Advanced Wind Mitigation Methodologies, Pt. 1-
Internet Course (5th Edition)

Section 1: Addressing the NEED for Wind Mitigation

Slide 1: Advanced Wind Mitigation Methodologies, Pt. 1- Internet Course (5th Edition)

Slide 2: Welcome to Advanced Wind Mitigation Methodologies, Pt. 1- an Internet Course detailing content from the 5th edition of the Florida Building Code.

Slide 3: I am your instructor Roy Terepka. If you have any questions or comments about the course material presented, I encourage you to contact me at the email address listed below.

Slide 4: Course Objectives

By completing Part 1 of this course you will:

- Understand the need for Wind Mitigation Retrofitting in Florida,
- Learn techniques for home retrofitting including:
    - Prescriptive Techniques for the Installation of Gable-end Bracing,
    - Strengthening and Fastening Roof-Decking Attachments, and
    - Installing Secondary Water Barriers for Roofs.

In Part 2 of the course I will cover:

- the concept of the continuous load path,
- improving roof-to-wall connections, and
- opening protection requirements and approved products.

Slide 5: Hurricane History in Florida

In 2002 the Florida Building Code adopted provisions to strengthen construction practices, to better resist damage from a hurricane-force storm event. This was spurred by the devastation caused by Hurricane Andrew in 1992.

Then, the 2005 hurricane season developed as one of the most active seasons on record. It included 27 named storms, with 15 hurricanes, including seven major ones. It was the most devastating hurricane season the country had ever experienced. During this season, the State of Florida was impacted by four hurricanes, with Wilma ranking as one of the costliest on record. By the end of the hurricane season, 37 of our 67 counties had been declared a federal disaster area, with Miami-Dade, Broward, Palm Beach, and Monroe receiving the most damage.

Just Wilma alone impacted more than 275,000 housing units, resulting in 4.6 billion dollars in insurance claims. Between the 2004 and 2005 hurricane seasons there was a total of 2.8 million insurance claims filed, resulting in over 36 billion dollars in damages. As a result of the insurance industry's recovery response, which included cancelling policies and increasing rates, low and moderate income citizens, already faced with paying high insurance rates, got hit with even higher premiums after the loss.

Although located in Texas, this image of a Galveston home is the perfect example of what can be achieved (and saved) with stronger building construction techniques. While other structures failed under the high winds of Hurricane Ike in 2008, another active hurricane season, this home which was specifically constructed to withstand high wind damage, was the only surviving structure to weather the storm.



<u>Slide 6:</u> Why learn about wind mitigation?

The executive and legislative branches of Florida government have thus made hurricane preparedness, response and recovery a statewide priority. Long-term measures must be taken to protect Florida's homes and businesses to reduce potential losses and ensure the continuation of an affordable insurance market. One of the most cost-beneficial methods of achieving this, is to harden homes to protect against the physical, economic and social impacts of future storms.

In Florida, we have seen significant improvements in mitigating losses due to high wind events since the Code changes were first adopted. However, in order to reinforce and strengthen buildings that were constructed before 2002, including over 4.5 million owned residences and 1.9 million rentals, wind mitigation retrofitting must be achieved. That is why roofing and building contractors are required to fulfill at least one hour of their continuing education requirements with a Wind Mitigation Methodologies course.

Slide 7: Mitigation Techniques

According to the Florida Statutes, the course should address the following mitigation techniques for existing site-built single family residential structures, including but not limited to:

1. Prescriptive techniques for the installation of gable-end bracing,
2. Secondary water barriers for roofs and standards relating to secondary water barriers,
3. Prescriptive techniques for improvement of roof-to-wall connections,
4. Strengthening or correcting roof-decking attachments and fasteners during reroofing, &
5. Adding or strengthening opening protections.

The Legislature finds that the integration of these specifically identified mitigation measures is critical to addressing the serious problem facing the state from damage caused by windstorms.

Slide 8: Insurance Discounts

The need to address wind mitigation in the legislature with such specificity is in part due to the insurance industry. The Florida Cabinet re-evaluated wind mitigation credits for homes built to the new building code standards and determined that consumers who proactively protected their homes from hurricanes should receive a more sizeable insurance discount, and doubled the amount of credits offered to consumers. Now, homeowners that take the initiative to mitigate and harden their homes can, over the life of their insurance policy or mortgage, double their savings on insurance credits.

Slide 9: Qualifying Safeguards

In order to accurately assess premiums for wind insurance, insurers must offer discounts to those who install the proper safeguards, as well as for new construction projects that adhere to the minimum Florida Building Code as currently revised. Such safeguards include, but are not limited to:

- fixtures or construction techniques which enhance roof strength,
- roof covering performance,
- roof-to-wall strength,
- wall-to-floor-to-foundation strength,
- opening protection, and
- window, door, and skylight strength.

These features must be identified on the Uniform Mitigation Verification Inspection Form and be verified and signed by an authorized wind mitigation inspector in order to qualify for the discounts. Authorized licenses include specially trained home inspectors, building code inspectors, general, building, or residential contractors, professional engineers and professional architects.

According to the Florida Office of Insurance Regulation, securing the roof and protecting the windows are the two most cost effective measures that can be taken to secure the home and reduce insurance

premiums. And so, for Homeowners, Insurers, and Contractors wind mitigation has become a necessary focus of attention in recent years.

Slide 10: Eligibility of the Structure

In pinpointing the appropriate methods for performing these improvements we'll be looking at the retrofitting and alteration guidelines in Florida Building Code- Existing Building, which provides state standards for retrofitting homes to increase the resistance of gable end walls to out-of-plane wind loads. These are different than requirements for new construction and are intended for voluntary use. [**FBC-Existing Building**- 1701.1 Purpose.]

There are ten eligibility used to determine whether these retrofitting provision will work for a residence. The building must: [**FBC-Existing Building**- 1701.2 Eligible condition.]

1. be in occupancy Group R-3 (1- and 2-family dwellings),

2. include one or more wood-framed gable end walls constructed using platform framing techniques,

3. have a mean roof height of 35 feet or less,

4. include attic-framing members in the area where retrofit members will be installed that are made of conventional lumber assembled with nails or truss plates,

5. include a wall below the gable end wall that is made of, concrete, masonry, or conventional lumber assembled with nails or truss plates,

6. have, or will be provided with, studs or vertical webs spaced 24 inches on center, maximum for each gable end wall being retrofitted,

7. have a maximum height of 16 feet for each gable end wall being retrofitted,

8. be assigned to risk category I or II in accordance with Table 1604.5 in the Florida Building Code, Building, which is reserved for buildings and structures that represent a relatively low hazard to human life in the event of failure, such as one- and two-family dwellings and accessory structures. [**FBC-Building**- 1604.5 Risk category and Table 1604.5 Risk Category of Buildings and Other Structures.]

9. have a ceiling diaphragm in the area of the retrofit that is comprised of a minimum $^{1}/_{2}$-inch gypsum board, minimum nominal $^{3}/_{8}$-inch wood structural panels, or plaster, and

10. have a roof diaphragm in the area of the retrofit that is a minimum of nominal 4-foot by 8-foot paneling made of plywood, oriented strand board (OSB), or similar, or boards butted to each other along their long edges and ends. [**FBC-Existing Building**- 1701.2 Eligible condition.]

TABLE 1604.5 RISK CATEGORY OF BUILDINGS AND OTHER STRUCTURES

RISK CATEGORY	NATURE OF OCCUPANCY
I	Buildings and other structures that represent a low hazard to human life in the event of failure, including but not limited to: • Agricultural facilities. • Certain temporary facilities. • Minor storage facilities. • Screen enclosures.
II	Buildings and other structures except those listed in Risk Categories I, III and IV
III	Buildings and other structures that represent a substantial hazard to human life in the event of failure, including but not limited to: • Buildings and other structures whose primary occupancy is public assembly with an occupant load greater than 300. • Buildings and other structures containing elementary school, secondary school or day care facilities with an occupant load greater than 250. • Buildings and other structures containing adult education facilities, such as colleges and universities, with an occupant load greater than 500. • Group I-2 occupancies with an occupant load of 50 or more resident care recipients but not having surgery or emergency treatment facilities. • Group I-3 occupancies. • Any other occupancy with an occupant load greater than 5,000[a]. • Power-generating stations, water treatment facilities for potable water, waste water treatment facilities and other public utility facilities not included in Risk Category IV. • Buildings and other structures not included in Risk Category IV containing quantities of toxic or explosive materials that: Exceed maximum allowable quantities per control area as given in Table 307.1(1) or 307.1(2) or per outdoor control area in accordance with the *Florida Fire Prevention Code;* and Are sufficient to pose a threat to the public if released [b].
IV	Buildings and other structures designated as essential facilities, including but not limited to: • Group I-2 occupancies having surgery or emergency treatment facilities. • Fire, rescue, ambulance and police stations and emergency vehicle garages. • Designated earthquake, hurricane or other emergency shelters. • Designated emergency preparedness, communications and operations centers and other facilities required for emergency response. • Power-generating stations and other public utility facilities required as emergency backup facilities for Risk Category IV structures. • Buildings and other structures containing quantities of highly toxic materials that: Exceed maximum allowable quantities per control area as given in Table 307.1(2) or per outdoor control area in accordance with the *Florida Fire Prevention Code;* and Are sufficient to pose a threat to the public if released[b]. • Aviation control towers, air traffic control centers and emergency aircraft hangars. • Buildings and other structures having critical national defense functions. • Water storage facilities and pump structures required to maintain water pressure for fire suppression.

a. For purposes of occupant load calculation, occupancies required by Table 1004.1.2 to use gross floor area calculations shall be permitted to use net floor areas to determine the total occupant load.

b. Where approved by the building official, the classification of buildings and other structures as Risk Category III or IV based on their quantities of toxic, highly toxic or explosive materials is permitted to be reduced to Risk Category II, provided it can be demonstrated by a hazard assessment in accordance with

Slide 11: Materials

All existing lumber framing members and ceiling and roof diaphragms that will be used in the retrofit area must be in sound condition suitable for their purpose. [**FBC-Existing Building**- 1703.1 Existing materials.] So when you're inspecting these components look for defects or damage that could reduce the load-carrying capacity of the member. If any wood materials are found to be insufficient, they should be replaced with new materials. New materials and replacement materials must comply with applicable provisions of the Florida Building Code and/or Residential Code, as applicable.
[**FBC-Existing Building**- 1703.2 New and replacement materials.]

The materials used in the retrofit, including lumber, brackets, connectors, and nails and screws also have specific requirements, sizes and capacities. For example, all lumber must be #2 Spruce-Pine-Fir (South) or better and must be at least 2-inches in nominal thickness where used. All brackets, straps,

plates and connectors must be made of galvanized sheet steel approved for the connection type (i.e. wood-to-wood, wood-to-CMU, or wood-to-concrete.) [**FBC-Existing Building**- 1703.3 Material specifications for retrofit and Table 1703.3 Material Specifications for Retrofits.]

TABLE 1703.3 MATERIAL SPECIFICATIONS FOR RETROFITS

Component	Minimum Size or Thickness	Minimum Material Grade or Type	Minimum Capacity
All lumber	2-inch nominal thickness Minimum depth will vary according to application	#2 Spruce-Pine-Fir (S) or better	Not applicable
Gusset angle bracket	14 gage thickness	Galvanized sheet steel *approved* for connecting wood-to-wood, wood-to-CMU, or wood-to-concrete.	350 pounds uplift and lateral load
Stud-to-plate connector	14 gage thickness	Galvanized sheet steel *approved* for connecting wood-to-wood.	500 pounds uplift
Metal connectors	20 gage thickness	Galvanized sheet steel *approved* for connecting wood-to-wood, wood-to-CMU, or wood-to-concrete.	Not applicable
Nail plates and straps	20 gage thickness	Galvanized sheet steel *approved* for connecting wood-to-wood.	Not applicable

Fasteners can include deck screws, wood screws or nails. #9 deck or wood screws can be 1 $^{1}/_{2}$ inches or 3 inches. Nails must either be 8d common nails, 1 $^{1}/_{2}$ inches, or 10d common nails, 3 inches. Fine threaded screws, finish screws, or drywall screws are not permitted fastener types. [**FBC-Existing Building**- Table 1703.5 Nail and Screw Requirements and 1703.5.1 Screws.] Keep in mind that any fasteners used to secure connectors, must be those that are specifically approved by the manufacturer, and nail plates should have holes that are sized for a minimum of 8d or 10d nails or #9 screws. [**FBC-Existing Building**- 1703.5 Fasteners, 1703.6 Metal connectors and nail plates.]

TABLE 1703.5 NAIL AND SCREW REQUIREMENTS

Minimum Fastener Length	Fastener Type	Shank Diameter (Neglecting galvanizing) Minimum and maximum	Minimum Length of thread	Minimum Head Diameter
1 $^{1}/_{2}$ inches	#9 screws	0.177 inches	1 $^{1}/_{4}$ inches	0.28 inches
	8d common nails	0.131 inches	Not applicable	0.28 inches
3 inches	#9 screws	0.177 inches	1 $^{1}/_{2}$ inches	0.28 inches
	10d common nails	0.148 inches	Not applicable	0.28 inches

For SI: 1 inch = 25.4 mm.

Slide 12: Section Complete

Before we jump into the strengthening provisions and techniques, I want to let you know about some resources that have been built into this course for your convenience. There is a GLOSSARY detailing the terms used throughout this Chapter, at the top of the course player. [**FBC- Existing Building**- 1702 Definitions.] Next to that is a CODE tab which contains all the Figures and Tables referenced throughout

the course as well as any sections of code not fully covered. You can view this material at any time, while watching the class.

Now, let's have a quick learning exercise and then jump into the retrofitting techniques in Section 2.

Slide 13: Learning Exercise 1

No Narration

Section 2: Retrofitting Gable Ends

Slide 1: Advanced Wind Mitigation Methodologies, Pt. 1- Internet Course (5th Edition)

Slide 2: Welcome to Section 2 of your on-line-class, Retrofitting Gable Ends!

Slide 3: Section Preview

In this portion of the course we will review prescriptive techniques for the installation of gable end bracing, including:

- Use of Retrofit Studs,
- Lateral Braces,
- Straps to connect between retrofit studs and lateral braces, and
- Connecting the bottom of the gable end wall to the wall below.

Slide 4: General Schematic

The retrofits that we're about to review are specifically intended for platform framed gable end walls and do not apply to balloon framed gable end walls, which consist of a framing system wherein the vertical wall framing members of the gable end wall and the rectangular wall below are continuous from the top of the gable end wall to the bottom of the wall below. [**F.B.C.- Existing Building-** 1709.1.3- Balloon framed gable end wall and 1702- Definitions.]

Let's take a look at this Figure [**Figure 1704.1**- General Means of Gable End Retrofit], which details the basic components in the retrofit of a truss gable end using the L-Bent Strap method. (The methodology for a conventionally framed gable end will be similar.) The overall scheme we see here uses lateral braces, retrofit studs, attachment straps, and connections to the wall below to strengthen the load path and supplement existing framing. [**F.B.C.- Existing Building-** 1704.1- General Requirements.]

