

9.0 Strengthening and Bracing Gable End Walls

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. See Section 10 to help you decide which to do first.

There are two types of obstructions that have been anticipated in preparing this retrofit guide. Specific guidance is provided for ways to work around these obstructions without reducing the effectiveness of the retrofits. One type is where there are obstructions 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 12.

Horizontal braces attached to the tops of ceiling joists or the bottom chord of trusses:

Walk carefully. If the ceiling framing members are bouncy you need to walk as gently as possible to avoid flexing them so much that cracks develop in drywall ceilings (especially at tape joints), cause drywall texture to fall off, or crack plaster. Most ceiling finishes are brittle and fragile. The advantage of installing bottom braces first is that they will help distribute your weight over several ceiling members (a large area) thus reducing the likelihood of causing too much deflection on a single member. This will reduce the chance of causing cosmetic damage to ceilings. Still, one should tread softly. If any boards or plywood is already in place, then be sure it is secured so it does not slide from under foot or flip up because you walked on an unsupported end.

Installing the bottom horizontal braces will give you a better walking and working surface than just the 1-1/2" edge of ceiling framing and makes doing the rest of the work easier. Next install all the upper Horizontal Braces. Having the lower and upper braces in place will allow you to make more accurate measurements of the lengths of the required retrofit studs. Figure 14 shows the positioning of top and bottom horizontal braces.

