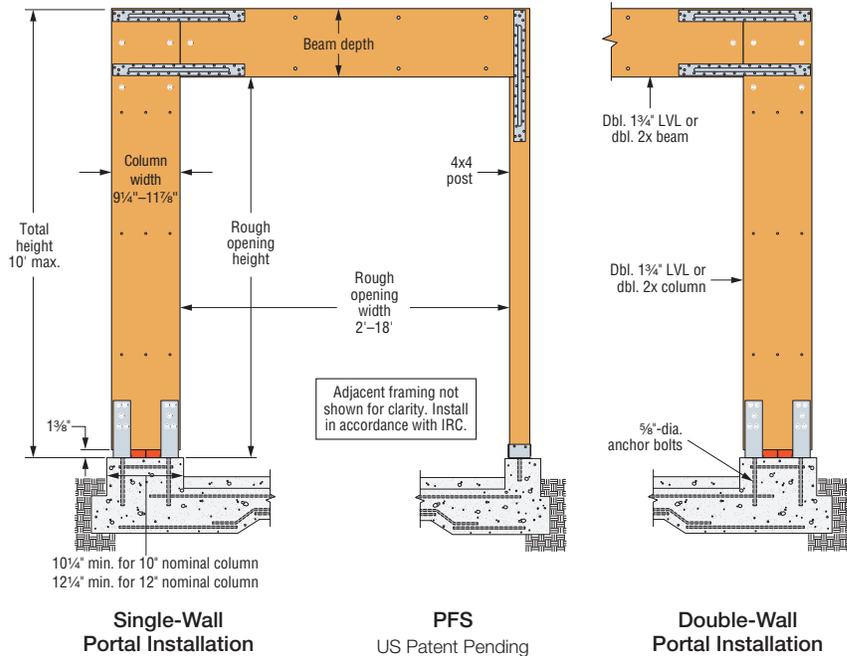
Simpson Strong-Tie Narrower Bracing Alternatives

Simpson Strong-Tie offers even narrower alternatives to code-prescribed braced wall panels. These pre-engineered and tested alternatives maximize equivalent braced wall lengths in narrow spaces and provide solutions for areas where the code-prescribed Wall Bracing methods cannot be utilized. Our free Strong-Wall Bracing Selector (SWBS) program can be used to help select the best Strong-Wall narrow alternative for your specific requirements. Visit strongtie.com/wallbracing to try this design tool.

Strong-Wall® Site-built Portal Frame System (PFS)

Simple and quick to install, The Strong-Wall Site-built Portal Frame System (PFS) provides an easy and economical way to meet code-required wall bracing requirements with narrow wall widths. With a width as narrow as 9 1/4", it is especially well suited for garage portals but can also be used in standard wall framing to create a portal around picture windows or sliding glass doors.

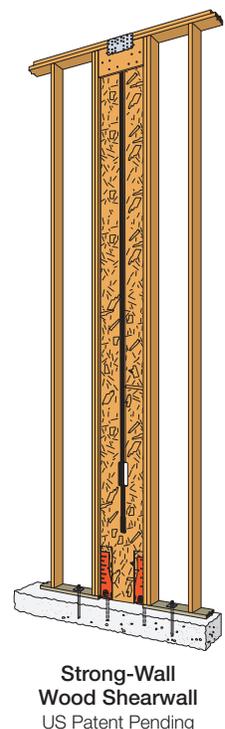
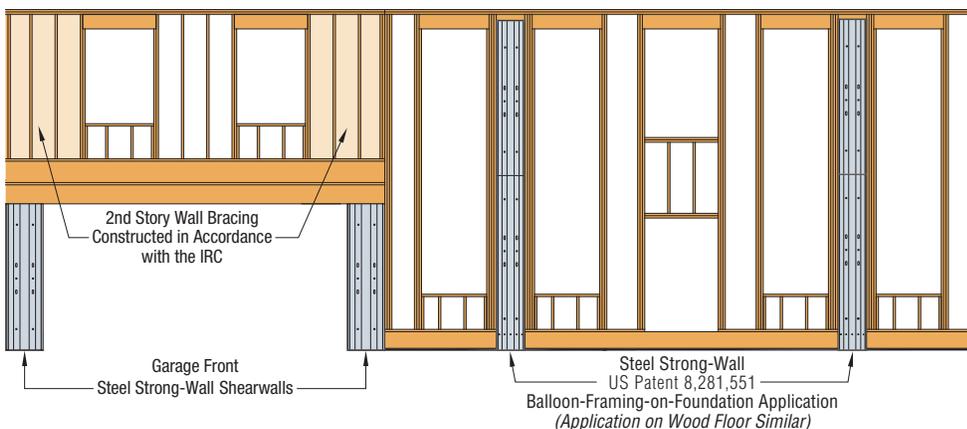
All of the necessary hardware for assembling the PFS is supplied in a convenient kit. Visit strongtie.com/PFS for more information and use the Strong-Wall Bracing Selector to find the best PFS configuration for your specific requirements.