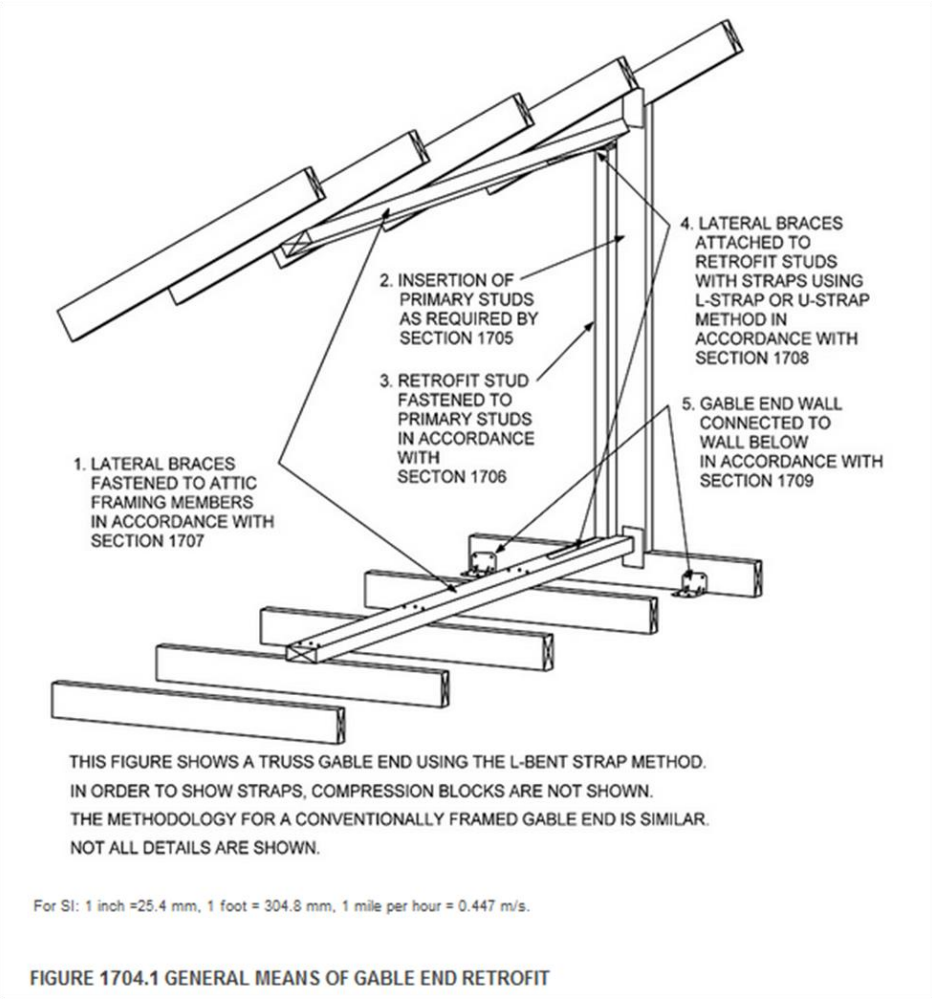


FIGURE 1704.1 GENERAL MEANS OF GABLE END RETROFIT

First lateral, or horizontal, braces are fastened to attic framing members and retrofit studs are installed at each primary stud. **[Sections 1706 and 1707].** Sometimes primary studs need to be added where existing studs are spaced too far apart, but we'll discuss that in a minute. **[Section 1705]**. Then, employing either the L-Strap Method or the U-Strap Method, the lateral braces are attached to the retrofit studs. **[Section 1708].** Finally, the gable end wall is connected to the wall below using a gusset angle bracket specific to the material application **[Section 1709]**.

Slide 5: Added Studs-Requirement

Sometimes it will be necessary to add to the existing studs along the gable end wall before retrofit studs can be installed. When an existing stud and its adjacent stud are both longer than 3 feet and the center to center distance between them is greater than 22 $^{1}/_{2}$ inches, you must add an additional stud. This also applies to the top truss of a piggyback truss assembly. The length of the added stud needs to be the maximum length of the existing stud minus the depth of the top chord and bottom chord members. [**F.B.C.- Existing Building-**1705.1- Requirements for added studs.] They should be installed with the same orientation as the existing studs; and for piggyback trusses added studs must align with the primary studs in the truss below, and at a minimum, have the same narrow and wide face dimensions

as existing studs. [**F.B.C.- Existing Building**-1705.2- Placement of added studs and 1705.1- Requirements for added studs.]

If an existing stud is interrupted by other members, such as by a diagonal in a truss, you must install retrofit stud sections above and below the interrupting member to provide continuity from the top of the bottom chord to the bottom of the top chord of the gable end framing, or wood structural members must be added to provide this continuity. [**F.B.C.- Existing Building**-1705.1- Requirements for added studs.]

Slide 6: Added Studs-Attachment

For conventionally framed gable end walls, each end of an added stud must be attached to the top and bottom plates. For truss construction, each end of an added stud will be attached to the top and bottom chord of the truss. In either case, the attachment will be made using a stud-to-plate metal connector with a minimum uplift capacity of 175 pounds using 1 $^{1}/_{2}$-inch long fasteners. Table 1703.5-Nail and Screw Requirements, specifies the requirements for each fastener type. [**Table 1703.5**- Nail and Screw Requirements]. [**F.B.C.- Existing Building**-1705.3- Attachment of added studs.]

TABLE 1703.5 NAIL AND SCREW REQUIREMENTS

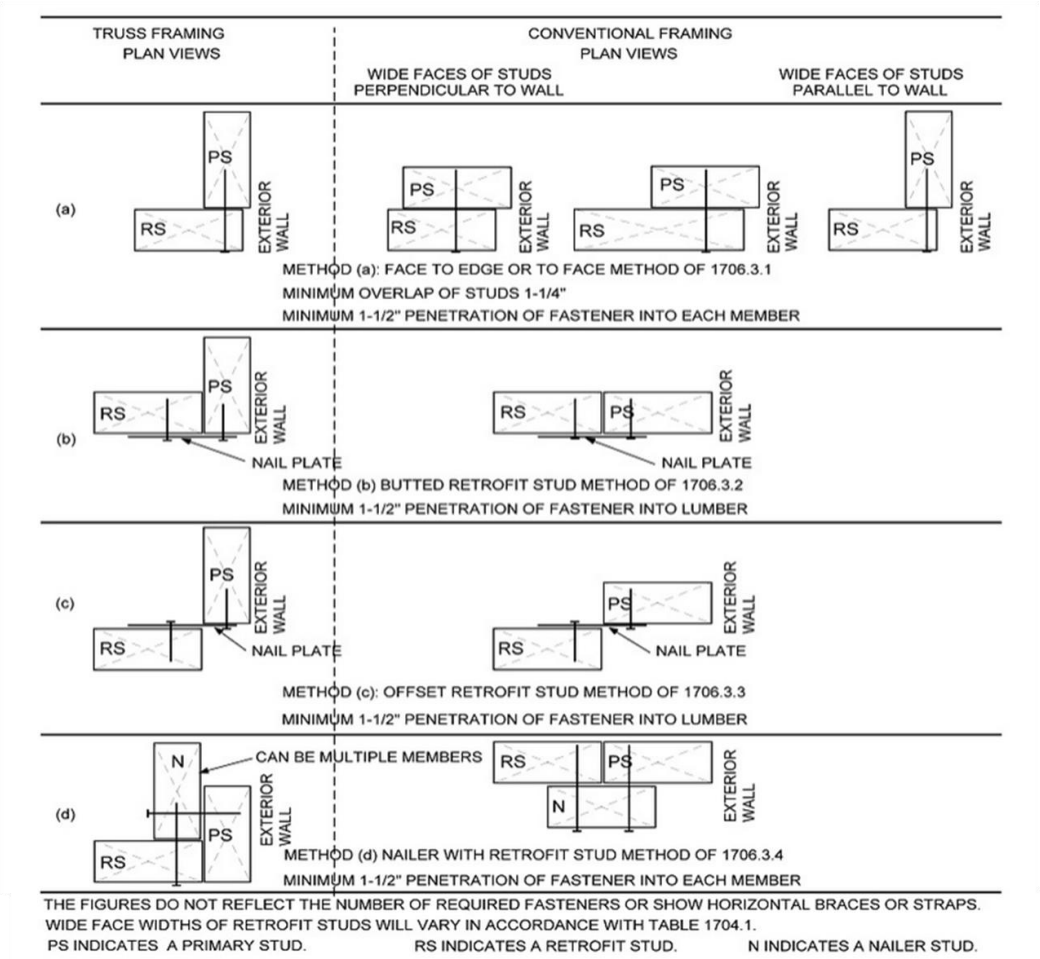
Minimum Fastener Length	Fastener Type	Shank Diameter (Neglecting galvanizing) Minimum and maximum	Minimum Length of thread	Minimum Head Diameter
1 $^{1}/_{2}$ inches	#9 screws	0.177 inches	1 $^{1}/_{4}$ inches	0.28 inches
	8d common nails	0.131 inches	Not applicable	0.28 inches
3 inches	#9 screws	0.177 inches	1 $^{1}/_{2}$ inches	0.28 inches
	10d common nails	0.148 inches	Not applicable	0.28 inches

For SI: 1 inch = 25.4 mm.

In some situations, where existing studs are longer than 3 feet but extend to only one end of attic-framing members it is possible to omit the retrofit stud and its associated lateral braces from that location by installing a ladder assembly meeting specific installation conditions. Likewise, there are alternative retrofitting methods for existing studs that are interrupted because of existing conditions. [**F.B.C.- Existing Building-** 1705.4- Interrupted or short existing studs and 1706.6- Omitted retrofit stud -- Ladder assembly.]

Slide 7: Configuration Methods

Before we continue with the requirements for installing retrofit studs to the primary (existing or added) studs, let's review the four Retrofit Configurations we'll be dealing with. Method (A) is the face to edge or to face method. (B) is the butted retrofit stud method, (C) is the offset retrofit stud method, and method (D) includes both a nailer stud and retrofit stud. [**Figure 1706.3**- Placement of Retrofit Studs]. [**F.B.C.- Existing Building-** 1706.3.1 Method (a): Face to edge or to face method and 1706.3.2 Method (b): Butted retrofit stud method and 1706.3.3 Method (c): Offset retrofit stud method and 1706.3.4 Method (d): Nailer with retrofit stud method.]



For SI: 1 inch = 25.4 mm.

FIGURE 1706.3 PLACEMENT OF RETROFIT STUDS

The method that you choose will be based on the structure's exposure category, the design wind speed, and the stud height, according to Table 1704.1. [**Table 1704.1**- Retrofit Configuration as a Function of Exposure Category, Design Wind Speed, and Stud Height].

TABLE 1704.1 RETROFIT CONFIGURATION AS A FUNCTION OF EXPOSURE CATEGORY, DESIGN WIND SPEED, AND STUD HEIGHT

RETROFIT ELEMENTS				SIZE AND NUMBER OF RETROFIT ELEMENTS Stud length limitations based on Exposure, Basic Wind Speed, and Configuration			
Exposure Category	Max Ultimate Design Wind Speed, V_{ult} (3-sec gust) (Interpolation is not permitted)	Connections of gable end wall to wall below. On center spacing (Section 1708)		Configurations A, B, C, or D			
		Gusset angle bracket (inches)	Fasteners to secure sill plate to wall (inches)	A	B	C	D
D	≤ 130 mph	39	14	6'-11"	10'-11"	14'-3"	16'-0"
D	>130 – 140 mph	34	12	6'-7"	10'-5"	13'-7"	16'-0"
D	>140 – 150 mph	29	10	6'-2"	9'-9"	12'-10"	16'-0"
D	>150 – 160 mph	26	9	5'-11"	9'-1"	12'-0"	15'-4"
D	>160 – 170 mph	23	8	5'-6"	8'-7"	11'-4"	14'-9"
D	>170 – 180 mph	20	7	5'-2"	8'-1"	10'-8"	14'-2"
C	≤130 mph	46	16	7'-4"	11'-6"	15'-1"	16'-0"
C	>130 – 140 mph	39	14	7'-0"	10'-11"	14'-5"	16'-0"
C	>140 – 150 mph	34	12	6'-8"	10'-5"	13'-8"	16'-0"
C	>150 – 160 mph	30	11	6'-4"	9'-10"	13'-0"	16'-0"
C	>160 – 170 mph	27	9	5'-11"	9'-3"	12'-3"	15'-6"
C	>170 – 180 mph	24	8	5'-7"	8'-9"	11'-7"	15'-0"
B	≤130 mph	63	22	8'-2"	12'-10"	16'-0"	Note a
B	>130 – 140 mph	54	19	7'-9"	12'-2"	15'-0"	Note a
B	>140 – 150 mph	47	17	7'-5"	11'-8"	15'-3"	16'-0"
B	>150 – 160 mph	42	15	7'-1"	11'-2"	14'-7"	16'-0"
B	>160 – 170 mph	37	13	6'-10"	10'-8"	14'-0"	16'-0"
B	>170 – 180 mph	33	12	6'-7"	10'-4"	13'-6"	16'-0"
Retrofit studs Minimum size and number (Section 1706)				2 × 4	2 × 6	2 × 8	2 each 2 × 8
Lateral brace above and below (top and bottom) Minimum size and number (Section 1707)				2 × 4	2 × 4	2 × 4	2 each 2 × 8
Retrofit Elements for L-bent strap applications (Section 1708.1.1)							
Fasteners at each end for strap connecting retrofit studs to lateral braces using $1^1/_2$-inch long fasteners complying with Table 1703.5 Minimum number				3	5	6	5 at each end of each strap
Fasteners to connected compression blocks to lateral braces using 3-inch long fasteners complying with Table 1703.5 Minimum number				4	6	7	5
Retrofit Elements for U-bent strap applications (Section 1708.1.2)							
Fasteners to connect straps to each edge of lateral braces using $1^1/_2$-inch long fasteners complying with Table 1703.6 Minimum number				3	4	4	4 at each end of each strap

For SI: 1 inch =25.4 mm, 1 foot = 304.8 mm, 1 mile per hour = 0.447 m/s.

a. Configuration C is allowable.

<u>Slide 8:</u> Exposure Categories

Exposure categories are covered in Chapter 16 of Florida Building Code- Building. Essentially, for each wind direction considered, the exposure category must accurately reflect ground characteristics like natural topography, vegetation and construction features. [**F.B.C.- Building-** 1609.4- Exposure category.]

The three types of <u>surface roughness</u> are:

- Surface Roughness B- Urban and suburban areas, wooded areas and other terrain with numerous closely-spaced obstructions having the size of single-family homes or larger.

- Surface Roughness C- Open terrain with scattered obstructions having heights generally less than 30 feet. This category includes flat open country, and grasslands.
- Surface Roughness D- Flat, unobstructed areas and water surfaces. This category includes smooth mud flats, salt flats and unbroken ice.

[**F.B.C.- Building-** 1609.4.2- Surface roughness categories.]

The exposure category is easy to pinpoint once the ground surface roughness has been determined.

Exposure B: generally applies where Surface Roughness B dominates in the upwind direction for approximately $^1/_3$ to $^1/_2$- mile, depending on the building height.

