

## 5.0

# Planning and Completing *Worksheets*

***Polish or redraw the sketch you made in the attic:*** At this stage you should have collected information from the building department and from your house's attic. In deciding what retrofit measure to use you probably need to redraw the sketches you made in the attic so they are more legible. You will also be adding details that you will collect based on the information in this section and in particular from **Table 6.1 or 7.1**. So first, redraw your sketches if necessary; starting at the left, number each stud to be retrofitted. If you made the decision that one or all retrofit studs would have L- and U-bent straps, then those locations should have two rows allocated to them on the worksheet because the number of fasteners will differ from one end to the other (see the Sample Worksheet in **Section 17**).

***Making worksheets from the gable end sketches:*** To each redrawn sketch page made in the attic, you will add installation details to make each similar to the **sample worksheet** shown in **Section 17**. This revised sketch page becomes your **worksheet**, and it will be used to make a materials list. Once you are in the attic, the sketch page will give you all the information you need about strap lengths, numbers of fasteners in straps and compression blocks, and lengths of compression blocks. You might want to make copies of the redrawn attic sketches before you add retrofitting details to make them into working sketches. When adding details to your **worksheet** it would be best to use a pencil so you can erase easily.

If there are impediments or obstructions that make installation of horizontal braces difficult or impossible now is the time to read **Section 11**. If retrofit studs cannot be installed in a straightforward manner now is the time to read **Section 12**. Most likely these sections will have work arounds which have been anticipated in this retrofit guide and meet building code requirements.

<b>L-Strap Method Specification Table</b>										
Requirements that comply with building code provisions for the L-Bent Strap method										
Column →		1	2	3	4	5				
	Row number ↓	Exposure Category	Max 3 sec gust Basic wind speed	Spacing for right angle brackets	Spacing for screws sill plate to wall	Maximum Allowable length of Retrofit Stud				
						<b>Retrofit Configuration</b>				
						A	B	C	D	
<b>Building code requirements</b>	1	C	110	38"	19"	8'-0"	11'-3"	14'-9"	16'-0"	
	2	C	120	32"	16"	7'-6"	10'-6"	13'-6"	16'-0"	
	3	C	130	28"	14"	7'-0"	10'-0"	12'-3"	16'-0"	
	4	C	140	24"	14"	7'-0"	10'-0"	12'-3"	16'-0"	
	5	C	150	20"	10"	6'-6"	8'-9"	11'-0"	16'-0"	
	6	B	110	48"	24"	8'-0"	12'-3"	16'-0"	NR	
	7	B	120	40"	20"	8'-0"	11'-3"	14'-9"	16'-0"	
	8	B	130	36"	16"	8'-0"	11'-3"	14'-9"	16'-0"	
	9	B	140	30"	15"	7'-6"	10'-6"	13'-6"	16'-0"	
	10	B	150	26"	13"	7'-0"	10'-0"	12'-3"	16'-0"	
	11	Retrofit Elements					Size and number of retrofit elements			
	12	Horizontal Braces on attic floor and ceiling, size and number					2x4	2x4	2x4	2 each 2x4
	13	Retrofit Studs, size and number					2x4	2x6	2x8	2 each 2x8
	14	1-1/4" long fasteners to connect straps to retrofit studs and to horizontal brace at each end using #8 screws 1-1/2" long or 8d nails, minimum number					6	9	12	8
	15	Strap length, minimum length (this is not a building code requirement per se, but is the minimum length to get all the fasteners installed that are required in the line above)					24" flat 21" coil	36" flat 31" coil	49" flat 38" coil	30" flat 29" coil
	16	Bend L-bent straps from the middle as indicate in the row					7"	9"	11"	11"
	17	Compression block 3" fasteners secure compression blocks to horizontal braces, each block minimum number					6	8	10	12
18	Compression block length for 2 fasteners placed side-by-side, minimum length					10"	12-1/2"	15"	17-1/2"	
19	Horizontal Brace all 2x4s 8' long, number					2	2	2	4	
20	Retrofit Stud, range of lengths					3 - 8'	10 - 12'	14 to 16'	16'	
21	Retrofit Stud assumed length for ordering					8'	12'	16'	2 each 16'	
22	Retrofit Stud size					2x4	2x6	2x8	2 each 2x8	
<b>Assumed cost each</b>	23	Assumed Horizontal Brace, 2x4x8', cost each					\$ 3.00	\$ 3.00	\$ 3.00	\$ 3.00
	24	Assumed Retrofit Stud, cost each					\$ 3.00	\$ 7.13	\$ 12.00	\$ 12.00
	25	Assumed Strap, cost each					\$ 1.55	\$ 2.79	\$ 4.00	\$ 3.18
	26	Assumed cost of 1-1/4" fasteners, screws assumed each					\$ 0.09	\$ 0.09	\$ 0.09	\$ 0.09
	27	Assumed cost of 3" fasteners, screws assumed each					\$ 0.08	\$ 0.08	\$ 0.08	\$ 0.08
<b>Costs</b>	28	Cost for 1 retrofit (HB+RS+Straps+1-1/2" Fasteners+3" Fasteners)					\$ 18.02	\$ 26.67	\$ 36.00	\$ 66.48

**Notes**

**NOT** all building code requirements are included in the table or these notes.

Compression blocks are assumed to be made from scraps and lengths are base on 2 fasteners across.