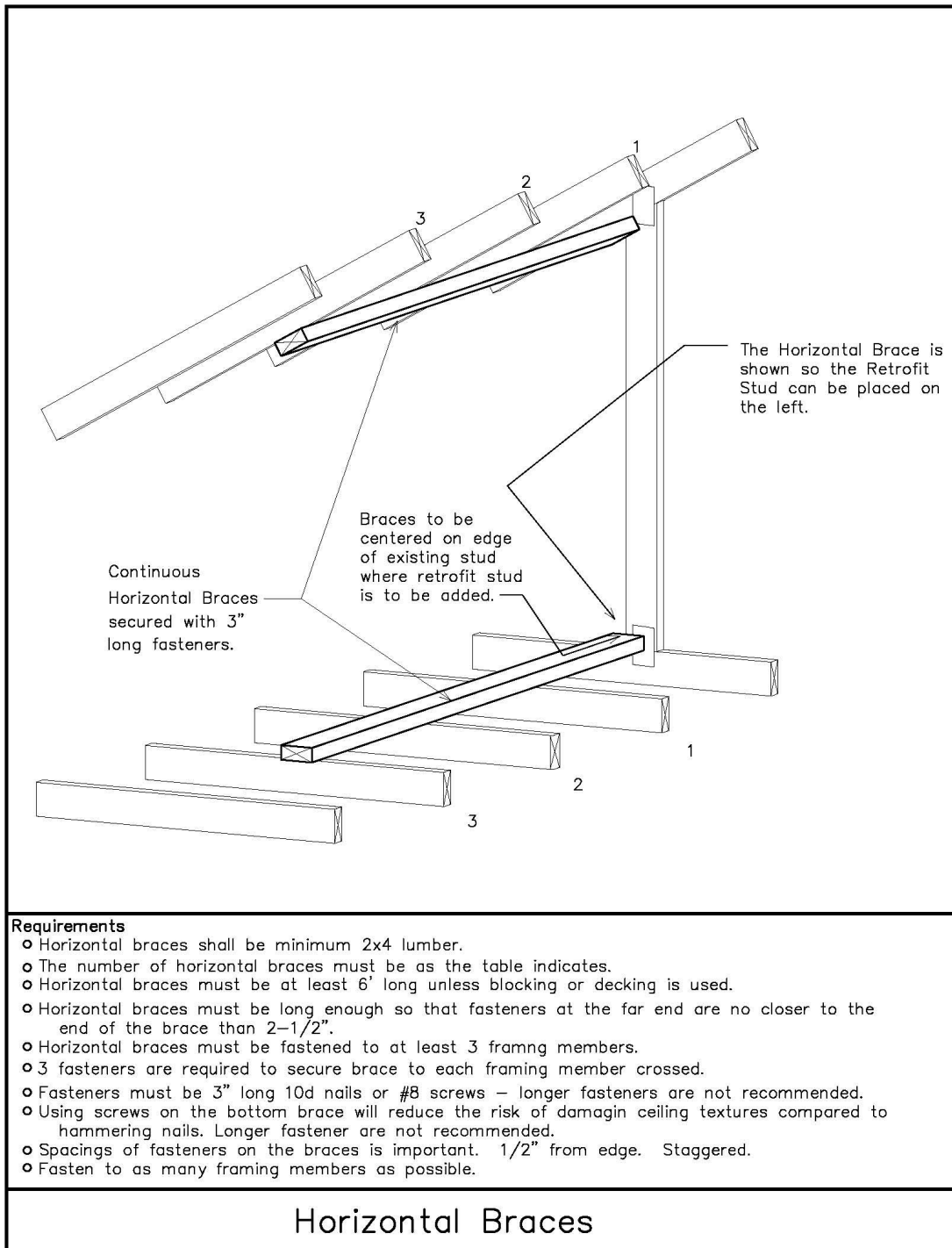


Figure 14. Sketch showing location of top and bottom horizontal braces

Where to install the horizontal braces: You have some flexibility in placing horizontal braces. Horizontal braces can be installed on either side of existing studs as long as that is where a retrofit stud can be installed. Horizontal braces can be run at an angle to avoid obstacles. They can be fished under some obstacles. If need be, they can even

be shortened 2' if blocking is added and can be shortened even more if a plywood deck is installed that spans the area blocked by the obstacle. They do need to be secured to each framing member over which they cross, unless the member is near the wall and its only function is to be deadwood to support ceiling drywall. Reevaluate which side of an existing stud is the best place to install a retrofit stud. It is ok to switch sides back and forth depending on what works best, i.e. the retrofit studs don't have to be consistently on the same side. So you don't make a mistake by forgetting which side you have decided to use you might consider using a black marking pen to place an arrow on each existing stud. It is perfectly ok to angle a brace so it runs at an angle from the wall to skirt obstructions. Just be sure that by running it at an angle that the brace is still long enough to extend at least 2" beyond the framing member most distant (about 6 feet) from the gable end wall. If you angle them you need not angle the end cut of the brace so that it fully butts the existing stud or retrofit stud. However you do need to make an angle cut on the Compression Block so that its end pushes against the Retrofit Stud and fully butts against the existing or the Retrofit Stud. This is so that the compression function will be fully effective.

Impediments: See section 11 for instructions for dealing with impediments.

Length of the brace: When you measure for a horizontal brace be sure that you allow 2" of extra length at the far end so the fasteners there are not too close to the end of the brace. The measurement need not be very precise as long as the horizontal brace meets the 6' minimum length and 2" beyond the last framing member requirements.

Cutting the braces: You may prefer to cut the braces outside the attic because it will probably be easier to cut there than inside the attic. It may also be a little easier to feed them and carry them in the attic if they are shorter. On the other hand it may not make much difference. You should save the dropping (cut off section) to use as Compression Blocks. The cuts you make need not be very pretty. You may want to cut the upper brace at the same time because the length will likely be the same. In fact, while you are at it, you may want to cut all the Horizontal Braces, both lower and upper unless there is an odd one or two that need to be longer because they need to skirt an obstruction.

Fasten to framing: When you install horizontal braces onto floor framing members you may notice that some floor 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 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.

You will see on Figure 15 that the 3 fasteners used to secure a brace to a framing member are off set 1/2" from adjacent ones. In practice this means that one fasteners

should be placed about 1/2" from the edge of the brace and about 1/2" from the edge of the framing member. The next fastener should be placed about in the middle of the brace (sideways) and about 1/2" from the other edge of the framing member as the first fastener. 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.