Exposure D: generally applies where Surface Roughness D dominates in the upwind direction for approximately 1 mile; or where B or C exposures are present immediately upwind of the site, but Exposure D conditions dominate within 600 feet.

Exposure C: applies for all cases where Exposures B and D do not apply.

[**F.B.C.- Building-** 1609.4.3- Exposure Categories.]

Slide 9: Design Wind Speed

Once you have determined the exposure category, the next step in figuring out which Retrofit Configuration you will use is to pinpoint the design wind speed for the structure's location. [**Table 1704.1**- Retrofit Configuration as a Function of Exposure Category, Design Wind Speed, and Stud Height]. We can look to the Building Code and Residential Code to determine the Ultimate-Design Wind Speed for any particular location. Figure R301.2(4) Ultimate Design Wind Speeds, V_{ult}, specifies the appropriate wind speed for each county in the State of Florida. [**F.B.C.- Residential-** Figure R301.2(4) Ultimate Design Wind Speeds, V_{ult}].You can also find this same information in Building Code- Building by referring to Figure 1609A for Risk Category II wind speeds. The information is the same, but Figure R301.2(4) is a little easier to read, and delineates the wind-borne debris regions. [**F.B.C.- Building-** Figure 1609A, Ultimate Design Wind

Speeds, V_{ULT}, For Risk Category II Buildings and Other Structures.]

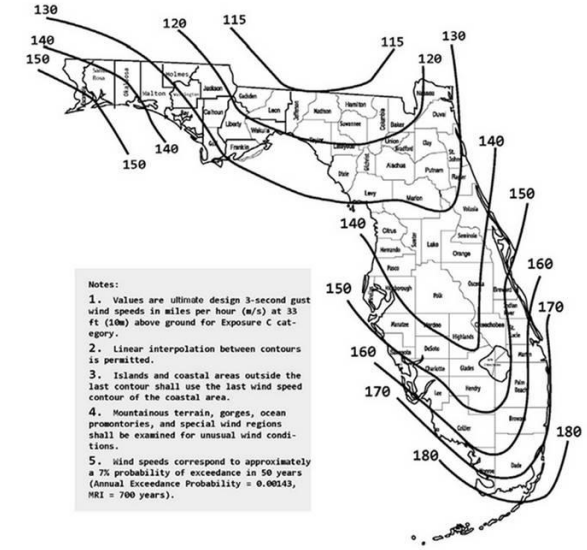


FIGURE 1609A ULTIMATE DESIGN WIND SPEEDS, V_{ULT}, FOR RISK CATEGORY II BUILDINGS AND OTHER STRUCTURES

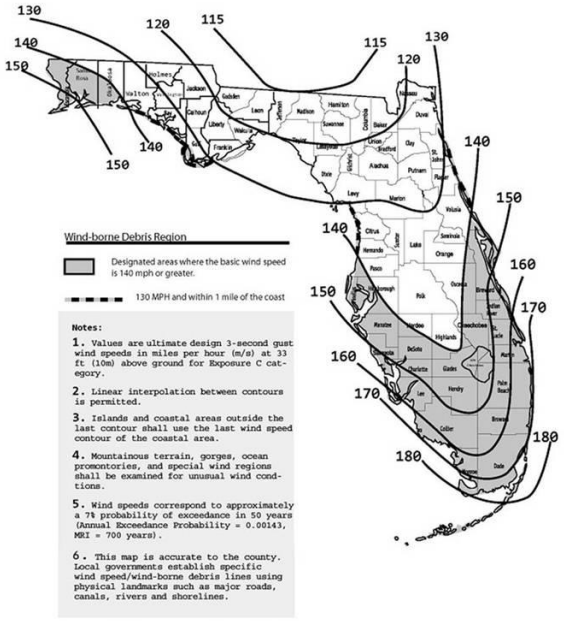


FIGURE R301.2(4) ULTIMATE DESIGN WIND SPEEDS V_{ult}

Simply pinpoint your location and correspond the specified wind speed to the range indicated in Table 1704.1. For example, in Pinellas county the design wind speed is between 140 and 150 miles per hour. For an Exposure B building, I can now determine the best Retrofit Configuration based on the stud heights I'm dealing with. The chosen configuration will dictate how our retrofit studs are installed. [**Table 1704.1**- Retrofit Configuration as a Function of Exposure Category, Design Wind Speed, and Stud Height].

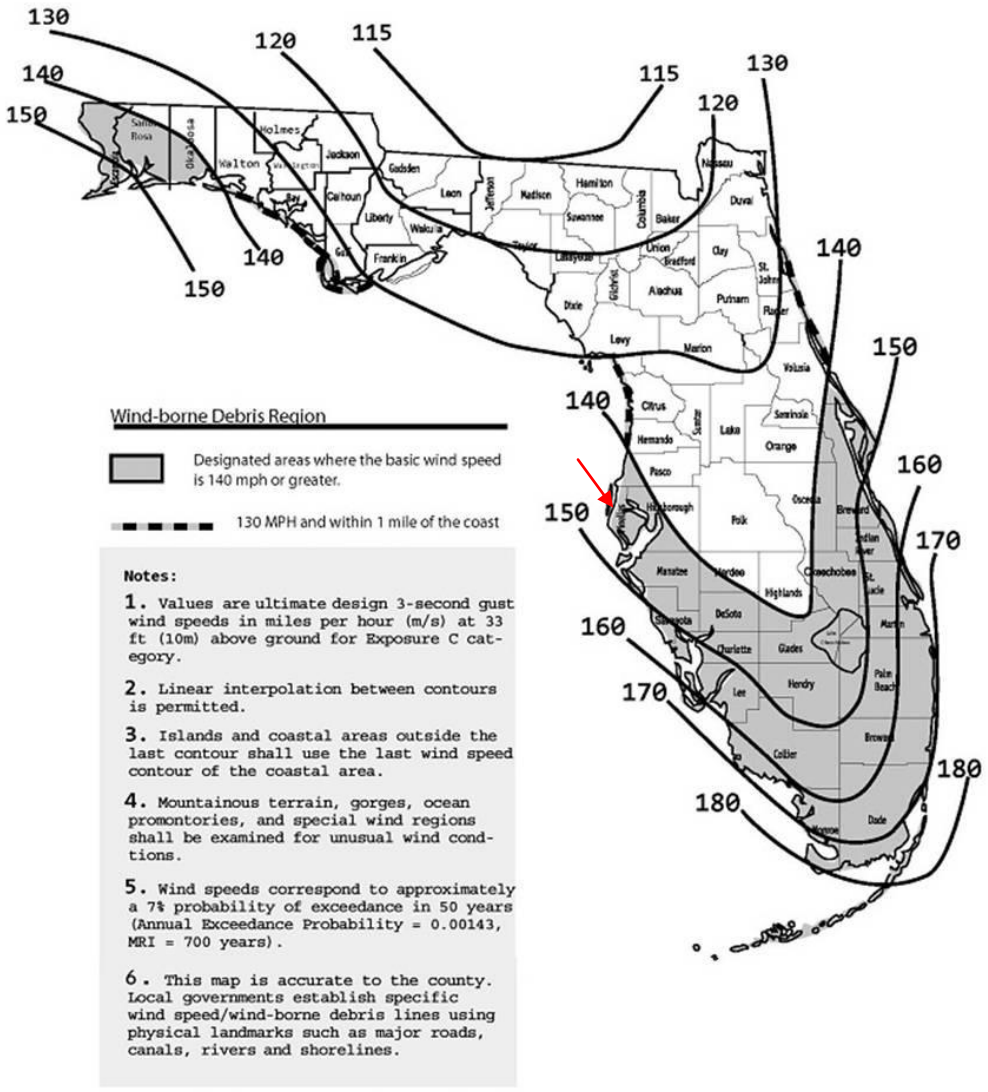


FIGURE R301.2(4) ULTIMATE DESIGN WIND SPEEDS V_{ult}

TABLE 1704.1 RETROFIT CONFIGURATION AS A FUNCTION OF EXPOSURE CATEGORY, DESIGN WIND SPEED, AND STUD HEIGHT

RETROFIT ELEMENTS				SIZE AND NUMBER OF RETROFIT ELEMENTS Stud length limitations based on Exposure, Basic Wind Speed, and Configuration			
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		Gusset angle bracket (inches)	Fasteners to secure sill plate to wall (inches)	A	B	C	D
D	≤ 130 mph	39	14	6'-11"	10'-11"	14'-3"	16'-0"
D	>130 – 140 mph	34	12	6'-7"	10'-5"	13'-7"	16'-0"
D	>140 – 150 mph	29	10	6'-2"	9'-9"	12'-10"	16'-0"
D	>150 – 160 mph	26	9	5'-11"	9'-1"	12'-0"	15'-4"
D	>160 – 170 mph	23	8	5'-6"	8'-7"	11'-4"	14'-9"
D	>170 – 180 mph	20	7	5'-2"	8'-1"	10'-8"	14'-2"
C	≤130 mph	46	16	7'-4"	11'-6"	15'-1"	16'-0"
C	>130 – 140 mph	39	14	7'-0"	10'-11"	14'-5"	16'-0"
C	>140 – 150 mph	34	12	6'-8"	10'-5"	13'-8"	16'-0"
C	>150 – 160 mph	30	11	6'-4"	9'-10"	13'-0"	16'-0"
C	>160 – 170 mph	27	9	5'-11"	9'-3"	12'-3"	15'-6"
C	>170 – 180 mph	24	8	5'-7"	8'-9"	11'-7"	15'-0"
B	≤130 mph	63	22	8'-2"	12'-10"	16'-0"	Note a
B	>130 – 140 mph	54	19	7'-9"	12'-2"	15'-0"	Note a
B	>140 – 150 mph	47	17	7'-5"	11'-8"	15'-3"	16'-0"
B	>150 – 160 mph	42	15	7'-1"	11'-2"	14'-7"	16'-0"
B	>160 – 170 mph	37	13	6'-10"	10'-8"	14'-0"	16'-0"
B	>170 – 180 mph	33	12	6'-7"	10'-4"	13'-6"	16'-0"
Retrofit studs Minimum size and number (Section 1706)				2 × 4	2 × 6	2 × 8	2 each 2 × 8
Lateral brace above and below (top and bottom) Minimum size and number (Section 1707)				2 × 4	2 × 4	2 × 4	2 each 2 × 8
Retrofit Elements for L-bent strap applications (Section 1708.1.1)							
Fasteners at each end for strap connecting retrofit studs to lateral braces using $1^1/_2$-inch long fasteners complying with Table 1703.5 Minimum number				3	5	6	5 at each end of each strap
Fasteners to connected compression blocks to lateral braces using 3-inch long fasteners complying with Table 1703.5 Minimum number				4	6	7	5
Retrofit Elements for U-bent strap applications (Section 1708.1.2)							
Fasteners to connect straps to each edge of lateral braces using $1^1/_2$-inch long fasteners complying with Table 1703.6 Minimum number				3	4	4	4 at each end of each strap

For SI: 1 inch =25.4 mm, 1 foot = 304.8 mm, 1 mile per hour = 0.447 m/s.

a. Configuration C is allowable.

Slide 10: Requirements for Retrofit Studs

Now that we know how to figure out the exposure category, wind speed, and stud length limitations for each design configuration, let's go over the general requirements for retrofit studs, and then discuss specific requirements for each configuration type.

A retrofit stud must be installed at each primary stud longer than 3 feet, where lateral braces can be installed at each end and secured to the attic framing members. Installation and securement of the lateral brace will vary based on the type of construction and configuration method. [**F.B.C.- Existing Building** -Section 1707 Lateral Braces] Also, the length and size of the retrofit stud is determined by 1) the configuration method as outlined in Table 1704.1, and 2) the securement method utilized. [**F.B.C.- Existing Building**- 1706.1- Requirements for retrofit studs.]

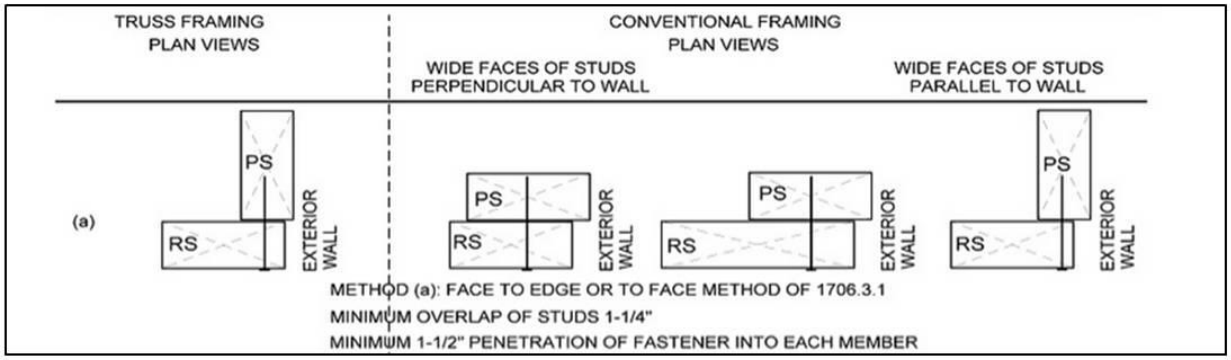
For the L-bent strap securement method, retrofit studs must extend from the top of the lower lateral brace up to the bottom of the upper lateral brace, with a maximum gap of $^1/_8$ inch allowed at the bottom and $^1/_2$ inch allowed at the top. For the U-bent strap securement method, retrofit studs must extend beyond the ends of lateral braces so that lateral braces can fully butt against the retrofit studs. [**F.B.C.- Existing Building-** 1706.1- Requirements for retrofit studs.]

The primary studs of piggyback trusses need to have retrofit studs sized and placed so that a single continuous retrofit stud is installed and fastened to the primary stud of both the lower and upper truss. The bottom chord of the upper truss needs to be connected to the retrofit stud using an approved connector with minimum tension capacity of 175 pounds. [**F.B.C.- Existing Building-** 1706.2- Piggyback trusses.]

Slide 11: Placement of Retrofit Studs

Retrofit studs can be placed on either side of primary studs, and shall be installed according to one of the following methods, all of which require a minimum of 1 $^1/_2$ -inch fastener penetration into the lumber members.

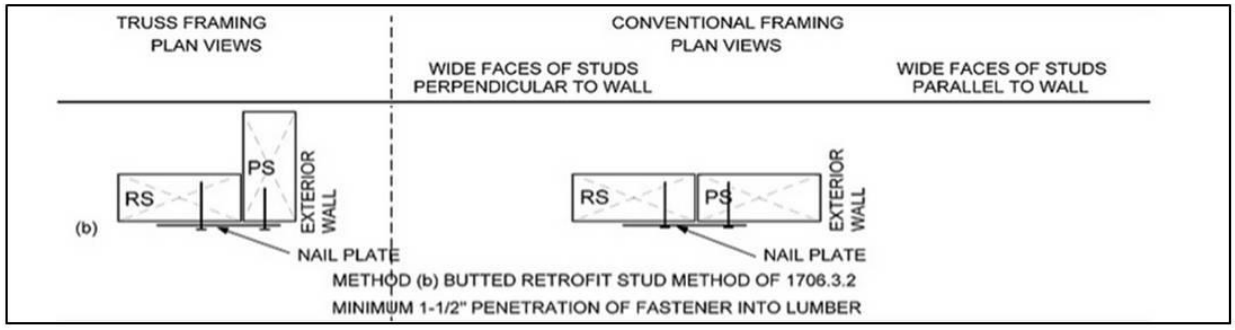
For method (a): **"Face to Edge or to Face Method,"** you can see the basic position for the retrofit stud in relation to the primary stud in plan view for both Truss Framing and Conventional Framing. For either framing type the studs are placed immediately adjacent to one another so that the retrofit stud overlaps the edge or side of the primary stud by at least 1-$^1/_4$.
[**F.B.C.- Existing Building- Figure 1706.3-** Placement of retrofit studs (a) and 1706.3.1 Method (a): Face to edge or to face method.]