Strong-Wall Shearwalls: Steel Strong-Wall (SSW) and Strong-Wall Wood Shearwall (WSW)

In areas where code-defined bracing methods are not adequate, a code-listed shearwall product such as a Simpson Strong-Tie Strong-Wall shearwall (wood or steel) can provide a solution that meets the intent of the code while avoiding the need for an engineered solution.

Available in widths down to 12", Strong-Wall shearwalls provide the maximum equivalent braced wall length in narrow spaces. They can also provide equivalent Wall Bracing lengths for balloon-frame applications up to 20' tall. Visit strongtie.com/wallbracing for more information.





Connector Solutions to Meet the Wall Bracing Requirements of the International Residential Code®

Use of Holdowns to Reduce Wall Bracing Requirements

The following wall bracing code provisions offer advantages when holdowns are used, such as reducing the required length of bracing, eliminating the requirement for a corner return or eliminating the need to have a panel located at the corner.

Adjustments to Required Length of Wind Bracing (Table R602.10.3(2))

Table R602.10.3(2) specifies adjustment factors to be applied to the required length of wind wall bracing. Per Item 5 in this table, the amount of required wind-bracing length of several bracing methods may be multiplied by 0.80 when a minimum 800 lb. holdown is attached to both end studs of each braced wall panel and to the foundation or framing below. Note that this reduction is limited to braced wall panels that are only supporting a roof above. Refer to the details in Figures 1 and 2 for complete holdown solutions that meet this minimum 800 lb. requirement.

Item Number	Adjustment Based On	Story/Supporting	Condition	Adjustment Factor [multiply length from Table R602.10.3 (1) by this factor]	Applicable Methods
5	Additional 800 lb. holdown 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

Example: One-story house, 2 braced wall lines 60' apart

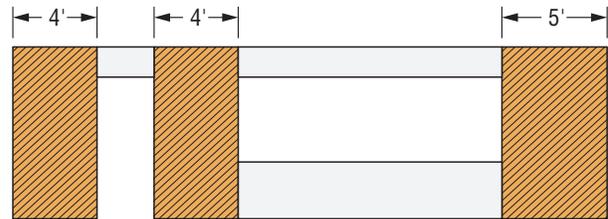
- Ultimate Design Wind Speed: 115 mph
- Wind Exposure Category: B
- 10' Roof eave-to-ridge height
- 10' Wall height

Option 1: Method WSP without Holdowns

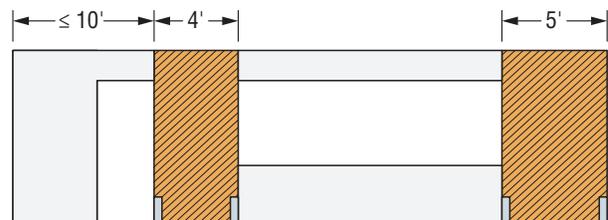
Length of wall bracing required = 10.5'

Option 2: Method WSP with 800 lb. Holdowns at each end of each braced wall panel

Length of wall bracing required = $0.80 \times 10.5' = 8.4'$

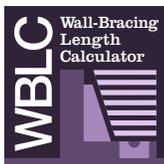


Method WSP without Holdowns



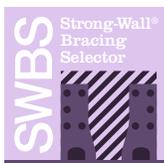
Method WSP with Holdowns

Simpson Strong-Tie Web Apps to Simplify Wall Bracing



Wall-Bracing Length Calculator

Calculate the required length of wall bracing to resist prescriptive lateral loads in accordance with the International Residential Code®.



Strong-Wall® Bracing Selector

Identify prescriptive and pre-engineered solutions to site-built shearwalls, allowing designers to quickly select space-efficient panels.



Post-to-Foundation Designer

Choose the most cost-effective holdown based on type of installation, demand load and post wood. For post-installed holdowns, quickly determine the required embedment depth based on the Simpson Strong-Tie anchoring solution.

Visit strongtie.com/software to see these and many more specification tools.