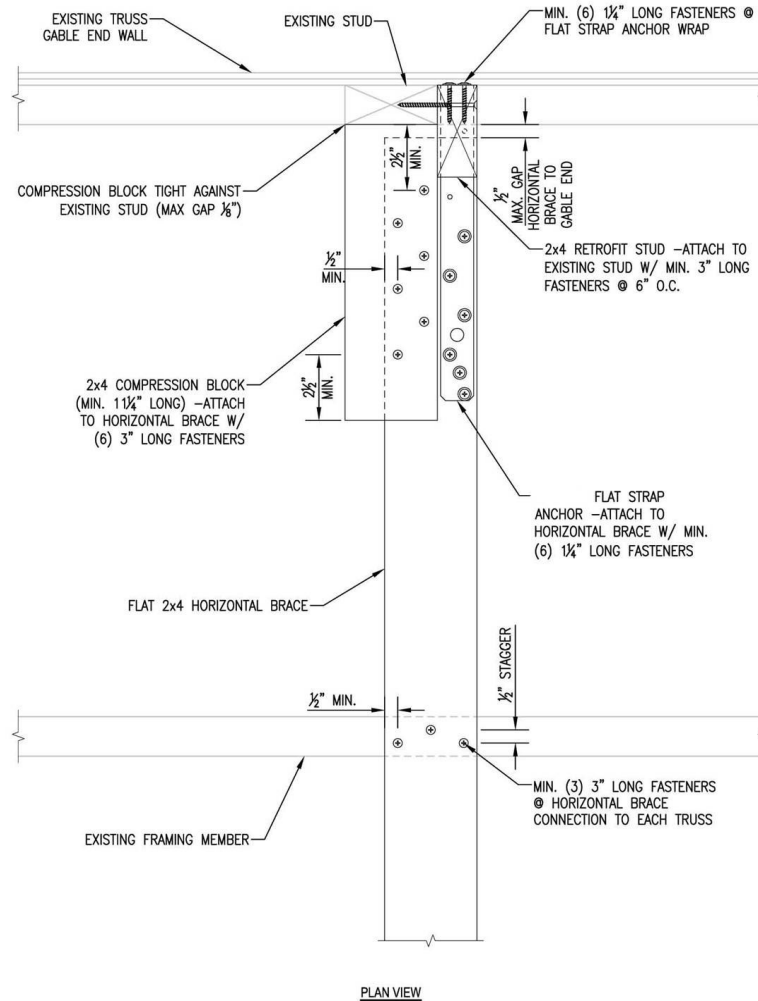


Figure 15. Layout of fasteners on horizontal brace for connection to framing members as well as connections of retrofit stud strap and one option for attachment of compression block.

If the ceiling material is drywall or plaster or other brittle or fragile finishes, 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.

Obstructions: A common thing you will have to deal with is wiring running over the top of ceiling framing members (Figure 16). **DO NOT sandwich a wire between a brace and a framing member.** That creates a fire hazard! To move a wire or to gain enough slack so that you can fish a Horizontal Brace under a wire, you may need to remove a staple or two that secures the wire to a framing member. Tools for that purpose include the claw part of a hammer, a medium sized slot (flat) screw driver, a pair of pliers, or nippers. Pull the staple up **WITHOUT** compressing the wire cable itself. Pliers and nippers should only be used to carefully grab and pry out the staple. In most cases, this is not a difficult job, just be very careful not to damage the wire or its protective cover. You can probably salvage staples for reuse. In some cases, it may be necessary to fish or needle the brace under wires as opposed to just moving the crossing point to a location that is not under the brace. You may also need to fish or needle a brace under an AC duct. Be gentle with AC ducts so as not to create costly leaks.