RETROFIT ELEMENTS				SIZE AND NUMBER OF RETROFIT ELEMENTS Stud length limitations based on Exposure, Basic Wind Speed, and Configuration			
Exposure Category	Max Ultimate Design Wind Speed, V_{ult} (3-sec gust) (Interpolation is not permitted)	Connections of gable end wall to wall below. On center spacing (Section 1708)		Configurations A, B, C, or D			
		Gusset angle bracket (inches)	Fasteners to secure sill plate to wall (inches)	A	B	C	D
B	>140 – 150 mph	47	17	7'-5"	11'-8"	15'-3"	16'-0"
Retrofit studs Minimum size and number (Section 1706)				2 × 4	2 × 6	2 × 8	2 each 2 × 8
Lateral brace above and below (top and bottom) Minimum size and number (Section 1707)				2 × 4	2 × 4	2 × 4	2 each 2 × 8

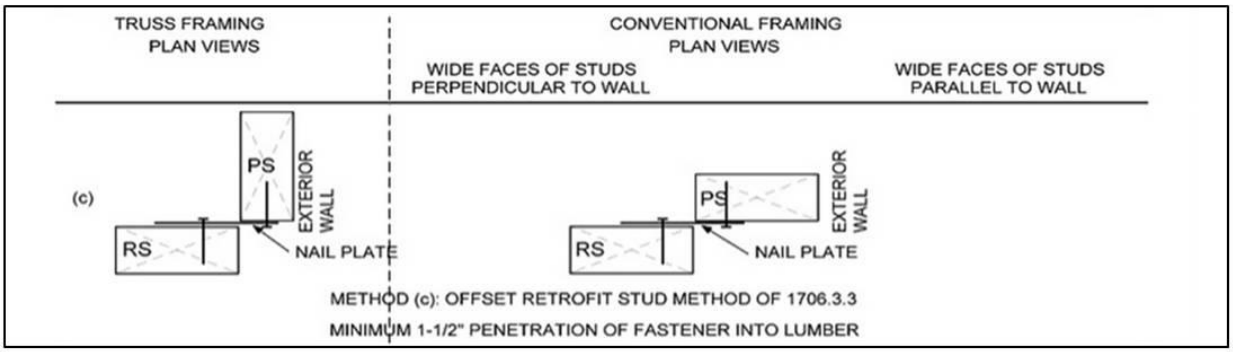
If we continue our hypothetical Exposure B location in Pinellas County, my retrofit stud cannot be longer than 7'-5" in order to use this configuration, and it must be a minimum of 2 x 4. The lateral brace above and below the retrofit stud must also be a minimum of 2 x4.
[**Table 1704.1**- Retrofit Configuration as a Function of Exposure Category, Design Wind Speed, and Stud Height].

For method (b): **"Butted Retrofit Stud Method"**, the narrow face of the retrofit stud is butted up snugly to the primary stud and utilizes a nail plate for securement. With this method, my hypothetical stud height is limited to 11'-8" and the minimum size is 2 x 6. However, the lateral braces above and below can still be 2 x 4.
[**F.B.C.- Existing Building- Figure 1706.3-** Placement of retrofit studs (b) and 1706.3.2 Method (b): Butted retrofit stud method.] [**Table 1704.1**- Retrofit Configuration as a Function of Exposure Category, Design Wind Speed, and Stud Height].



RETROFIT ELEMENTS				SIZE AND NUMBER OF RETROFIT ELEMENTS Stud length limitations based on Exposure, Basic Wind Speed, and Configuration			
Exposure Category	Max Ultimate Design Wind Speed, V_{ult} (3-sec gust) (Interpolation is not permitted)	Connections of gable end wall to wall below. On center spacing (Section 1708)		Configurations A, B, C, or D			
		Gusset angle bracket (inches)	Fasteners to secure sill plate to wall (inches)	A	B	C	D
B	>140 – 150 mph	47	17	7'-5"	11'-8"	15'-3"	16'-0"
Retrofit studs Minimum size and number (Section 1706)				2 × 4	2 × 6	2 × 8	2 each 2 × 8
Lateral brace above and below (top and bottom) Minimum size and number (Section 1707)				2 × 4	2 × 4	2 × 4	2 each 2 × 8

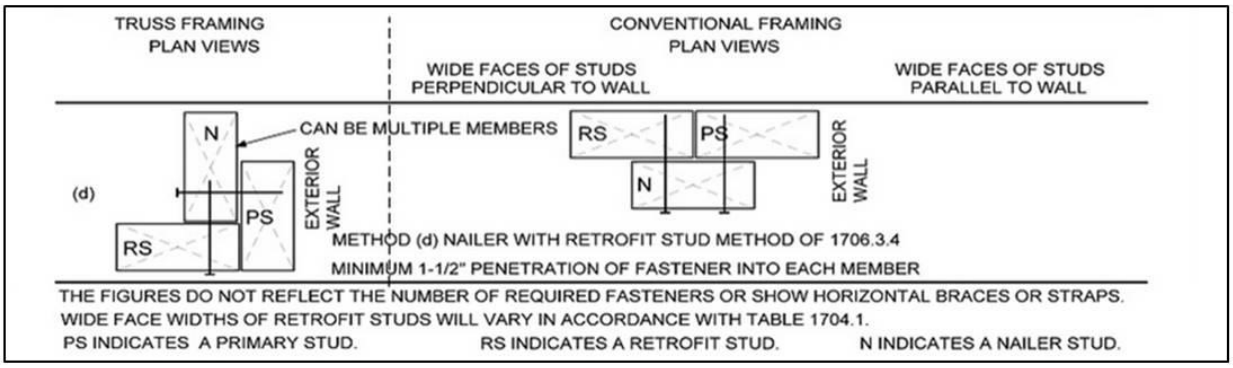
For method (c): **"Offset Retrofit Stud Method"**, the retrofit stud is next to, but offset from, the primary stud, with no overlap. A nail plate must be used to secure the two members. In this method the primary stud can be oriented edge wise or flat wise. The length limitation of the retrofit stud would be 15'-3" and must be a minimum of 2 x 8 for my Pinellas Exposure B structure. Our lateral brace for this method would still be 2 x 4. We'll take a look at the specifics for securing the nail plate in just a few minutes.
[**F.B.C.- Existing Building- Figure 1706.3-** Placement of retrofit studs (c) and 1706.3.3 Method (c): Offset retrofit stud method.] [**Table 1704.1**- Retrofit Configuration as a Function of Exposure Category, Design Wind Speed, and Stud Height].



RETROFIT ELEMENTS				SIZE AND NUMBER OF RETROFIT ELEMENTS Stud length limitations based on Exposure, Basic Wind Speed, and Configuration			
Exposure Category	Max Ultimate Design Wind Speed, V_{ult} (3-sec gust) (Interpolation is not permitted)	Connections of gable end wall to wall below. On center spacing (Section 1708)		Configurations A, B, C, or D			
		Gusset angle bracket (inches)	Fasteners to secure sill plate to wall (inches)	A	B	(C)	D
B	>140 – 150 mph	47	17	7'-5"	11'-8"	15'-3"	16'-0"
Retrofit studs Minimum size and number (Section 1706)				2 × 4	2 × 6	2 × 8	2 each 2 × 8
Lateral brace above and below (top and bottom) Minimum size and number (Section 1707)				2 × 4	2 × 4	2 × 4	2 each 2 × 8

For method (d): **"Nailer with Retrofit Stud Method"**, the underlying design is the same as method (b) but requires a nailer stud instead of a nail plate to secure the members. This is because the stud length can be as high as 16'-0" in most situations. This method calls for a minimum of two 2 x 8 studs, and two 2 x 8 lateral braces attached to the attic framing.

[**F.B.C.- Existing Building- Figure 1706.3-** Placement of retrofit studs (d) and 1706.3.4 Method (d): Nailer with retrofit stud method.] [**Table 1704.1**- Retrofit Configuration as a Function of Exposure Category, Design Wind Speed, and Stud Height].



RETROFIT ELEMENTS				SIZE AND NUMBER OF RETROFIT ELEMENTS Stud length limitations based on Exposure, Basic Wind Speed, and Configuration			
Exposure Category	Max Ultimate Design Wind Speed, V_{ult} (3-sec gust) (Interpolation is not permitted)	Connections of gable end wall to wall below. On center spacing (Section 1708)		Configurations A, B, C, or D			
		Gusset angle bracket (inches)	Fasteners to secure sill plate to wall (inches)	A	B	C	(D)
B	>140 – 150 mph	47	17	7'-5"	11'-8"	15'-3"	16'-0"
Retrofit studs Minimum size and number (Section 1706)				2 × 4	2 × 6	2 × 8	2 each 2 × 8
Lateral brace above and below (top and bottom) Minimum size and number (Section 1707)				2 × 4	2 × 4	2 × 4	2 each 2 × 8

Slide 12: Nailer Fastening

Nailer studs can be comprised of multiple members lengthwise, but must follow these other conditions for fastening:

1. Both the primary stud and the retrofit stud are butted to the nailer(s) and both are fastened to it with 3-inch fasteners, spaced 6-inches on center for each stud, and as with the other methods, there is a minimum penetration of 1 ½ inches.

2. Fasteners into nailers through the face of either member must be offset vertically by a minimum of 2 $^{3}/_{4}$ -inches.

3. Fasteners into nailers shall be a minimum of 2 $^{3}/_{4}$ -inches but not more than 6 inches from the end of the shorter of the primary stud or retrofit stud to which they are fastened.

4. Fasteners shall be placed a minimum of $^{1}/_{2}$ -inch from the edges of studs.
[**F.B.C.- Existing Building-** 1706.3.4 Method (d): Nailer with retrofit stud method.]

These are essentially the same fastening requirements for Configuration A for attaching the retrofit stud and primary stud. [**F.B.C.- Existing Building-** 1706.4.1 Fastener attachments.]

Slide13: Nail Plate Fastening

For methods (b) and (c), where a nail plate is used, the nail plate must be spaced and attached in accordance with the following conditions and corresponding Figure 1706.4.2 :
[**Figure 1706.4.2**- Nail Plate Fastening]:

1. The maximum vertical spacing between nail plates is 20 inches.

2. There must be at least three fasteners through each nail plate into both the primary and retrofit studs, for total minimum of 6 fasteners.

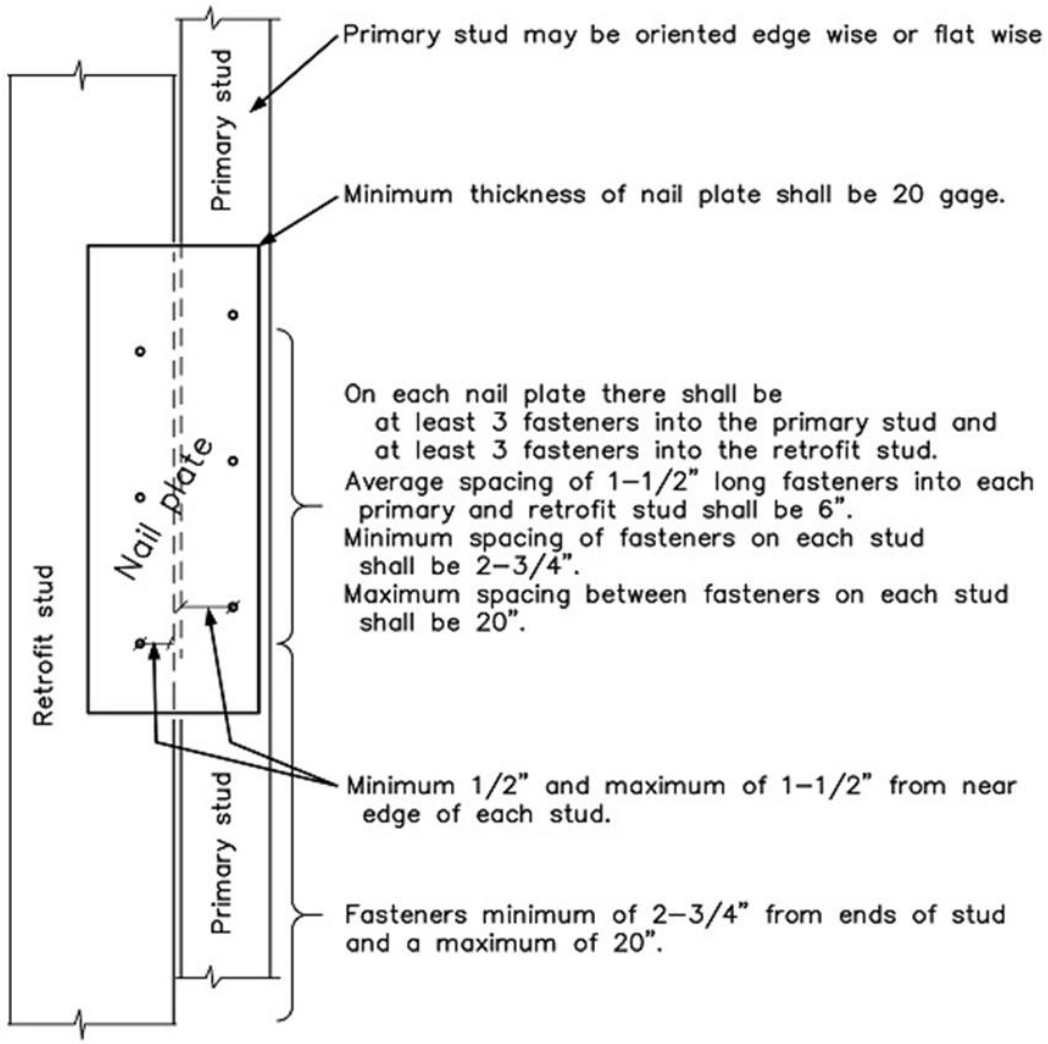
3. Fasteners used to secure nail plates to studs must be a minimum of 1 $^{1}/_{2}$-inches long and be located a minimum of 2 $^{3}/_{4}$-inches and a maximum of 6-inches from the ends of retrofit studs.

4. Fasteners should be a minimum of 2 $^{3}/_{4}$ -inches along the length and from ends of lumber.

5. Fasters must be at least $^{1}/_{2}$-inch from the edges of the studs and a maximum of 1 $^{1}/_{2}$-inches from the abutting vertical edges of primary and retrofit studs.

