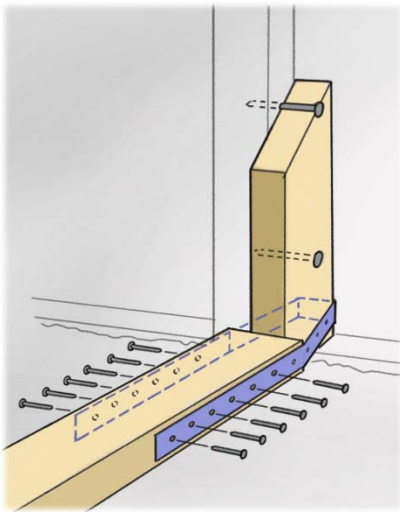


## 7.0 Implementation: Retrofitting Gable End Walls with U-Bent Straps

**Order of presentation:** To give you a better appreciation of what is involved in doing a gable end retrofit, we will first review the installation steps. After that we will tell you how to determine the materials you need and how to make a shopping list. We explain how to decide on what materials to select **Section 14** and what tools you may want in **Section 15**.

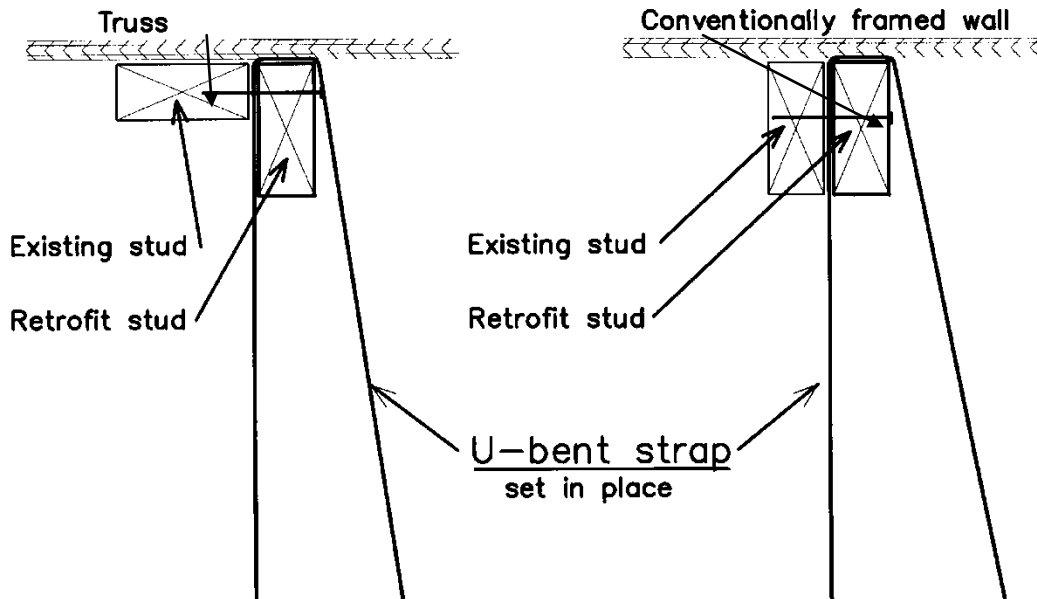
Bear in mind that you may want to make the wall-to-wall connections before strengthening and bracing the gable end. This will depend on how you will be making wall-to-wall connections. Generally, it is better to retrofit the gable end wall first so that the HGA or HGAM connectors will not be in the way of that work. To help you decide which to do first, see **Section 9** for frame walls below the gable end and **Section 10** for masonry walls below the gable end.

Two types of obstructions are addressed this retrofit guide which are also incorporated in the Florida Building Code and the *2012 International Building Code for Existing Buildings*. Specific guidance is provided for ways to work around these obstructions without reducing the effectiveness of the retrofits. One type is where there are impediments that prevent the effective installation of a retrofit stud. These include gable end vents where the existing framing (existing studs have been cut so that a gable end vent could be installed) or where pipes or other objects are in the way. The alternative measure for this is discussed in **Section 11**. The other type of obstruction is where there are obstructions on the floor or ceiling of the attic that prevent the installation of horizontal braces that extend the minimum of 6' into the attic. Alternative measures for this are discussed in **Section 10**.