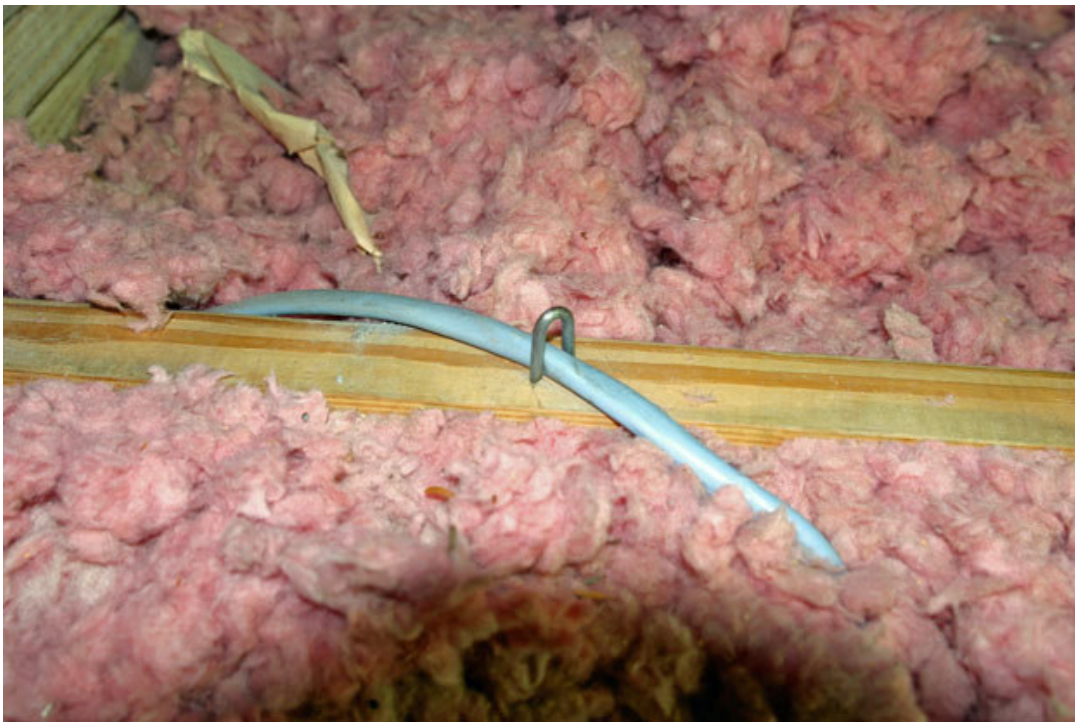


Figure 16. Electrical wiring running over ceiling joist.

Horizontal braces attached to the bottom edges of rafters or bottom edges of the top chords of trusses members:

Clearly, installing upper horizontal braces is not as easy as installing lower ones, but at least one does not have to bend over (Figure 17). It is difficult to hold a 6' brace up against the roof framing members while trying to hold it in position lengthwise, and fastening it. It seems to take 3 or 4 hands with one being at the other end 6' away. That sounds impossible, but actually is not nearly as hard as it sounds. Some hints will be offered in paragraphs below. Aside from having to hold the brace the installation procedure is the same as for the bottom brace.



Figure 17. Installation of upper horizontal brace.

Measure: The length of the upper brace will usually to be the same length as the bottom brace. It is likely that almost all the upper braces at a particular gable end will be the same length so you may prefer to cut them at the same time.

Cut: Cutting is straight forward and similar to that of the bottom braces.

Fasten to framing: Start fastening the brace at the end that butts up against the gable end wall. This will help assure that it is the right place and that it will be snug against the existing stud. Also, look down to make sure that you have positioned the brace on the same side of the existing stud where you have installed the bottom brace. If you have many gable end studs to retrofit you are apt to make the mistake of installing a brace on the wrong side of an existing stud. It is kind of dumb and waste of time, but is a mistake that most of us have made.

Hints: Hold the brace in place and mark where it crosses the roof framing member closest to the gable end and a second framing member about 4-feet farther away from the gable end wall. Start one fastener (screw or hammer driven nail) at each mark. Position yourself so that you can reach each of these fasteners and then lift the brace into place and drive the fasteners into the roof framing members starting with the fastener closest to the gable end. This will minimize the time required to hold the brace in place and allow anchoring the brace without having to hold the fasteners in addition to the brace and fastening tool. Usually one can hold the brace into place with only one hand especially if fasteners have been started, but if the brace is particularly heavy or long you may want to devise some help. One suggestion is to hang the far end from the last framing member with a rope by installing a fastener to the framing member.