6. Staggered fasteners used to secure nail plates should be spaced horizontally a minimum of $^{1}/_{2}$-inch.

[**F.B.C.- Existing Building-** 1706.4.2 Nail plate attachments and **Figure 1706.4.2** Nail Plate Fastening.]



For SI: 1 inch = 25.4 mm

FIGURE 1706.4.2 NAIL PLATE FASTENING

Methods (a) through (d) are the most ideal design configurations; however, there are several additional sections for instances when the ideal configuration cannot be achieved. Please refer to Sections 1706.5- 1706.9 to review all the installation requirements for reduced, omitted, interrupted, short and spliced retrofit studs.

[**F.B.C.- Existing Building-** 1706.5 Reduced width of retrofit studs, 1706.6 Omitted retrofit stud -- Ladder assembly, 1706.7 Interrupted primary studs, 1706.8 Short retrofit studs, and 1706.9 Spliced retrofit studs.]

Let's move on to the requirements for lateral braces.

Slide 14: Placement of Lateral Braces

Lateral braces are going to be installed at each end of a retrofit stud and attached to both attic framing members and the retrofit stud, using either the L-bent strap method or the U-bent strap method. The attachment technique will also vary according to the type of framing. We'll take look at those individual figures in just a minute. [**F.B.C.- Existing Building-** 1707.1 Requirements for lateral braces.]

The lateral braces need be placed perpendicular to the attic-framing members and extend so their wide faces are attached to a minimum of three attic-framing members. The attic-framing member that is farthest away from the gable end wall must be a minimum of 6 feet from the exterior sheathing or siding on that wall.

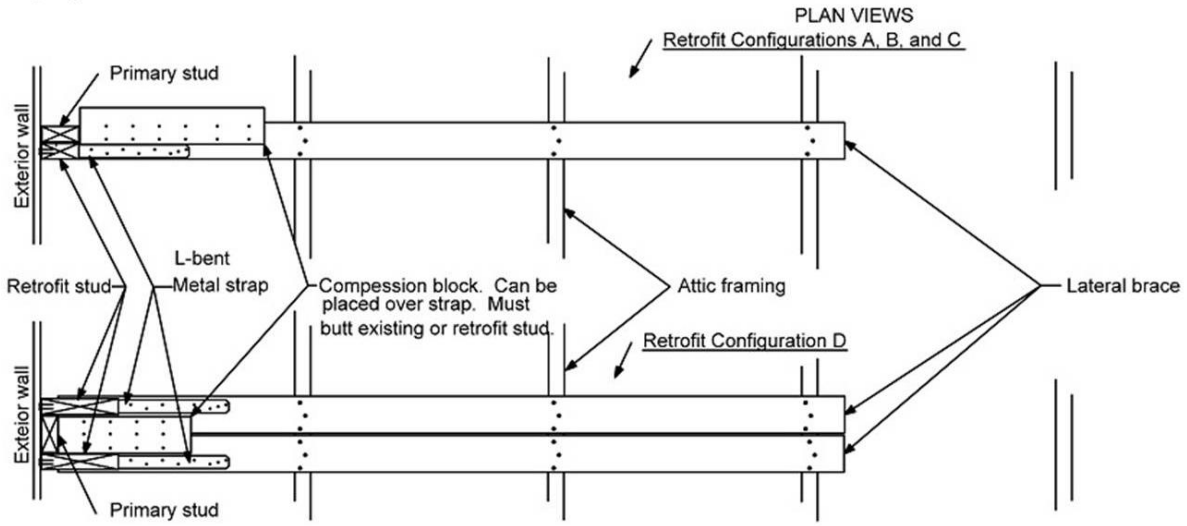
For the L-bent strap method, lateral braces are going to butt up against the sheathing or siding. For the U-bent strap method, the lateral braces will butt up against the retrofit studs. [**F.B.C.- Existing Building-** 1707.2 Placement.] Again, there are alternative installation provisions for where existing conditions prevent the placement of a continuous lateral brace on attic-framing members, and you can access those from the CODES Tab. Let's review the ideal attachment methods. [**F.B.C.- Existing Building-** 1707.2 Placement- Exception.]

Slide 15: Attachment of Lateral Braces to Attic-Framing Members

The lateral braces are attached to the attic framing members *and* to retrofit studs. The methods of attachment are going to be different for each.

To attach to attic-framing members or ridge ties, there must be a minimum of three 3-inch fasteners installed in each framing member the brace crosses. The fastener must be installed at least $^{1}/_{2}$-inch from any edge of the lumber (either the brace or the framing member) and be spaced at least 1-inch apart, across the width of the lateral brace. Lateral braces should extend a minimum of 2 $^{3}/_{4}$ -inches beyond the edge of the last attic-framing member to which they are attached.

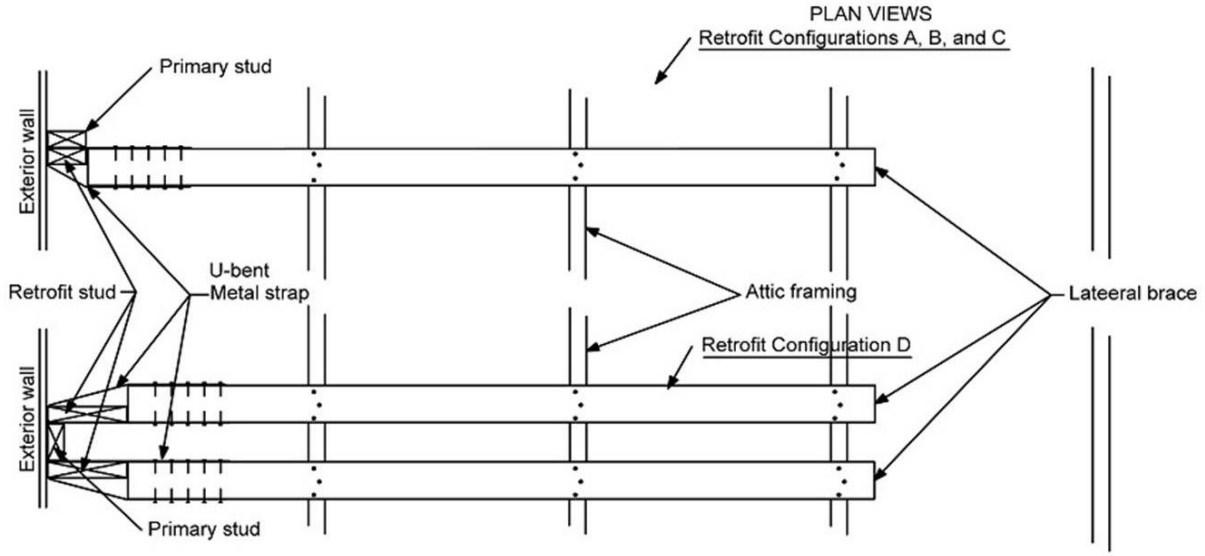
Here are two examples: one is for a Truss gable end wall with L-Bent straps and the second is for a Conventionally Framed gable end wall with U-Bent straps. [**F.B.C.- Existing Building-** 1707.3 Attachment of lateral braces.] [Figure 1707.1(1) Truss Gable End Wall with L-Bent Straps and 1707.1(4) Conventionally Framed Gable End Wall with U-Bent Straps]



Fasteners shall not be placed closer to end of lumber than 2-3/4".
Fasteners shall not be placed closer to edges of lumber than 1/2" except where straps dictate otherwise.
The number of fasteners shown is not necessarily the number required.

For SI: 1 inch = 25.4 mm

FIGURE 1707.1(1) TRUSS GABLE END WALL WITH L-BENT STRAPS



Fasteners shall not be closer to ends of lumber than 2-3/4".
Fasteners shall not be closer to edges of lumber than 1/2" except where straps dictate otherwise.
The number of fastners shown is not necessarily the number required.

For SI: 1 inch = 25.4 mm

FIGURE 1707.1(4) CONVENTIONALLY FRAME GABLE END WALL WITH U-BENT STRAPS

Slide 16: Blocking Attachment to Lateral Braces

Sometimes it will be necessary to install an anchor block in each space between ceiling members along the entire length of the lateral brace, except for the space next to the gable end wall. This will occur where ceiling joists or truss bottom chords are deeper than 6 -inches. In such a case you must observe the following conditions:

1. The anchor block must be a minimum of $^{15}/_{32}$-inch plywood, $^{7}/_{16}$-inch OSB, or nominal 2-inch thick #2 spruce-pine-fir, or better.

2. The wide face dimension of the anchor block must be at least as wide as the attic-framing member at the location where the block is installed. The anchor block must extend between attic-framing members and butt against them or their truss plates with a maximum gap of $^{1}/_{8}$-inch.

3. The wide face of anchor blocks are installed on the narrow face of the lateral brace, and should be placed on the brace with their attic interior edge flush with the attic interior face of the brace. However, they are permitted to be placed on different edges of the lateral brace.

4. Anchor blocks should be attached to the lateral braces using a single row of 8d or 10d common nails, or #9 screws with a minimum penetration into the brace equal to the thickness of the anchor block or 1-inch, whatever is greater. Place the maximum number of fasteners as possible in a single row while maintaining a minimum of 2 $^{3}/_{4}$ inches between fasteners and 2 $^{3}/_{4}$ inches from ends of anchor blocks. For a nominal 2-inch thick anchor block three fasteners is good. [**F.B.C.- Existing Building-** 1707.3.3 Blocking attachment to lateral braces.]

Slide 17: Alternative Provisions

Before we move on to the attachment of Lateral Braces to the Retrofit Studs, I just want to remind you of the alternate installation provisions for instances when existing conditions prevent the ideal installation. Check out the CODE tab for Sections 1707.4.1 through 1707.4.3 detailing the provisions for an Omitted, Interrupted, and Short lateral brace. [**F.B.C.- Existing Building-** 1707.4.1 Omitted lateral brace and 1707.4.2 Interrupted lateral braces and 1707.4.3 Short lateral brace.]

There are additional provisions in the following sections that are specific to truss assemblies. Section 1707.5 provides conditions for the installation of lateral braces on diagonal webs or vertical members of trusses where existing conditions prevent installation of the lateral braces on top or bottom chords. In general, the lateral brace must be positioned as close to the ceiling or roof diaphragms as possible without altering any truss components. This method does require a similar anchor block installation as discussed on the previous slide. [**F.B.C.- Existing Building-** 1707.5 Lateral brace connections to webs of trusses.]

Near roof peaks existing conditions can prevent the installation of lateral braces. In such cases 2 x 4 ridge ties should be installed horizontally on truss faces to provide anchorage for a required lateral brace. The installation should be no more than 4 inches below limiting conditions for any of the trusses used to support the lateral brace, and should be aligned to support a continuous lateral brace. Ridge ties must be installed on every truss over which the lateral braces passes, 3 trusses at a minimum, and be attached to an attic-framing member at least 6 feet from the exterior of the gable end wall. Specific fastening requirements apply. [**F.B.C.- Existing Building-** 1707.6 Installation at truss ridges.]

Also, where outlookers are installed to support a gable roof overhang, they need to be attached to the gable end truss or rafter with a connector and any interior rafter they butt against with a joist hanger or U-shaped metal connector; all having a minimum 175 pound uplift capacity. [**F.B.C.- Existing Building-** 1707.8 Outlookers.]

Slide 18: Attaching Lateral Braces to Retrofit Studs

The lateral braces must be attached to the top and bottom of each retrofit stud with metal straps, using either the L-bent or U-bent strap method. Either method can be use at either end of a retrofit stud. The straps must have product approval, be at least 1 $^{1}/_{4}$" wide, and come with pre-punched holes sized for 10d or 16d common nails or #9 screws. The straps will be fastened according to the size and number indicated for the Retrofit Configuration Method from Table 1704.1. [**Table 1704.1**- Retrofit Configuration as a Function of Exposure Category, Design Wind Speed, and Stud Height]. [**F.B.C.- Existing Building-** 1708.1 Attachment of lateral braces to retrofit studs.]

TABLE 1704.1 RETROFIT CONFIGURATION AS A FUNCTION OF EXPOSURE CATEGORY, DESIGN WIND SPEED, AND STUD HEIGHT

RETROFIT ELEMENTS				SIZE AND NUMBER OF RETROFIT ELEMENTS Stud length limitations based on Exposure, Basic Wind Speed, and Configuration			
Exposure Category	Max Ultimate Design Wind Speed, V_{ult} (3-sec gust) (Interpolation is not permitted)	Connections of gable end wall to wall below. On center spacing (Section 1708)		Configurations A, B, C, or D			
		Gusset angle bracket (inches)	Fasteners to secure sill plate to wall (inches)	A	B	C	D
D	≤ 130 mph	39	14	6'-11"	10'-11"	14'-3"	16'-0"
D	>130 – 140 mph	34	12	6'-7"	10'-5"	13'-7"	16'-0"
D	>140 – 150 mph	29	10	6'-2"	9'-9"	12'-10"	16'-0"
D	>150 – 160 mph	26	9	5'-11"	9'-1"	12'-0"	15'-4"
D	>160 – 170 mph	23	8	5'-6"	8'-7"	11'-4"	14'-9"
D	>170 – 180 mph	20	7	5'-2"	8'-1"	10'-8"	14'-2"
C	≤130 mph	46	16	7'-4"	11'-6"	15'-1"	16'-0"
C	>130 – 140 mph	39	14	7'-0"	10'-11"	14'-5"	16'-0"
C	>140 – 150 mph	34	12	6'-8"	10'-5"	13'-8"	16'-0"
C	>150 – 160 mph	30	11	6'-4"	9'-10"	13'-0"	16'-0"
C	>160 – 170 mph	27	9	5'-11"	9'-3"	12'-3"	15'-6"
C	>170 – 180 mph	24	8	5'-7"	8'-9"	11'-7"	15'-0"
B	≤130 mph	63	22	8'-2"	12'-10"	16'-0"	Note a
B	>130 – 140 mph	54	19	7'-9"	12'-2"	15'-0"	Note a
B	>140 – 150 mph	47	17	7'-5"	11'-8"	15'-3"	16'-0"
B	>150 – 160 mph	42	15	7'-1"	11'-2"	14'-7"	16'-0"
B	>160 – 170 mph	37	13	6'-10"	10'-8"	14'-0"	16'-0"
B	>170 – 180 mph	33	12	6'-7"	10'-4"	13'-6"	16'-0"
Retrofit studs Minimum size and number (Section 1706)				2 × 4	2 × 6	2 × 8	2 each 2 × 8
Lateral brace above and below (top and bottom) Minimum size and number (Section 1707)				2 × 4	2 × 4	2 × 4	2 each 2 × 8
Retrofit Elements for L-bent strap applications (Section 1708.1.1)							
Fasteners at each end for strap connecting retrofit studs to lateral braces using $1^{1}/_{2}$-inch long fasteners complying with Table 1703.5 Minimum number				3	5	6	5 at each end of each strap
Fasteners to connected compression blocks to lateral braces using 3-inch long fasteners complying with Table 1703.5 Minimum number				4	6	7	5
Retrofit Elements for U-bent strap applications (Section 1708.1.2)							
Fasteners to connect straps to each edge of lateral braces using $1^{1}/_{2}$-inch long fasteners complying with Table 1703.6 Minimum number				3	4	4	4 at each end of each strap

For SI: 1 inch =25.4 mm, 1 foot = 304.8 mm, 1 mile per hour = 0.447 m/s.

a. Configuration C is allowable.