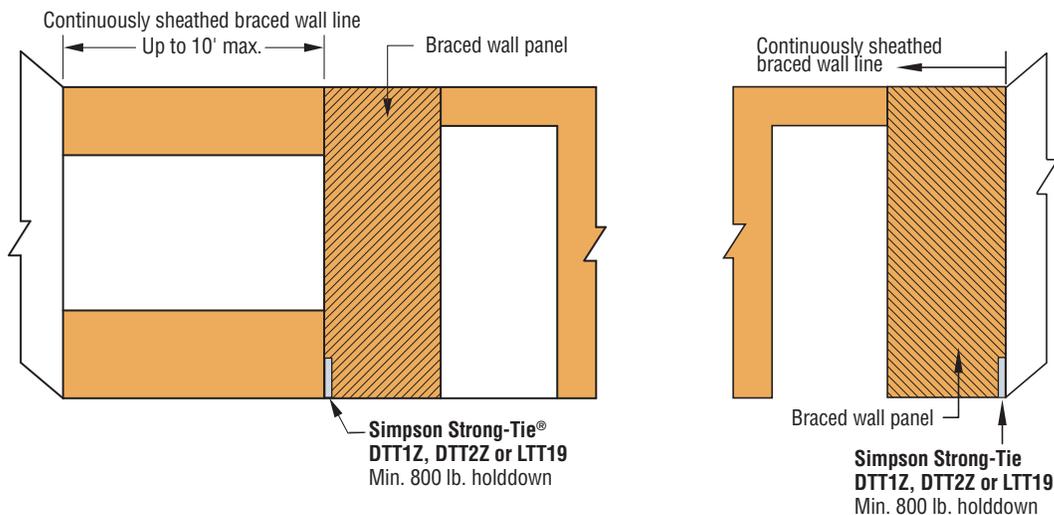
Connector Solutions to Meet the Wall Bracing Requirements of the International Residential Code®

End Conditions for Braced Wall Lines with Continuous Sheathing (R602.10.7)

Per Section R602.10.7, each end of a continuously sheathed braced wall line must have one of the following conditions:

- a min. 48" braced wall panel located at the end of the braced wall line; or
- a braced wall panel located at the end of the braced wall line and a return panel at the corner; or
- a 24" full-height panel segment (or 32" for structural fiberboard) located at the end of the braced wall line and a return panel at the corner; or
- a braced wall panel located at the end of the braced wall line with a min. **800 lb. holdown**; or
- a braced wall panel located within 10' of the corner with a min. **800 lb. holdown**

Therefore, the addition of a 800 lb. holdown to a continuously sheathed braced wall line in accordance with R602.10.7 can reduce the required length of braced wall panel at the end of the braced wall line, eliminate the need for a corner return, and allow for the first braced panel to be located up to 10' away from the corner. Refer to the details in Figures 1 and 2 on p. 3 for complete holdown solutions that meet this minimum 800 lb. requirement.

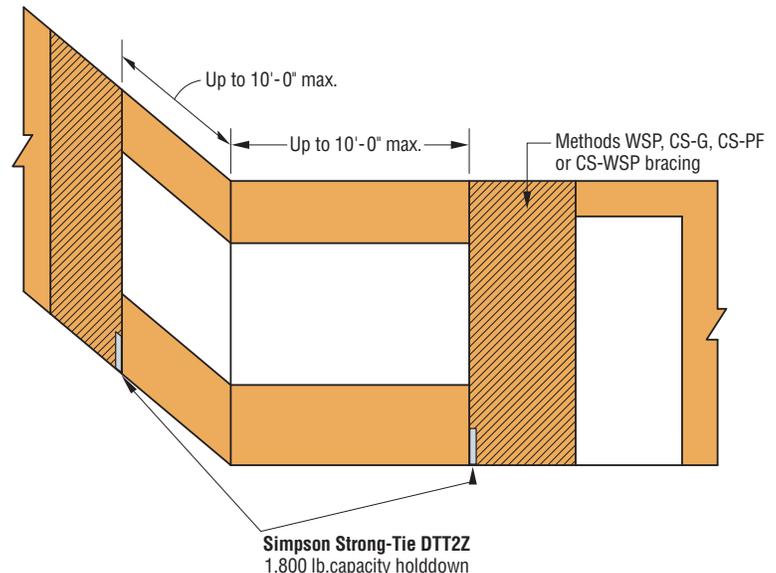


End Conditions for Braced Wall Lines in Seismic Design Categories D0, D1 and D2 (R602.10.2.2.1)

Per R602.10.2.2.1, braced wall panels in SDC D₀, D₁ and D₂ must be located at each end of a braced wall line with the following exceptions. WSP and continuous sheathing methods are permitted to be located up to 10' from the corner, provided one of the following two provisions are met:

- a min. 24" panel for methods WSP, CS-WSP, CS-G and CS-PF is applied to each side of the corner; or
- the end of each braced wall panel closest to the end of the braced wall line has an **1,800 lb. holdown**

Refer to Tables 1 and 2 for holdown options to meet the 1,800 lb. holdown requirement that permits method WSP and continuous sheathing panels to be located up to 10' away from the corner in SDC D₀, D₁ and D₂.