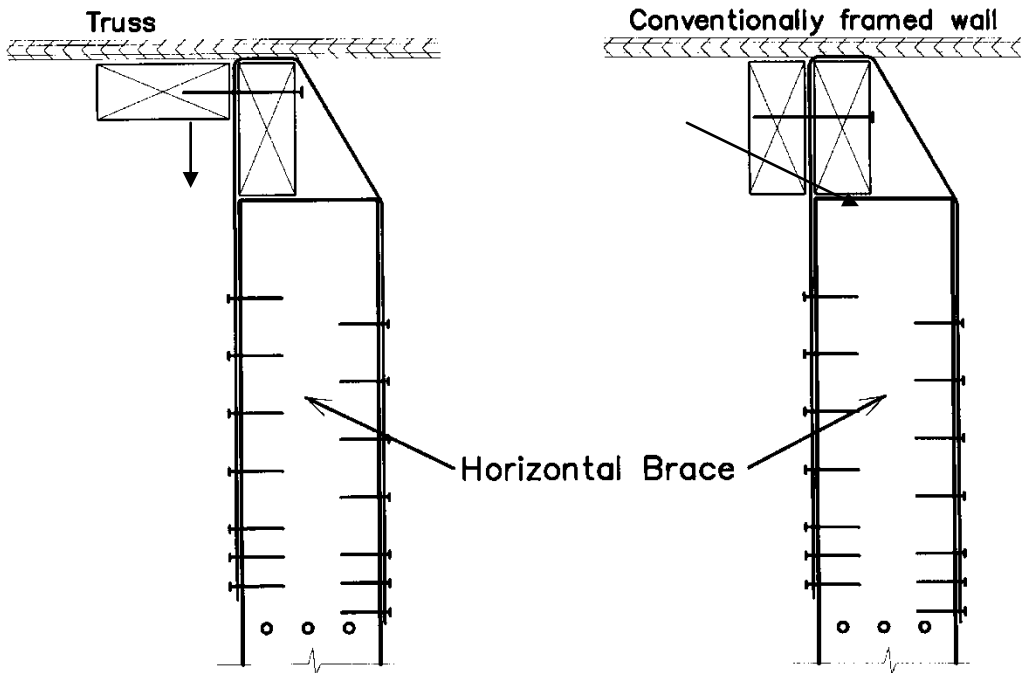


**Figure 7.1** This shows the strap of the U-bent method. First install the Retrofit Stud with the top and bottom with the already bent straps set behind it. Next install the two Horizontal Braces. And finally fasten the straps to the edges of the braces.

## U-Bent strap method viewed from above



**Step 1.** Set straps in place at top and bottom then fasten Retrofit Stud to existing stud.



**Step 2.** Butt Horizontal Brace to Retrofit stud, fasten the braces to attic framing, then fasten the straps to Horizontal Braces

**Figure 7.2** The two rows in this figure show in two steps the method of installation of U-bent straps. The two on the left side show a truss gable end and the two on the right show a conventionally framed wall. The only difference is the orientation of the existing studs. Do note that one edge of the Horizontal Brace lines up with one edge of the Retrofit Stud. In the L-bent strap method the Horizontal Brace can butt up to the middle of the retrofit stud.

## **Gable end retrofit installation steps using U-bent straps**

You can start and finish one retrofit location or install several or all the retrofit studs and then install at least the horizontal braces. The choice is yours. It will require less moving around at the gable end, and it is probably easiest to install a couple retrofit studs then their bottom horizontal braces. Then you will have the choice of installing the upper braces or moving to install more retrofit studs and their bottom braces. The advantage is that there will be more to stand on when installing the upper braces.

**Step 1. Cut retrofit stud.** Determine the length for each retrofit stud. Measure the length of the existing stud on the side where you plan to install the retrofit stud and 1-1/2" away from the existing stud on the side where you plan to install the retrofit stud. Use the shorter of the two lengths. The stud needs to extend from the top of the ceiling joists or truss bottom chord up to the bottom of the rafters or truss top chord. Make the stud as long as it can be and still be placed against the wall. Its top end can be cut square. It is not necessary to match the pitch of the roof. Cut the stud.

**Step 1b. Set retrofit stud with it loose strap in place.** Select the strap appropriate for the retrofit configuration by referring to row 15 of **Table 5.2** or refer to your worksheet. U-bent straps need to be bent symmetrically so the legs will be of equal length. Set the straps in place, one at each end. Until the retrofit stud is secured in place the straps may fall or slip out of place elevation wise. Not to worry.

If the attachment of wall sheathing or siding is at all suspect, apply a heavy bead of AFG-01 rated construction adhesive on the sheathing where the edge of the retrofit stud will be placed. **See page 44 in Section 8 for more details about this best practice.** Push the stud in place against the sheathing and existing stud. Fasten the retrofit stud to the existing one using 3" fasteners. The fasteners should be no closer than 2-1/2" to the ends of the retrofit stud, no farther apart on the stud than 6" and no closer than 2-1/2" to each other. With the completion of this step you have made the existing stud at least twice as strong and if the existing stud is flat on the wall, you have made the stud almost three times stronger. Finish fastening the retrofit stud by fastening the straps to the horizontal braces. These straps restrain the retrofit stud from being pulled out by wind pressure. They provide the tension connection.

**Step 2. Install retrofit studs.** You may find it easiest to fasten the retrofit stud to the existing one by starting with the top fastener because you can hold and install that strap without having to hold the bottom strap in place. After installing the first fastener you need to make sure the bottom strap remains at the proper elevation.