Let's take a look at some of the details for the L-Bent Strap Method.

When the metal strap is bent into an 'L' shape it can be secured vertically to the back of the retrofit stud (nearest the exterior of the gable end wall) and horizontally to the face of the lateral brace. [**Figure 1707.1(1)**- Truss Gable End Wall with L-Bent Straps]. This figure details the installation of L-Bent straps for Configurations A, B, and C [**Figure 1708.1.1(1)-** L-Bent Strap Method for Configurations A, B, and C]. Configuration D is slightly different because it features two lateral braces and additional fasteners.

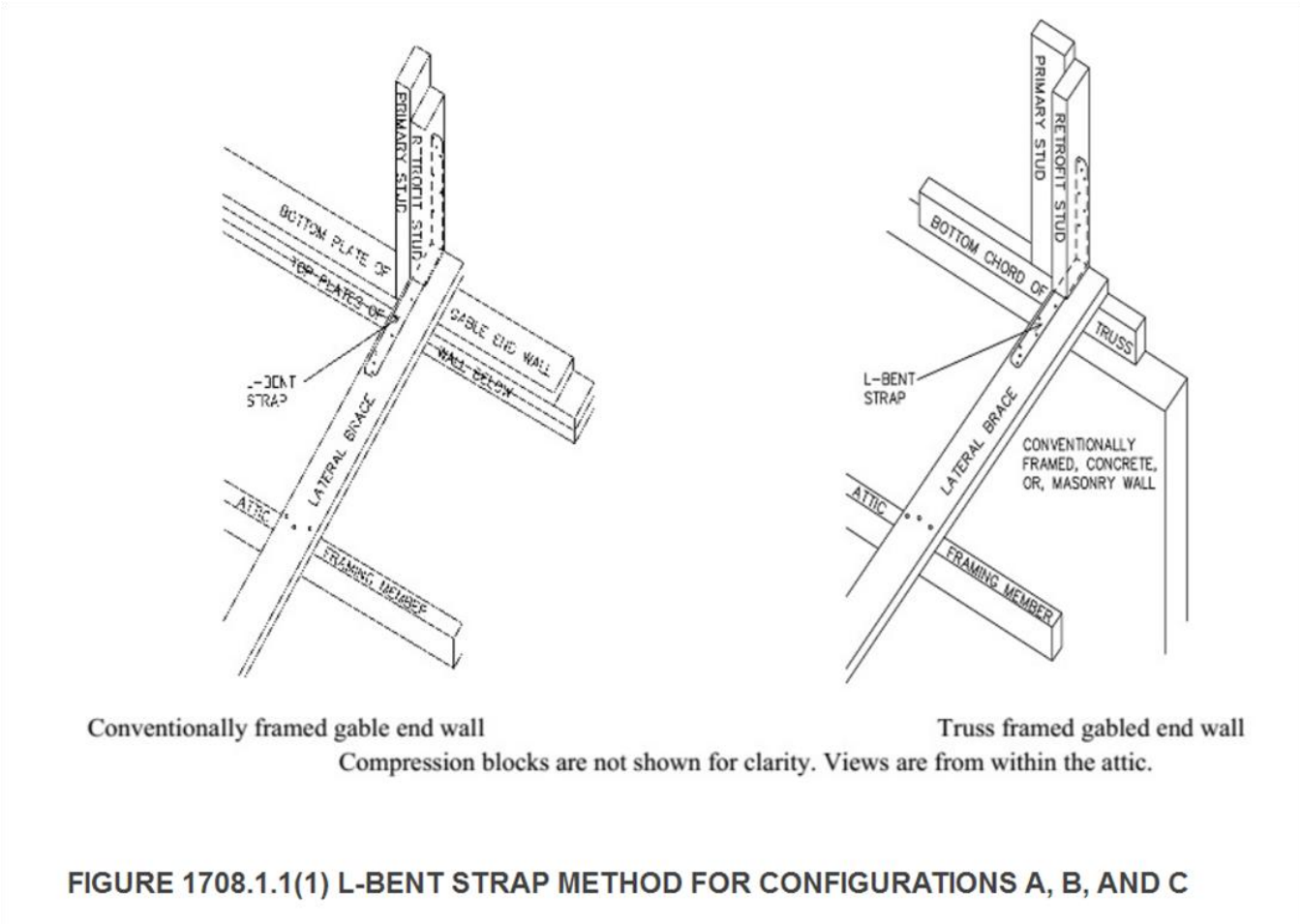


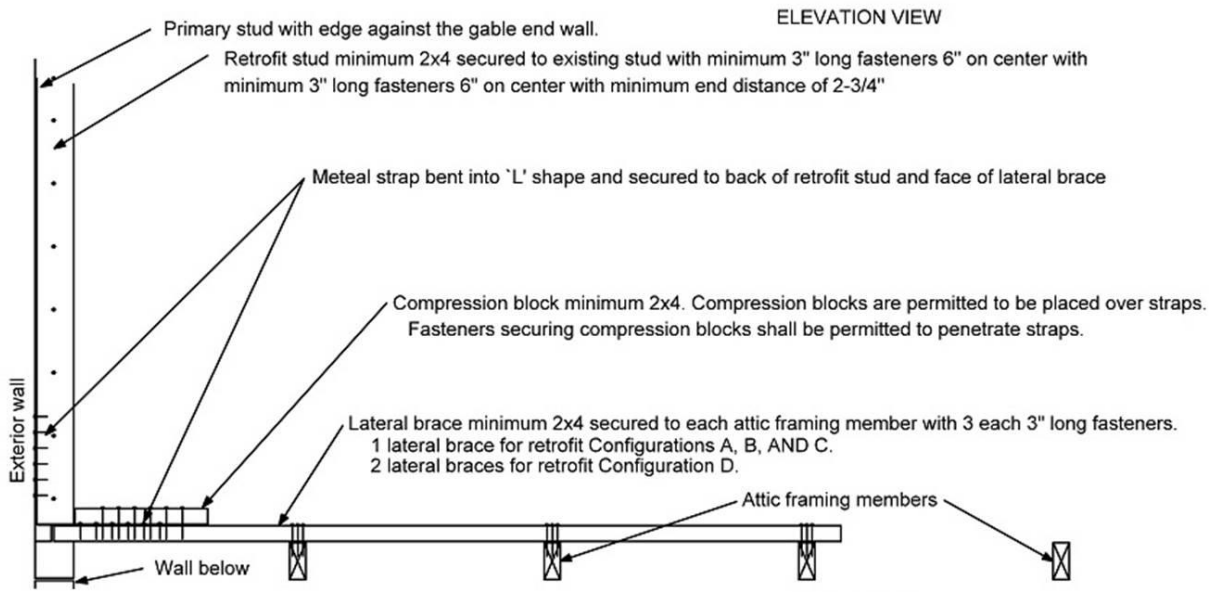
FIGURE 1708.1.1(1) L-BENT STRAP METHOD FOR CONFIGURATIONS A, B, AND C

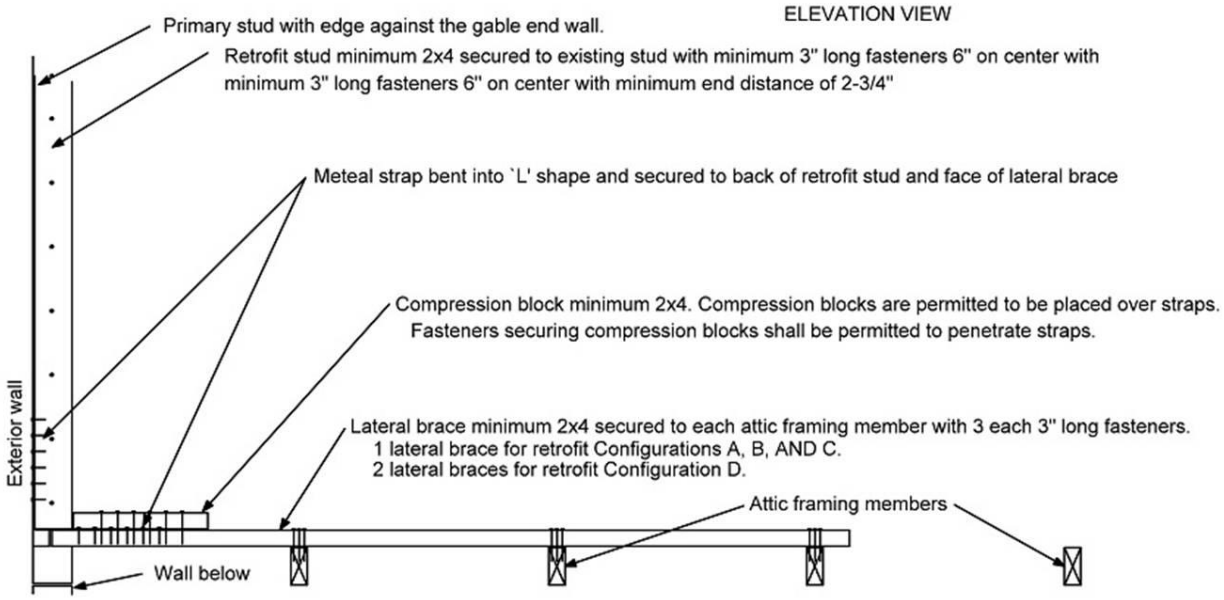
You want to be sure the strap is long enough and bent appropriately to accommodate the number of fasteners needed at each end, while maintaining a minimum distance of 2 $^{3}/_{4}$ inches from fasteners to the end of retrofit studs. It is okay to twist or bend the straps where they transition between the tops of retrofit studs and lateral braces to follow roof pitch. While they can be bent or twisted at multiple locations along their length, there can only be one bend or twist at any given location. The bend that occurs over the end of the retrofit stud must be at a right angle, or a 90° bend.
[**F.B.C.- Existing Building-** 1708.1.1 L-Bend Strap Method (1, 2, and 3).]

<u>Slide 19:</u> Compression Blocks for L-Bent Strap Method

After fastening your strap in place, compression blocks are placed on top of the lateral brace and butted up directly against the primary or retrofit stud. The compression block can be placed over the

strap or beside the strap. Figure 1707.1(1) details the placement for truss systems and Figure 1707.1(2) details conventionally framed systems. The minimum contact area between compression blocks and studs is an area equivalent to 1 $^{1}/_{2}$" x 1 $^{1}/_{2}$", or 2.25 square inches, however angled contact is permissible. [**F.B.C.- Existing Building-** 1708.1.1 L-Bend Strap Method (4).] [**Figure 1707.1(1)** Truss Gable End Wall With L-Bent Straps and Figure 1707.1(2) Conventionally Framed Gable End Wall With L-Bent Straps].



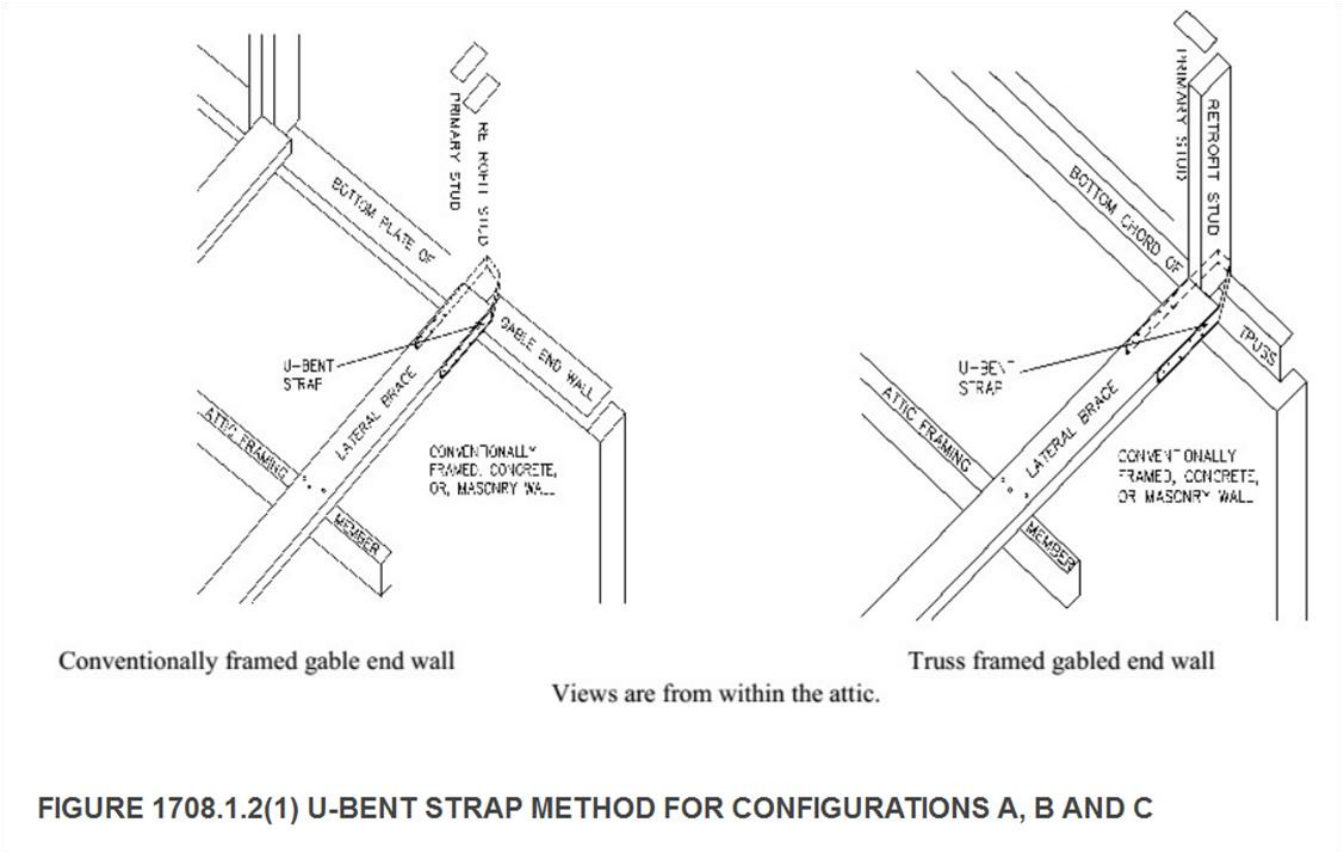


The number of 3-inch fasteners needed to connect to lateral braces is indicated in Table 1704.1, and is also based on the configuration method used. Fasteners should be placed a minimum of 2 $^{3}/_{4}$ inches

from end of compression blocks, 2 $^{3}/_{4}$ inches from each other along the length of the block, and $^{1}/_{2}$ inch from edges of both the compression block and the lateral brace. It's okay if the fastener securing the compression block penetrates through the strap. [**F.B.C.- Existing Building-** 1708.1.1 L-Bend Strap Method (5).] [**Figure 1707.1(2)**- Conventionally Framed Gable End Wall with L-Bent Straps].