Assumed costs are based on Florida June, 2010 prices without sales tax.

Not included are costs for brackets to make (Gable end wall)-to-(Wall below) connections.

3" fasteners must be 10d nails with minimum diameter of 0.148" and must be 3" long minimum OR

#8 3" long screws (drywall or other brittle metal screws are not acceptable)

1-1/4" fasteners must be 8d nails minimum 1-1/4" long OR minimum #8 minimum 1-1/2" long screws

**Table 5.1. Specifications for the L-bent strap method which meet building code requirements and other helpful information. Be sure to read the notes below the table. A copy of this table is available for printing in Section 17.**

U-Strap Method Specification Table									
Requirements that comply with building code provisions for the U-Bent Strap method									
Column →		1	2	3	4	5			
	Row number ↓	Exposure Category	Max 3 sec gust Basic wind speed	Spacing for right angle brackets	Spacing for screws sill plate to wall	Maximum Allowable length of Retrofit Stud			
						Retrofit Configuration			
						A	B	C	D
Building code requirements	1	C	110	38"	19"	8'-0"	11'-3"	14'-9"	16'-0"
	2	C	120	32"	16"	7'-6"	10'-6"	13'-6"	16'-0"
	3	C	130	28"	14"	7'-0"	10'-0"	12'-3"	16'-0"
	4	C	140	24"	14"	7'-0"	10'-0"	12'-3"	16'-0"
	5	C	150	20"	10"	6'-6"	8'-9"	11'-0"	16'-0"
	6	B	110	48"	24"	8'-0"	12'-3"	16'-0"	NR
	7	B	120	40"	20"	8'-0"	11'-3"	14'-9"	16'-0"
	8	B	130	36"	16"	8'-0"	11'-3"	14'-9"	16'-0"
	9	B	140	30"	15"	7'-6"	10'-6"	13'-6"	16'-0"
	10	B	150	26"	13"	7'-0"	10'-0"	12'-3"	16'-0"
	11	Retrofit Elements				Size and number of retrofit elements			
	12	Horizontal Braces on attic floor and ceiling, size and number				2x4	2x4	2x4	2 each 2x4
	13	Retrofit Studs, size and number				2x4	2x6	2x8	2 each 2x8
	14	1-1/4" long fasteners to connect straps to each of the two 1-1/2" edges of horizontal braces using #8 screws 1-1/2" long or 8d nails, minimum number				6	7	7	6
	15	Strap length, minimum length (this is not a building code requirement per se, but is the minimum length to get all the fasteners installed that are required in the line above)				30" flat 30" coil	36" flat 37" coil	49" flat 41" coil	36" flat 37" coil
	16	Bend all U-bent straps symmetrically				0	0	0	0
	17	Horizontal Brace all 2x4s 8' long, number				2	2	2	4
	18	Retrofit Stud, range of lengths				3 - 8'	10 - 12'	14 to 16'	16'
	19	Retrofit Stud assumed length for ordering				8'	12'	16'	2 each 16'
	20	Retrofit Stud size				2x4	2x6	2x8	2 each 2x8
Assumed cost each	21	Assumed Horizontal Brace, 2x4x8', cost each				\$ 3.00	\$ 3.00	\$ 3.00	\$ 3.00
	22	Assumed Retrofit Stud, cost each				\$ 3.00	\$ 7.13	\$ 12.00	\$ 12.00
	23	Assumed Strap, cost each				\$ 3.18	\$ 2.79	\$ 4.00	\$ 2.79
	24	Assumed cost of 1-1/4" fasteners, screws assumed each				\$ 0.09	\$ 0.09	\$ 0.09	\$ 0.09
	25	Assumed cost of 3" fasteners, screws assumed each				\$ 0.08	\$ 0.08	\$ 0.08	\$ 0.08
Costs	26	Cost for column (HB+RS+Straps+1-1/2" Fasteners+3" Fasteners)				\$ 20.32	\$ 24.67	\$ 32.60	\$ 59.64

**Notes**

**NOT all** building code requirements are included in the table or these notes.

Assumed costs are based on Florida June, 2010 prices without sales tax.

Not included are costs for brackets to make (Gable end wall)-to-(Wall below) connections.