Once you have installed all the lower and upper horizontal braces, you will be about one third of the way through strengthening the gable end wall.

Installing retrofit studs and strapping:

Measure: With the braces in place it is relatively easy to make accurate measurements of the required lengths for the retrofit studs. If you are going to install the retrofit stud along the taller side (side towards the roof's ridge) of the existing stud, just measure from the top of the lower horizontal brace along the edge of the existing stud up to the point where that edge lines up with the bottom of the upper horizontal brace. If you are going to install the retrofit stud along the shorter side (the side towards the eave of the roof) of the existing stud, you will need to hold the tape measure 1-1/2 inches away from the shorter edge of the existing stud and measure from the top of the horizontal brace up to the bottom of the upper horizontal brace. As an alternate, if you have figured out the slope of the roof, you can measure along the short side of the existing stud and reduce the length by multiplying the width of the retrofit stud by the slope ratio. For example, if you found that the roof slope was 5 in 12 (5 inches rise in 12 inches width or 5 feet rise in 12 feet of width) you can multiply the width of the retrofit stud (1-1/2") times 5 and divide by 12 to get a length reduction of 5/8". A snug fit at the top is preferred, but be sure to leave a little space for the bottom strap. Note that if you are installing retrofit studs on a gable truss with diagonals, you will either have to select the next size up 2x member and notch it around the diagonal or align the retrofit stud so that its narrow edge butts up against the face of the existing stud and one face of the retrofit stud lines up flush with one of the edges of the existing stud. The second alternative will allow you to attach the retrofit stud to the existing stud using mending plates.

Impediments: See section 12 for instructions on dealing with impediments and more specific guidance on installing retrofit studs on gable ends with diagonals.

Cut: Cut the stud to length. It will probably be easiest to cut a stud in the attic just after having measured for it. Then, before you install the straps, check the length by placing the retrofit stud in the desired location and make sure that it will fit snugly against the existing stud.

Bend Straps or Not. There are two issues related to bending straps. One is where to make the bend and the other is how to make the bend. Unfortunately, you can't just make the bend in the middle of the strap unless you use one that is considerably longer than you actually need. Since part of the strap wraps under the retrofit stud and you can't install fasteners in this area, you need a longer length of strap wrapping under the retrofit stud and sticking out along the horizontal brace than the length running along the back edge of the retrofit stud. Consequently, when using the strap lengths listed in Tables 1 and 5, make the bends at the locations indicated in Table 5. This will distribute the number of fastener holes in the strap at each end of the strap where the holes need to be. Ideally the bends would be nice sharp bend that are not too rounded. The other strap bending issue is that you may find it difficult to make sharp bends in heavy gauge straps without using a vise or without anything in the attic to safely bend

the strap over. One suggestion is to bend them out of the attic where you can make the bends more carefully and sharper using a vise or a substitute. Another suggestion is to apply them to the retrofit stud and then bend them using a hammer to make the bend sharper. NEVER make a bend and then undo it. If a strap cannot be used because the bend is at the wrong place the strap cannot be re-bent. That weakens the strap too much. Thin straps are pretty easy to bend over the ends of retrofit studs after the straps have been fastened to retrofit studs. After bending with one's hand, a whap or two with a hammer will result in a nice sharp bend. Figure 18 illustrates the installation of the retrofit stud.