<u>Slide 20:</u> U-Bent Strap Method

Bending the metal strap into a 'U' shape, allows you to secure it by wrapping the brace around the back of the retrofit stud and attaching it to the two narrow edges of the lateral brace. [**Figure 1707.1(3)**- Truss Gable End Wall with U-Bent Straps]. This figure details the installation of U-Bent straps for Configurations A, B, and C [**Figure 1708.1.2(1)-** U-Bent Strap Method for Configurations A, B, and C]. Again, configuration D will be slightly different because it features two lateral braces and two retrofit studs.



Conventionally framed gable end wall

Truss framed gabled end wall

Views are from within the attic.

FIGURE 1708.1.2(1) U-BENT STRAP METHOD FOR CONFIGURATIONS A, B AND C

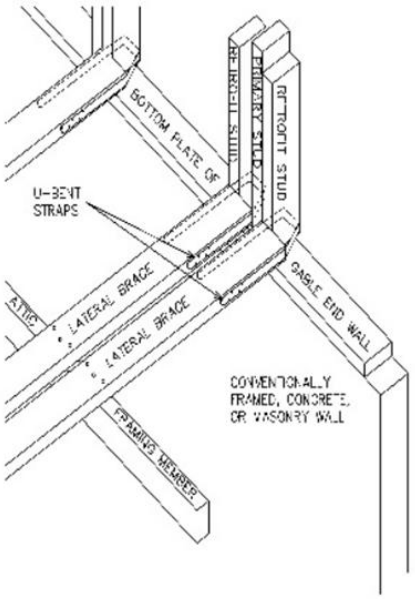
To use this method you must ensure that the lateral brace is placed in such a way that one narrow face of the lateral brace is aligned with one wide face of the primary or retrofit stud, and the strap is bent so that it is in contact with the narrow edge closest to the gable end wall of the stud being wrapped, which you can see in the Figure. The bends at the back of the wrapped stud should be crisp, and there can be no more than $^{1}/_{4}$" of a gap between the lateral brace and the stud. They should be butted snugly together.

For this method we'll use 1 $^{1}/_{2}$" long fasteners, and then refer to Table 1704.1 to check how many fasteners are needed for the Configuration Method used, just like in the L-Bent Method. They too,

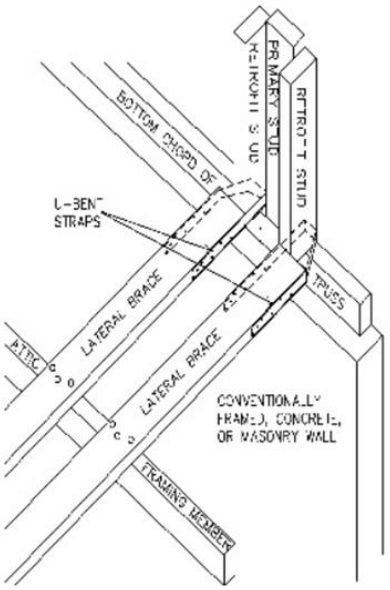
should be placed a minimum of 2 $^{3}/_{4}$" from the end of the lateral brace. The permissions for bending or twisting the strap are also the same as in the L-Bent method. [**F.B.C.- Existing Building-** 1708.1.2 U-Bend Strap Method (1-6).]

Here is how it would look for Configuration D, using two retrofit studs and two lateral braces. [**Figure 1708.1.2(2)-** U-Bent Strap Method for Configurations D].

FIGURE 1708.1.2(1) U-BENT STRAP METHOD FOR CONFIGURATIONS A, B AND C



Conventionally framed gable end wall



Truss framed gabled end wall

FIGURE 1708.1.2(2) U-BENT STRAP METHOD FOR CONFIGURATION D

<u>Slide 21:</u> Truss Gable End Wall

Now that we have our retrofit studs and lateral braces all installed and connected, it's time to secure the wall below. Gable end walls need to be connected to the wall below along gable ends where the primary studs are longer than 3 feet. [**F.B.C.- Existing Building-** 1709.1 Requirements.]

For a <u>truss</u> gable end wall you will use a gusset angle bracket fastened to the bottom chord of roof trusses and to the wall below using the spacing specified in Table 1704.1. For our hypothetical location, the spacing would be 47". [**Table 1704.1**- Retrofit Configuration as a Function of Exposure Category, Design Wind Speed, and Stud Height]. You will use four fasteners through each leg of the gusset angles to effectively secure the bracket. Fasteners should be placed at least $^{5}/_{8}$" from edges of lumber, and are permitted to penetrate truss plates. If you can't get all four fasteners in because of existing conditions, it will be necessary to install a second supplementary bracket between 2 $^{3}/_{4}$" to 8" away from the first one. You

have to use at least as many fasteners that were missing from the first bracket to secure the second bracket. [**F.B.C.- Existing Building-** 1709.1.1 Truss gable end wall and Exception.]

TABLE 1704.1 RETROFIT CONFIGURATION AS A FUNCTION OF EXPOSURE CATEGORY, DESIGN WIND SPEED, AND STUD HEIGHT

RETROFIT ELEMENTS				SIZE AND NUMBER OF RETROFIT ELEMENTS Stud length limitations based on Exposure, Basic Wind Speed, and Configuration			
Exposure Category	Max Ultimate Design Wind Speed, V_{ult} (3-sec gust) (Interpolation is not permitted)	Connections of gable end wall to wall below. On center spacing (Section 1708)		Configurations A, B, C, or D			
		Gusset angle bracket (inches)	Fasteners to secure sill plate to wall (inches)	A	B	C	D
D	≤ 130 mph	39	14	6'-11"	10'-11"	14'-3"	16'-0"
D	>130 – 140 mph	34	12	6'-7"	10'-5"	13'-7"	16'-0"
D	>140 – 150 mph	29	10	6'-2"	9'-9"	12'-10"	16'-0"
D	>150 – 160 mph	26	9	5'-11"	9'-1"	12'-0"	15'-4"
D	>160 – 170 mph	23	8	5'-6"	8'-7"	11'-4"	14'-9"
D	>170 – 180 mph	20	7	5'-2"	8'-1"	10'-8"	14'-2"
C	≤130 mph	46	16	7'-4"	11'-6"	15'-1"	16'-0"
C	>130 – 140 mph	39	14	7'-0"	10'-11"	14'-5"	16'-0"
C	>140 – 150 mph	34	12	6'-8"	10'-5"	13'-8"	16'-0"
C	>150 – 160 mph	30	11	6'-4"	9'-10"	13'-0"	16'-0"
C	>160 – 170 mph	27	9	5'-11"	9'-3"	12'-3"	15'-6"
C	>170 – 180 mph	24	8	5'-7"	8'-9"	11'-7"	15'-0"
B	≤130 mph	63	22	8'-2"	12'-10"	16'-0"	Note a
B	>130 – 140 mph	54	19	7'-9"	12'-2"	15'-0"	Note a
B	>140 – 150 mph	47	17	7'-5"	11'-8"	15'-3"	16'-0"
B	>150 – 160 mph	42	15	7'-1"	11'-2"	14'-7"	16'-0"
B	>160 – 170 mph	37	13	6'-10"	10'-8"	14'-0"	16'-0"
B	>170 – 180 mph	33	12	6'-7"	10'-4"	13'-6"	16'-0"
Retrofit studs Minimum size and number (Section 1706)				2 × 4	2 × 6	2 × 8	2 each 2 × 8
Lateral brace above and below (top and bottom) Minimum size and number (Section 1707)				2 × 4	2 × 4	2 × 4	2 each 2 × 8
Retrofit Elements for L-bent strap applications (Section 1708.1.1)							
Fasteners at each end for strap connecting retrofit studs to lateral braces using $1^1/_2$-inch long fasteners complying with Table 1703.6 Minimum number				3	5	6	5 at each end of each strap
Fasteners to connected compression blocks to lateral braces using 3-inch long fasteners complying with Table 1703.5 Minimum number				4	6	7	5
Retrofit Elements for U-bent strap applications (Section 1708.1.2)							
Fasteners to connect straps to each edge of lateral braces using $1^1/_2$-inch long fasteners complying with Table 1703.6 Minimum number				3	4	4	4 at each end of each strap

For SI: 1 inch =25.4 mm, 1 foot = 304.8 mm, 1 mile per hour = 0.447 m/s.

a. Configuration C is allowable.

The angle bracket needs to be specific to the materials of construction for the wall below (i.e. lumber-to-lumber, lumber-to-concrete or lumber-to-masonry).
[**F.B.C.- Existing Building-** 1709.1.1.1 Wood frame wall below and 1709.1.1.2 Concrete or masonry wall below.]

For a wood frame wall below the manufacturer's specified fasteners must be used. The fasteners installed in top plates must penetrate through the full depth of the lowest top plate.
[**F.B.C.- Existing Building-** 1709.1.1.1 Wood frame wall below]

<u>Slide 22:</u> Concrete/Masonry Wall - Sill Plate Options

For a concrete or masonry wall below, the connection will be determined by the presence and thickness of a sill plate. [**F.B.C.- Existing Building-** 1709.1.1.2 Concrete or masonry wall below.]

Where there is no sill plate the gusset angle bracket will be installed directly to the wall below and to the bottom chord of the truss. [**F.B.C.- Existing Building-** 1709.1.1.2 Concrete or masonry wall below (2.1).]

Where there is a sill plate of any thickness on top of the bond beam the bracket needs to be installed so the fastener passes all the way through the sill plate and connects directly to the concrete or masonry wall below. The fastener must be long enough to be embedded to the same depth as would normally be specified by the manufacturer for a direct connection. [**F.B.C.- Existing Building-** 1709.1.1.2 Concrete or masonry wall below (2.2).]

For a larger sill plate, at least 1 $^{1}/_{2}$" thick, a gusset bracket for lumber-to-lumber connection needs to be fastened directly to the sill plate using four 1 $^{1}/_{2}$-inch long fasteners. Regardless of how well the sill plate is attached to the wall, you must anchor it to the wall below on each side of the gusset angle bracket with concrete screws, embedded to the same depth as specified by the gusset manufacturer for a direct connection in concrete. $^{3}/_{8}$-inch washers should be used under the heads of the fasteners. These fasteners should be placed at least 2 $^{3}/_{4}$-inches, but no more than 8-inches, from the gusset angle bracket. [**F.B.C.- Existing Building-** 1709.1.1.2 Concrete or masonry wall below (2.3).]

Slide 23: Platform Framed Gable End Wall

For conventionally framed gable end walls, the bottom end of each primary stud of gable end walls needs to be connected to bottom members by a stud-to-plate connector with a minimum uplift capacity of 175 pounds.

If there is a sill plate, the stud should be connected to it, if the ceiling joist is the lowest outer member of the wall then the stud can be connected to the joist. It should be positioned on the wide face of the joist near the top, so that it extends up the stud to full width.
[**F.B.C.- Existing Building-** 1709.1.2 Platform framed gable end wall and 1709.1.2.1 Stud Connections.]

Slide 24: Connection to the Wall Below

The gable end wall must also be connected to the wall below using one of the following methods:

1. Where there is a wood frame wall below the gable end wall and there is a sill or bottom plate on top of the plates of the wall below, you can connect the sill plate to the top plate of the wall below using wood screws with a shear capacity of at least 150 pounds for 1 $^{1}/_{2}$-inches side member thickness. You want to make sure that the threads of the screws substantially engage the lower top plate, and that you maintain the spacing indicated in Table 1704.1, which would be 17" for our hypothetical structure in Pinellas county. [**Table 1704.1**- Retrofit Configuration as a Function of Exposure Category, Design Wind Speed, and Stud Height]. Leave at least 1 $^{3}/_{4}$ inches to the edges of lumber and 2 $^{3}/_{8}$ inches from the ends. [**F.B.C.- Existing Building-** 1709.1.2.2 Wall Connections.]

2. If the wood frame gable end wall has a ceiling joist as the lowest outer member of the wall, that joist must be connected to the wall below using the methods previously discussed on Slide 21 attaching the ceiling joist to the wall below as required for the bottom chord of a roof truss.
[**F.B.C.- Existing Building-** 1709.1.1 Truss gable end wall and 1709.1.2.2 Wall Connections.]

3. Where the wall below is a concrete or masonry wall, the sill or bottom plate of the gable end wall needs to be connected to the wall below using $^{1}/_{4}$-inch diameter concrete or masonry screws of the same type used for gusset angles and of sufficient length to achieve embedment of at least 1 $^{1}/_{2}$ -inches into the concrete or 2 $^{3}/_{4}$ -inches into the masonry. A washer sized for the diameter of the lag bolt or wood screw must be placed under the head of each fastener. Again, fastener spacing can be found by consulting Table 1704.1.
[**F.B.C.- Existing Building-** 1709.1.2.2 Wall Connections.]

Slide 25: Section Complete

That completes our discussion of Gable-end Bracing. We covered a lot of material in this Section so let's have a quick learning exercise to see how much you've learned.

Slide 26: Learning Exercise 2

Section 3: Roof Sheathing and Secondary Water Barriers

Slide 1: Advanced Wind Mitigation Methodologies Part I- Online Retrofit Course

Slide 2: Welcome to Section 3 of your Advanced Wind Mitigation Methodologies Course- Roof Sheathing and Secondary Water Barriers.

Slide 3: In this portion of the course we will:

- Review roof system mitigation techniques including:
  - Strengthening Roof Sheathing and Fastening, and
  - Installing a Secondary Water Barrier
- And Outline important costs associated with these improvements

Slide 4: Code Requirements

According to the Federal Alliance for Safe Homes, the roof covering and particularly the underlying sheathing form a primary defense for a home's protection from damage due to high wind and rain. Unfortunately, this shield is often the first to be lost during a high-wind event. Loss of the sheathing can result in excessive damage due to water infiltration because once it's gone the interior is completely exposed to the elements.

How do the mitigation provisions deal with this element of the roof system? Well the Florida Building Code- for Existing Buildings details the following retrofits on single family residential structures when a roof is replaced or removed:

1. Roof-decking attachment and fastening should be strengthened as outlined by Section 708.7.1 and

2. A secondary water barrier shall be provided as outlined by Section 708.7.2.

[**F.B.C.- Existing Building-** Section 708.7.]