**Step 3. Install bottom horizontal braces.** Place the bottom horizontal brace on the attic floor and press it tightly against the retrofit stud. The 2x4 brace must be 6' feet plus 2-1/2" long or whatever additional length it may take to cross three framing members and extend 2-1/2" beyond the last framing member. The horizontal brace must be fastened to at least 3 framing members, and it must be fastened to any other framing member(s) it crosses that are at the same elevation. The brace must extend beyond the last framing member by at least 2-1/2" so that the fasteners don't pull out of

the brace when wind pressure pulls the wall outward and so the fasteners do not split the end of the brace when they are installed. The fasteners on the horizontal braces should be placed at least a 1/2" from the edges of the brace and 1" from each other. This spacing does not leave much margin for error of placement. Just do the best you reasonably can. Most people will find it easiest to work in the attic by first installing all the braces on the attic floor. That gives a broader walking surface. Remember you can run the brace at an angle to avoid an obstacle but you must maintain the 6' and three attachments. With the horizontal braces snugly butted to the retrofit stud and fastened to the attic floor framing, the bottom of the gable end is restrained from being pushed into the attic by wind. It serves the same compression function as the compression blocks for the L-bent method.

When you install horizontal braces onto attic floor framing members you may notice that some floor framing members are lower or higher than the rest resulting in gaps between the horizontal brace and one or more flooring members. Gaps need to be filled with wood shims. Gaps tend to be more of a problem with block walls than frame walls. Start installing fasteners at the wall end to ensure that the brace will be on the correct side of the existing stud and jammed against the existing stud. Install fasteners to attach the horizontal brace. Attach a fastener to every framing member over which the brace passes. Fastening to a rafter used solely to support ceiling material, and located next to the exterior wall below, is not necessary. Nevertheless, fastening needs to be made to at least three primary framing members unless blocking or decking is used.

**Step 4. Install top horizontal braces.** With the retrofit studs and bottom braces installed, the top horizontal braces can be installed. This brace restrains the top of the gable end wall from being pushed into the attic. When you install horizontal braces onto roof framing members you may notice that some roof framing members are lower or higher than the rest resulting in the horizontal brace not making contact with one or more members. Gaps need to be filled with wood shims. Gaps tend to be more of a problem with block walls than frame walls. Start installing fasteners at the wall end to help assure that the brace will be on the correct side of the existing stud and jammed against the existing stud. Fasten the horizontal brace to every framing member over which the brace passes. Fastening needs to be made to at least three primary framing members unless blocking is used.

**Step 5. Fasten straps.** Refer to row 14 of **Table 5.2** for the configuration letter of this stud to determine the number of fasteners to place into each end of the straps. Fasten the straps to the edges of the horizontal braces. Remember the fastener closest to the end of the brace must be at least 2-1/2" from the end of the brace. You have now made the tension connection for the gable end wall. The connection that keeps the gable end wall from being pulled off the house by negative wind pressure.

You will see on **Figure 15** that the three fasteners used to secure a brace to a framing member are offset 1/2" from adjacent ones. In practice this means that one fastener should be placed about 1/2" from the edge of the brace and about 1/2" from the edge of the framing member. The second fastener should be placed about in the middle of the

brace (sideways) and about 1/2" from the other edge of the framing member. The third fastener should be placed in line with the first one and about 1/2" from the edge of the brace. This minimizes the chance of splitting the framing member which, because of its narrow 1-1/2" width, is susceptible to splitting. When a fastener splits wood its effectiveness will be significantly reduced. Adding more fasteners is apt to further weaken the connection instead of making it better.

If the ceiling material is drywall, plaster or another brittle or fragile finish, screws are usually a better choice for fastening down the braces on the ceiling framing members. Installing screws produces negligible impact loads as compared to installing nails, especially when the nails are driven with a hammer.

### **Gathering materials**

**Table 7.1** below along with your worksheets will make determining the number of each kind of material very easy. Notice that at most 10 different kinds of materials are used. For most gable ends there are only eight.

**Table 7.1. Materials takeoff form for the U-bent strap method. Instructions for use are given immediately above this caption and below the table.**

<b>U-Bent Strap Method Materials Takeoff</b>									
Item	Retrofit Configuration								Grand Total Number Needed
	A		B		C		D		
	Num @	X #	Num @	X #	Num @	X #	Num @	X #	
2x4x8' for Horizontal Braces	2		2		2		4		
2x4x8' for Retrofit Studs	1		---	---	---	---	---		
2x6x12' for Retrofit Studs	---	---	1		---	---	---	---	
2x8x16' for Retrofit Studs	---	---	---	---	1		2		
24" straps 20 gauge	---	---	---	---	---	---	---	---	---
30" straps 20 gauge	2	---	---	---	---	---	---	---	
36" straps 20 gauge	---	---	2	---	---	---	4		
49" straps 18 gauge	---	---	---	---	2		---	---	
1-1/4" fasteners, screws	24		28		28		48		
3" fasteners, screws	75		83		91		182		
Pounds 1-1/4" screws	0.14		0.16		0.16		0.28		
Pounds 3" screws	0.99		1.09		1.20		2.40		
<b>Number of retrofits for this Configuration --&gt;</b>	# =		# =		# =		# =		

**To use this table to determine quantities:**

First, in the bottom row enter the number of retrofits for each of the Configurations.

Next, multiple that number by Num @ for each row entry.

Finally, total the numbers across each row and enter that number in the Total column.

Screw weights will vary according to the particular brand and model selected.