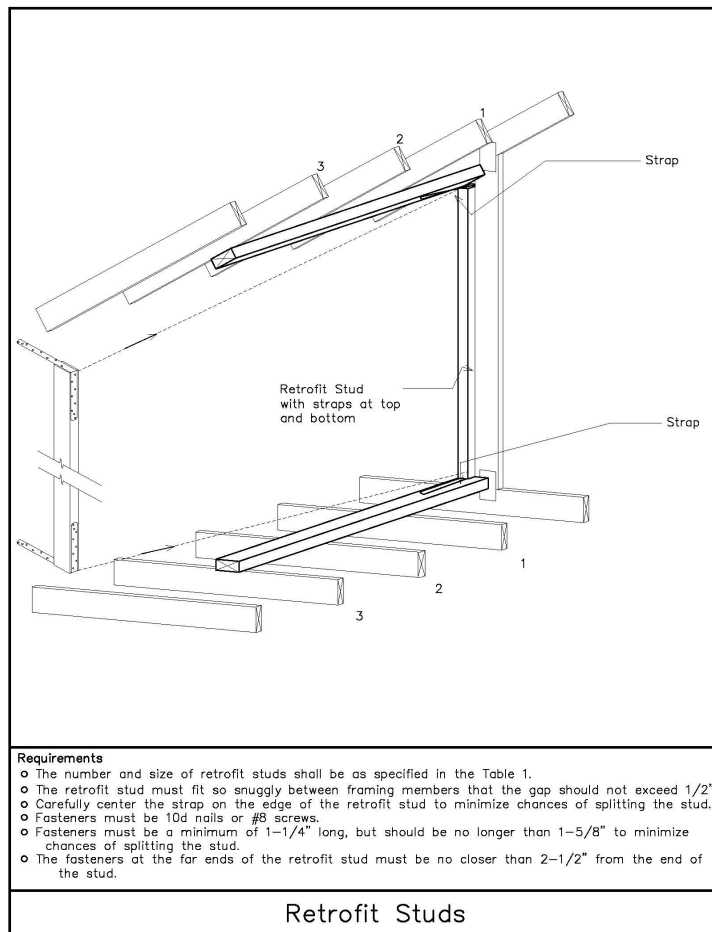


Figure 18. Installation of retrofit stud.

If you use coil strap you will have to cut it. For that you can use a good heavy duty pair of tin snips or easier yet, use a hacksaw across the flat of the strap to make a little groove and then bend the strap back and forth until it snaps. With coil strapping you will need to straighten it out somewhat and then make the bend at the appropriate length indicated in Table 5. Remember that the shorter length of the bent strap is the part that you will attach up the back of the retrofit stud and the longer portion will run under the retrofit stud and extend along the horizontal brace.

TABLE 5
Recommended Strap Lengths and
Bending Locations

Method and number of fasteners at each end from Table 1	Minimum length of flat strap from Table 1	Recommended length of flat strap Model LSTA or MSTA straps	Recommended length of coil strap Model CS16 or CS18
Method #1 6 at each end	21"	21" strap - bend at 9-1/2"; or use 24" strap & bend at 11"	21" bend at 9-1/2"
Method #2 9 at each end	30"	30" strap - bend at 13- 1/4"; or better yet use 36" strap & bend at 16-1/2"	30" bend at 13"
Method #3 12 at each end	38"	Long enough LSTA or MSTA straps are not available	38" bend at 16"
Method #4 8 on each strap at each end	30"	30" strap - bend at 12"; or use 36" strap & bend at 15"	30" bend at 13"

Notes for using the table.

1. When installing straps the key is to have at least the minimum number of fasteners installed at each end in accordance with the first column of the table.
2. The bend location is in relation to the stud (not brace) end of the strap. The short leg of a bent strap always goes on the retrofit stud.
3. Where a strap is cut compared to where the holes are makes a difference, but the worst case is taken into account in specifying both the needed minimum of length strap and the bend location.
4. Some manufacturers of connectors and straps add 'Z' to the end of the model to indicate that the connector is more rust resistant. This is probably not important for straps in attics, but of course it does no harm.
5. Fasteners should not be placed closer than 2-1/2" from the end of a retrofit stud.