Connector Solutions to Meet the Wall Bracing Requirements of the International Residential Code®

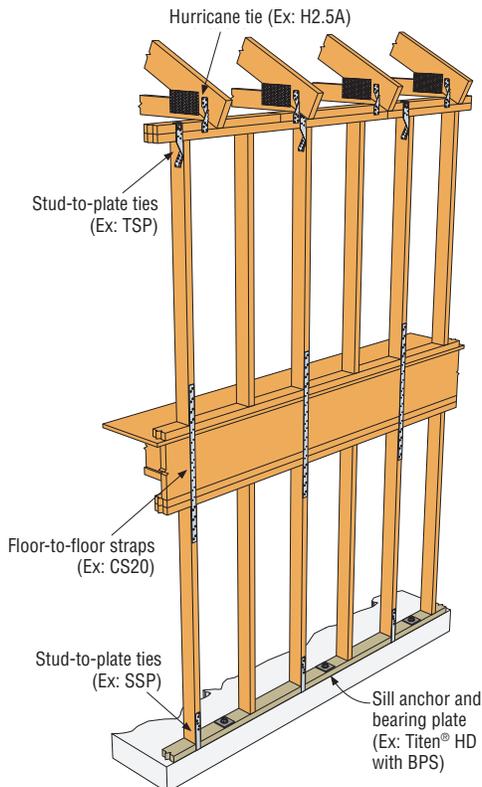
General Uplift and Anchorage Connector Requirements for All Braced Wall Panels

Uplift Connections

Section R602.10.2.1 requires that braced wall panel uplift loads be resisted in accordance with Section 602.3(5). Section R602.3.5 specifies the connection requirements for the framing members in braced wall panels that support roof rafters or trusses. When the uplift loads in the wall exceed the capacity of the standard nailed connections given in the general wood wall framing fastening schedule (Table R602.3(1)), uplift connectors are required. Per Section R602.3.5:

- Where the net uplift at the top of the wall exceeds 100 plf, uplift framing connectors shall be installed to provide a continuous load path from the top of the wall to the foundation or to a point where the uplift force is 100 plf or less.

Refer to the current Simpson Strong-Tie® *Wood Construction Connectors* catalog and *Fastening Systems Technical Guide* for uplift connectors and Strong-Drive screws that can be used to meet these continuous load path requirements.

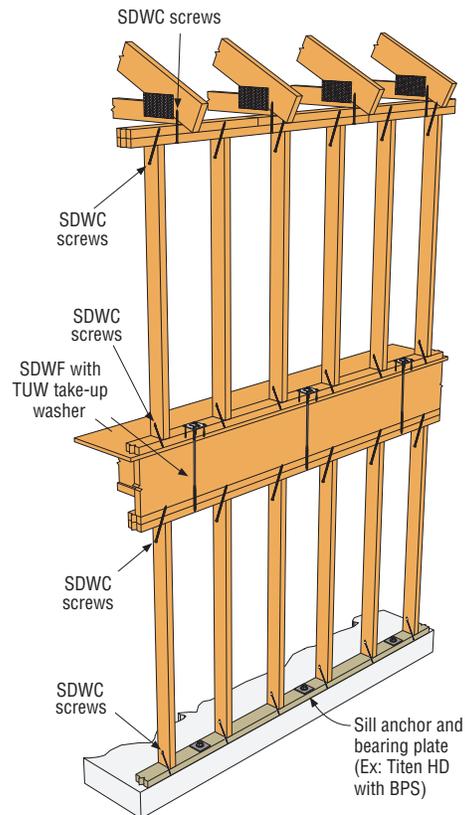


Continuous Uplift Load Path with Structural Connectors

Anchorage

Per Section R602.11, all braced wall line sills must be anchored to concrete or masonry foundations in accordance with R403.1.6 and R602.11.1:

- R403.1.6 requires a minimum of ½"-diameter anchor bolts with minimum 7" embedment spaced a maximum of 6' on center or other approved equivalent anchors. The sill plate anchors in Table 4 are approved as 1:1 replacements for these ½"-diameter anchor bolts.
- R602.11.1 requires the anchorage of buildings in SDC D₀, D₁ and D₂ and townhouses in SDC C to also include a plate washer not less than 0.229" by 3" square except where approved anchor straps are used. See p. 5 for a bearing plate that meets this plate washer requirement. Alternately, the cast-in-place MASA mudsill anchors (Table 4) can be used in lieu of the anchor bolts and plate washers in these high seismic zones.



Continuous Uplift Load Path with Strong-Drive Screws
SDWC, SDWF patented, see strongtie.com/patents for info.

This technical bulletin is effective until December 31, 2022, and reflects information available as of January 1, 2021. This information is updated periodically and should not be relied upon after December 31, 2022. Contact Simpson Strong-Tie for current information and limited warranty or see strongtie.com.