3" fasteners must be 10d nails with minimum diameter of 0.148" and must be 3" long minimum OR

#8 3" long screws (drywall or other brittle metal screws are not acceptable)

1-1/4" fasteners must be 8d nails minimum 1-1/4" long OR minimum #8 minimum 1-1/2" long screws

**Table 5.2. Specifications for the U-bent strap method which meet building code requirements and other helpful information. Be sure to read the notes below the table. A copy of this table is available for printing in Section 18.**

You can transform your redrawn attic sketch into a **worksheet** by adding information to columns 4 through 10. You may have already decided from the attic inspection about the information to be entered in column 4 which indicates the L- or U-bent decision for each end of each retrofit stud. The information for rows 5 through 10 comes from **Table 5.1** or **Table 5.2** depending on whether the row is for an L- or U-bent end of a retrofit stud. Columns 9 and 10 apply only to L-bent applications. Let's now fill in this information using the instructions below.

1. L-bent or U-bent / Column 4 of Worksheet. For each retrofit stud your first decision is whether you are going to use an L-bent strap or a U-bent strap. When you decide, make an 'L' or 'U' at the end of each retrofit stud. You might want to circle those letters on your working sketch so you see them more clearly. You might well use L-bent on the bottoms and U-bent at the top. If both methods are used on a stud, use two lines in the table part of the worksheet. For each retrofit stud location mark an L or U in column 4 of the table on the worksheet.
2. Retrofit configuration letter (A, B, C or D) / Column 5 of Worksheet. Now go to **Table 5.1** for L-bent strap retrofits or to **Table 5.2** for U-bent retrofits. Here you will find in **Table 5.1** or **5.2** the retrofit configuration letter for each retrofit stud location. Your goal here is to learn for each retrofit stud location the retrofit configuration letter (A, B, C or D). You determine which letter to use by looking down Column 1 to find the exposure category (B or C) of your house. Then you move down in the next column until you find the basic design wind speed row that applies to your house. You might want to highlight or circle that row. Next, look at Column 5 which has four sub-columns. For each retrofit stud length, find the left most column that has a stud length that is equal to or just greater than the retrofit stud length for which you are finding the retrofit configuration letter. You might want to circle those letters on your working sketch so you see them more clearly. Note the configuration letter in column 5 for each retrofit stud on your Worksheet.
3. Retrofit stud width / Column 6 of Worksheet. Go to **Table 5.1** or **5.2** as appropriate for L- or U-bent. Knowing the configuration letter from column 5 of your worksheet, go to the appropriate configuration sub column of column 5 of the appropriate table. Then go to row 13 where the size of retrofit studs is given. Mark that size in column 6 of the worksheet, for example 2x4, 2x6, 2x8 or 2-2x8.
4. Straps / Columns 7 & 8 of Worksheet. Go to **Table 5.1** or **5.2**. Looking in the appropriate configuration column read down to row 14 to find the minimum length of the strap. Mark that number in column 7 of your worksheet. Similarly, find the number of fasteners to be placed at each end of each strap in row 15 and mark that in column 8 of your worksheet.
5. Compression blocks / Columns 9 & 10. If you have chosen U-bent strap, you are finished with this part of the worksheet. If you have chosen the L-bent method you will need to use a compression block with a minimum length that can accommodate the number of fasteners necessary to anchor it to the horizontal brace. Minimum lengths will vary according to the number of fasteners that are needed which depends on the configuration letter. Using the same methods as before find in row 18 of **Table 5.1** the compression block length. Enter that in

column 9 of the worksheet. Finally, in row 17 find the number of fasteners for each compression block and enter it in column 10.

Planning for the two major gable end retrofitting tasks (making the gable end strong and making the wall-to-wall connection) should be relatively easy now with the information gathered from the previous steps.

This essential information will set you on the path to effectively strengthening of your gable end. Section 9 gives you step-by-step retrofit implementation details.

**First approximation of cost:** The costs of gable end retrofits can vary. The cost estimates below are for each stud location. The majority of retrofits will fall into configurations A and B. Assuming A or B, a rough cost estimate to retrofit a gable end over a typical two-car garage would be \$140 and probably require that seven stud locations to be retrofitted. A 40' wide gable end in a category B or C exposure area and 130 mph wind speed would cost about \$340 for materials. These estimates do not include making the wall-to-wall connections that are necessary. HGA and HGAM connectors with their fasteners cost about \$6 each.

**Table 5.3**

<b>Estimate of material costs for each retrofitted stud location</b>		
<b>Configuration</b>	<b>Cost for L-bent</b>	<b>Cost for U-bent</b>
A	\$18	\$24
B	\$27	\$28
C	\$36	\$36
D	\$67	\$66

One needs to bear in mind that in areas with winds less than 140 mph with Exposure B and gable ends less than 11' high, most retrofits will be configuration A with a few configuration B so the costs will average \$22 for L-bent and \$25 for U-bent.

The cost for the garage example would be about **\$41** and about **\$77** for the 40' wide gable example. On the one hand these costs may seem high. On the other hand they can save your house.