Install the straps: Select one of the 1-1/2" wide edges of the retrofit stud and install a strap at each end of the retrofit stud. If you have pre-bent the strap, make sure that it is oriented such that the bent leg wraps across the end of the stud as shown in Figure 18. When fastening the strap to the 1-1/2" edge of the stud, it is important that every fastener required by the table is installed and that the strap is centered on the edge of the retrofit stud. There are two critical distances that need to be respected to achieve the full strength of the connection. One is the edge distance between a fastener and the edge of the retrofit stud. That distances needs to be no less than 3/8". Placement of the strap in the middle of the 1-1/2" edge of the stud is very critical because the placement of holes in commonly available straps results in the holes being exactly 3/8" from the edge. Installing a fastener closer than 3/8" to the edge of the stud reduces its effectiveness. Installing the fastener too close to the edge can create a split along the

edge which would make those fasteners almost completely ineffective. To minimize the chance of splitting it is suggested that fasteners be installed at an angle towards the center of the stud. This will keep most of the fastener away from the edge. The other critical distance is that no fasteners should be closer to the end of a retrofit stud than 2-1/2”.

Stud-to-stud connection: Now you are ready to connect the retrofit stud to the existing stud. This will tie the two together so that you double or more than double the strength of the existing stud. To do this you need to place 3” fasteners no more than 6” apart along the length of the retrofit stud. If the existing stud has its wide face parallel to the gable end wall (truss stud) then install the fasteners through the back portion of the retrofit stud and into the middle of the 1-1/2” edge of the existing stud. Keep the top and bottom fasteners at least 2-1/2” from the ends of the retrofit stud in order to minimize chances of splitting the end of the retrofit stud and to make the fastener fully effective when it is stressed by wind loads. The retrofit stud and existing stud combination will increase the strength of the wall and help it resist the wind forces pushing or pulling on the wall. Its effectiveness will be limited in the pull mode unless the wall sheathing is well attached to the existing stud. In homes built prior to 2002 it is likely that the attachment is not adequate. If your gable end wall has plywood siding on it you may be able to spot the nail heads from outside the house and be able to check the nail spacing. Ideally the nails would be on average 6” or less apart.

Applying construction adhesive to the 1-1/2” edge of the retrofit that will be in contact with the sheathing will help restrain the sheathing from getting pulled off (Figure 19). Applying a bead of construction adhesive along the edge of the existing stud where it meets the sheathing on the opposite side from where the retrofit stud is to be installed will help as well. It is not known how many years construction adhesive will be effective in hot attics, but it is so easy and inexpensive to do that one can hardly go wrong. Be warned that some people may find the fumes offensive, but in a hot attic they will dramatically dissipate in a day or two. There is more information about using construction adhesive in Section 14.

Where you want to push a retrofit stud into place, you may well find nails or staples coming through the siding that prevent pushing the stud against the siding. You may be able to bend (clinch) them against the sheathing/siding or you may be able to snip them off with a pair of nippers or wire cutters. In any case it is ok if the retrofit stud is as far as 1/4 inch from the siding. It will still be just as effective. However, if the distance can be kept short then you can gain the important structural advantage of being to apply construction adhesive to help hold the wall sheathing/siding onto the wall.



Figure 19. Applying construction adhesive where retrofit stud will make contact with the sheathing

Installing straps on braces: Once the retrofit stud is securely fastened to the existing stud, you are left with the easy task of securing the straps coming from top and bottom of the retrofit stud to the two horizontal braces. The only heads up issue is to route the strap along the horizontal brace, away from the edge of the brace, so that you maintain an edge distance of least 1/2" between the fasteners and the edge of the brace. Experience has shown that to help assure the strap does not wonder off at too great an angle it is a good idea to install the first fastener near the retrofit stud and then install the next one at the end of the strap.

Installation of compression blocks:

Installing compression blocks is the easy final step. The lengths specified in the table are minimum lengths so it is perfectly ok to use scraps (droppings) of 2x4s, 2x6's, or 2x8's that are longer without having to cut them to precise lengths. The minimum size for lumber used as blocking is a 2x4. A key issue with compression blocks is to butt them snugly against the retrofit studs so they can act in compression with minimum movement of the wall studs. Another key issue is to be sure you install all of the fasteners so they are fully effective. That means positioning them a minimum of 1/2" from the edge of the block and horizontal brace, at least 2-1/2" apart along the length of

the block, and a minimum of 1" apart in the cross block direction (across the grain). Depending on how the strap runs on the horizontal brace you may need longer compression blocks in order to maintain the fastener spacing requirements.

With the installation of compression blocks complete you are finished with the gable end retrofit. That leaves only the wall-to-wall connection, unless you have already done it.

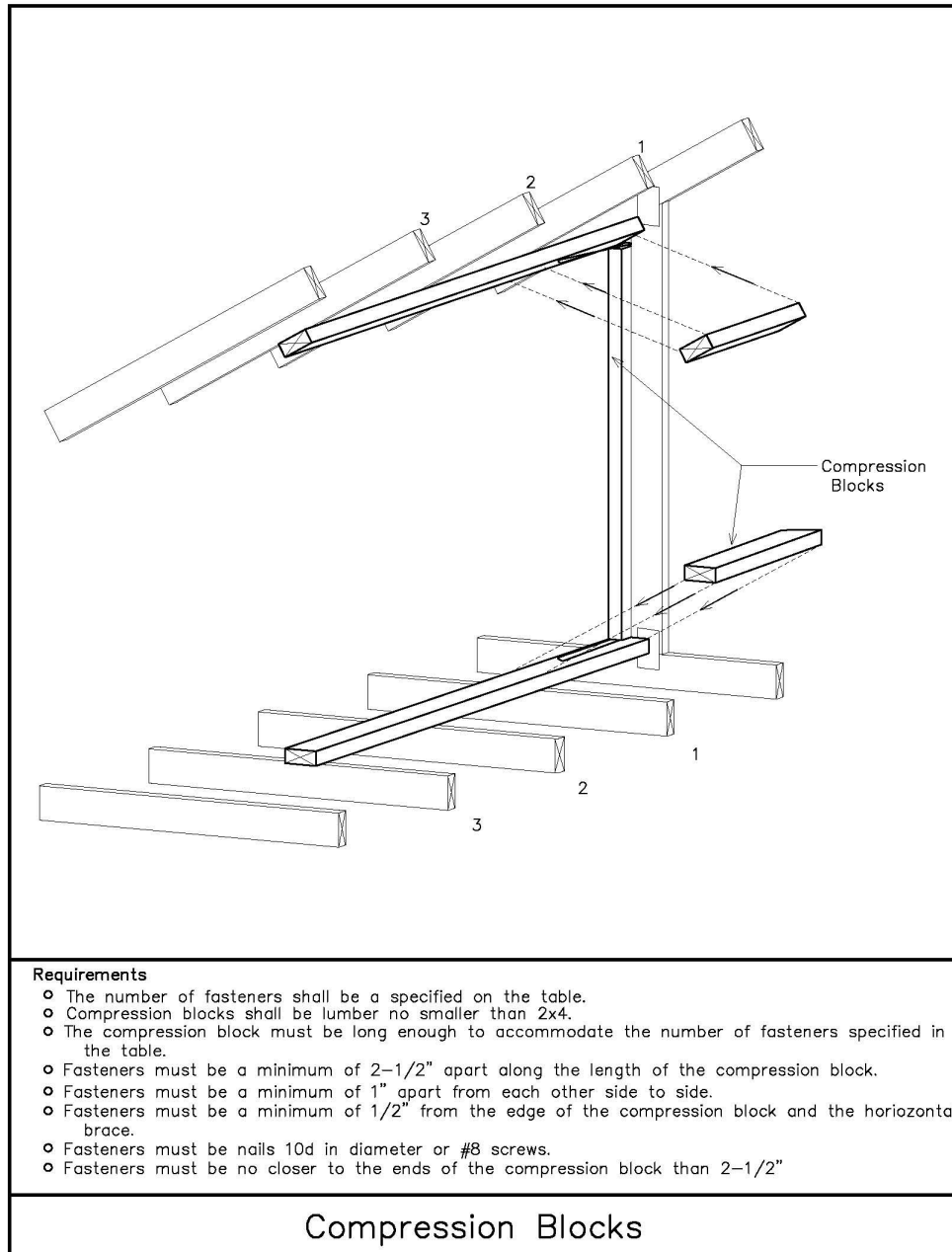


Figure 20. Installation of compression blocks.