The Code also specifies that where roofing materials are removed or replaced from more than 50% of the roof diaphragm of a building located where the Ultimate Design Wind Speed, V_{ult}, is greater than 115 mph, roof diaphragms, connections of the diaphragm to framing members, and roof-to-wall connections must be evaluated against current Code requirements for wind loads. If the diaphragms and connections are not capable of resisting at least 75 percent of those wind loads, they need to be replaced or strengthened according to the current specifications of Florida Building Code, Building.
[**F.B.C.- Existing** 706.3.2- Roof diaphragms resisting wind loads in high-wind regions] [**Figure 1609A**- Ultimate Design Wind Speeds, V_{ult}, For Risk Category II Buildings and Other Structures]

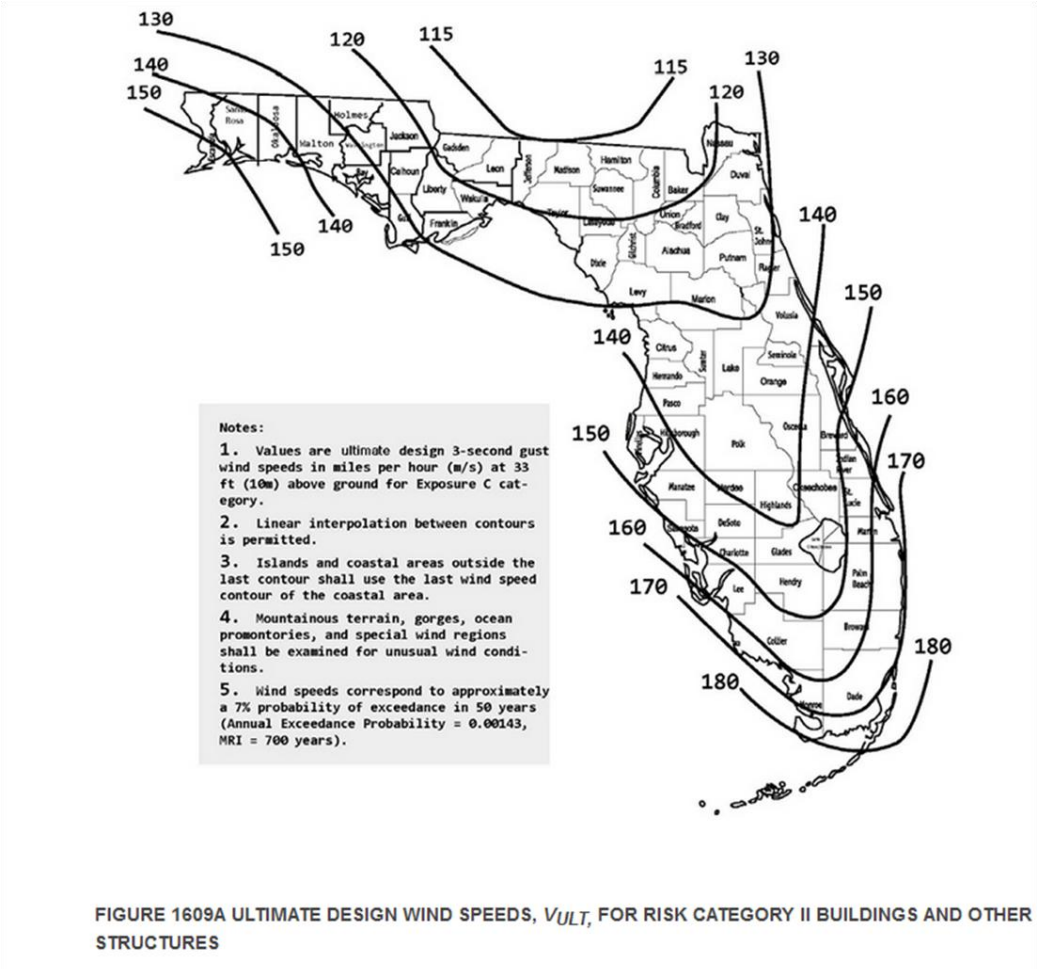


FIGURE 1609A ULTIMATE DESIGN WIND SPEEDS, V_{ULT}, FOR RISK CATEGORY II BUILDINGS AND OTHER STRUCTURES

Remember, Figures 1609A and R301.2(4) detail the Ultimate Design Wind Speeds for Risk Category II Buildings, and we can see that no locations in Florida for Risk Category II structures have an Ultimate Design Wind Speed less than 115 mph. So for any one- and two-family dwellings, where a roofing project results in replacing more than 50% of the roof diaphragm, those connections need to be evaluated. [**Figure R301.2(4)**- Ultimate Design Wind Speeds V_{ult}]

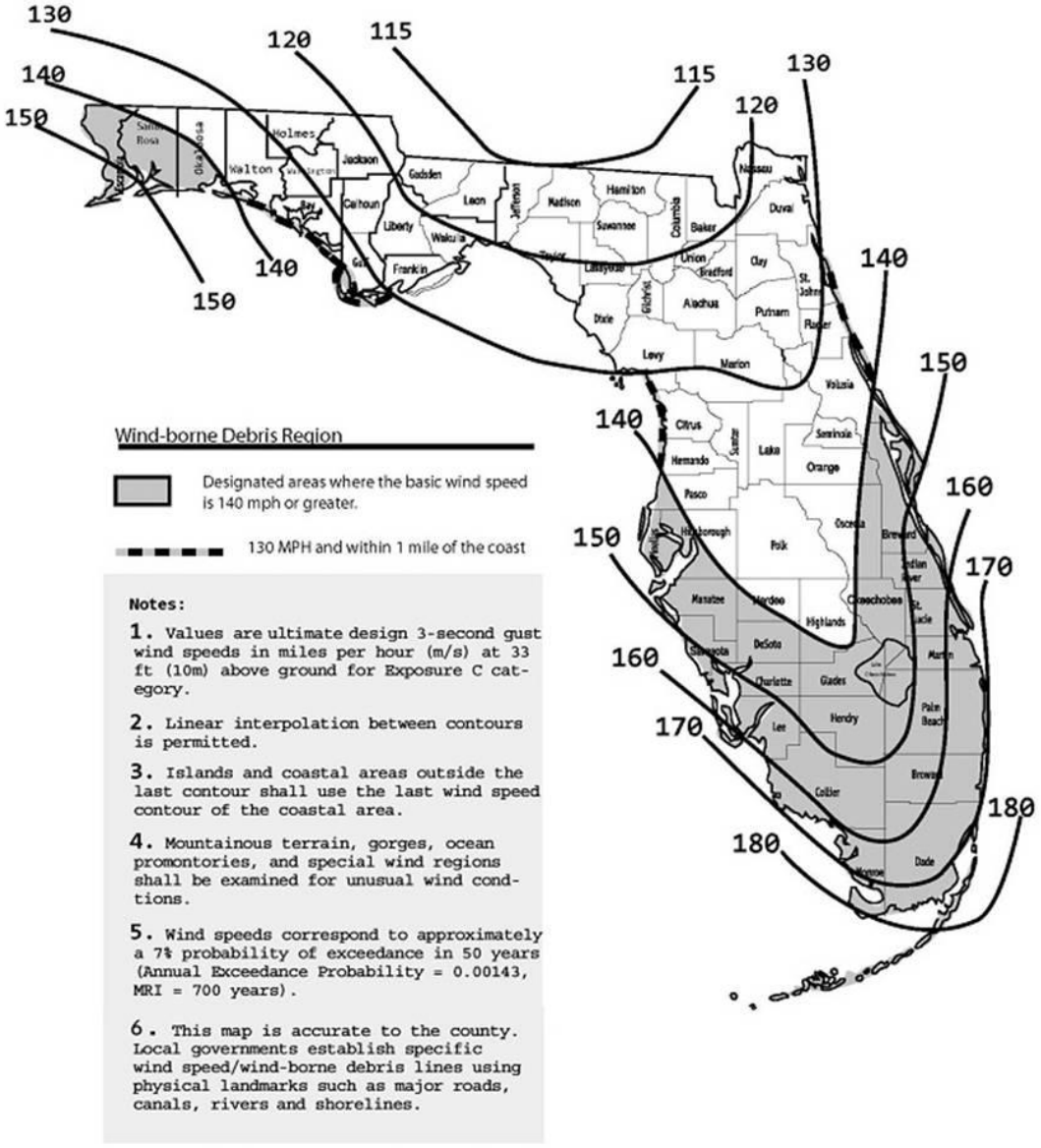


FIGURE R301.2(4) ULTIMATE DESIGN WIND SPEEDS V_{ult}

<u>Slide 5:</u> Decking Attachment

The first step in assessing the roof decking attachment is to inventory the existing fasteners and decking construction. Nails must be at least 8d, .113 inches in diameter, and no less than 2 $^{1}/_{4}$ inches long, in order to contribute to the existing nail count; regardless of head shape or diameter. [**F.B.C.- Existing Building-** Section 708.7.1]

If the decking consists of sawn lumber or wood planks up to 12" wide, they must be secured with at least two nails to each roof framing member the decking crosses.

If such decking is secured with smaller or fewer nails, you can bring it into compliance by simply adding fasteners, so that at least two 8d clipped head, round head, or ring shank nails are in place on each framing member the decking crosses. [**F.B.C.- Existing Building**- Section 708.7.1.1]

If the decking consists of wood structural panels, you need to consult this Table to find fastener and spacing requirements, and determine whether or not supplemental fasteners are needed. [**Table 708.7.1.2**- Supplement Fasteners at Panel Edges and Intermediate Framing.]

TABLE 708.7.1.2 SUPPLEMENT FASTENERS AT PANEL EDGES AND INTERMEDIATE FRAMING

EXISTING FASTENERS	EXISTING SPACING	V_{asd} 110 MPH OR LESS SUPPLEMENTAL FASTENER SPACING SHALL BE NO GREATER THAN	V_{asd} GREATER THAN 110 MPH SUPPLEMENTAL FASTENER SPACING SHALL BE NO GREATER THAN
Staples or 6d	Any	6" o.c.[b]	6" o.c.[b]
8d clipped head, round head, smooth or ring shank	6"o.c. or less	None necessary	None necessary
8d clipped head, round head, smooth or ring shank	Greater than 6" o.c.	6" o.c.[a]	6" o.c.[a]

For SI: 1 inch = 25.4 mm.

a. Maximum spacing determined based on existing fasteners and supplemental fasteners.

b. Maximum spacing determined based on supplemental fasteners only.

c. V_{asd} shall be determined in accordance with Section 1609.3.1 of the *Florida Building Code, Building* or Section R301.2.1.3 of the *Florida Building Code, Residential*.

The cost estimate for adding supplemental fasteners, as projected by the Florida Roofing Sheet Metal & Air Conditioning Contractors Association (FRSA), was $60.00 to $70.00 per 100 square feet (or 1 roofing square).

Slide 6: Use of Adhesives

Wood structural panel connections retrofitted with a two part urethane based closed cell adhesive sprayed onto the joint between the sheathing and framing members are deemed to comply with these requirements, provided that testing using the manufacturer's recommended application on panels, connected with 6d smooth shank nails at no more than a 6-inch edge and 12-inch field spacing, can demonstrate an uplift resistance of at least 200 psf. [**F.B.C.- Existing Building**- Section 708.7.1.2.]

According to a Clemson University Study conducted by the Department of Civil Engineering, the cost to apply an approved adhesive to strengthen the decking would be approximately $100 for a typical home, or $1.50-$2.50 per 4 x 8 panel of sheathing. So it's a relatively inexpensive method to secure roof decking more effectively in a typical home, especially since losing even a single sheet of roof

decking in a hurricane, will likely result in a major loss due to the ensuing water intrusion and wind-borne debris.

Slide 7: HVHZ Water Barrier

Alright, let's look at the methods for installing a secondary water barrier when the roof covering is removed or replaced. [F.B.C.- Existing Building- Section 708.7.2- Roof secondary water barrier for site-built single family residential structures.]

The first method can be used in either HVHZ or Non-HVHZ regions and it has two options:

Option 1- directly cover all joints in structural panel roof sheathing with 4" wide self-adhering polymer modified bitumen tape, commonly called “peel and seal” or “peel and stick”. Then install an underlayment system approved for the particular roof covering that will be used.
[**F.B.C.- Existing Building**- Section 708.7.2- Roof secondary water barrier for site-built single family residential structures (1).]

According to the FRSA the estimated cost for installing "peel and seal" as outlined for this improvement is $130.00 per square.

To create the best bond using "peel and seal" you should follow the age-old "shingle principle". In this approach the upper material is always lapped over the layer below so water will naturally flow down and away from the building- never into the structure- even if the adhesive bond fails.

Option 2- cover the entire roof deck with an approved asphalt impregnated 30# felt underlayment or an approved synthetic underlayment installed with nails and tin-tabs according to Florida Building Code, Building. No additional underlayment shall be required over the top of this sheet. The synthetic underlayment shall be fastened in accordance with the manufacturer’s recommendations.
[**F.B.C.- Existing Building**- Section 708.7.2- Roof secondary water barrier for site-built single family residential structures (1).]

Please refer to the CODE tab at the top of your course player for the specific requirements detailed for underlayments and fasteners for use in High-Velocity Hurricane Zones in Sections 1518.2 through 1518.4 of FBC-Building. [**F.B.C.- Building-** Section 1518.2- Underlayments and 1518.3 and 1518.4]

Slide 8: Non-HVHZ Water Barrier, Opt. 1

The second method can be used Outside the High Velocity Hurricane Zone and it also has two options:

Option 1- is to cover the entire roof deck with an approved self-adhering polymer modified bitumen sheet meeting ASTM D 1970, or an approved self-adhering synthetic underlayment that is installed according to manufacturer specifications.
[**F.B.C.- Existing Building**- Section 708.7.2- Roof secondary water barrier for site-built single family residential structures (2).]

ASTM D 1970 is the standard for self-adhering polymer modified bituminous sheet materials used as steep roofing underlayment to prevent leakage from water back-up due to ice dams.

Slide 9: Non-HVHZ Water Barrier, Opt. 2

Option 2- is to install an underlayment system that is approved for the roof covering you're going to use, but adhering to the following modifications, depending on roof slope:

The underlayment system will consist of approved asphalt impregnated ASTM D 226 Type I or II, which is commonly used in built-up roofs, or ASTM D 4869, Type II or IV (commonly used in steep slope roofing), or an approved synthetic underlayment. The felt is to be fastened with 1 inch round plastic cap, metal cap nails, or nails and tin-tabs attached to a nailable deck. The maximum fastener spacing in the field of the sheet is 12-inches on center, and at the overlaps it is 6-inches on center.

For roof slopes that require one layer of underlayment you need to install fasteners with two staggered rows in the field of the sheet. For roof slopes that require two layers of underlayment you only need one row in the field of the sheet.

Synthetic underlayments must also be fastened according to this section and the manufacturer's recommendation. [**F.B.C.- Existing Building-** Section 708.7.2- Roof secondary water barrier for site-built single family residential structures (2).]

There are two exceptions to this requirement for secondary water barriers:

Roof slopes < 2:12 (less than two in twelve) having a continuous roof system; and Clay and Concrete tile roof systems installed according to the Florida Building Code are deemed to comply with these requirements. [**F.B.C.- Existing Building**- Section 708.7.2- Roof secondary water barrier for site-built single family residential structures (Exception).]

Slide 10: Additional Resources

That completes our review of requirements for strengthening the roof deck and creating a secondary water barrier. Here are a few additional resources you might find helpful in your continued effort to understand the complex nature of wind mitigation in Florida.

- For information on the Residential Mitigation Program as well as access to many important resources, follow the links at **FloridaDisaster.org** The Residential Mitigation Retrofit Program partners with local housing authorities and non-profit organizations to promote wind mitigation and provide upgrades to residents. The Program utilizes the Florida Building Code as its standard for all retrofitting.
- You can also follow the links at **FloridaDisaster.org** to access a Wind Insurance Savings Calculator.
- You can access informative PDFs on secondary water barriers and find approved products for secondary water barriers, by performing a product search at **FloridaBuilding.Org.**

- There are quite a few municipalities that have released their own information guides on how to best implement the Hurricane Mitigation Provisions to suit the regulations of their particular jurisdiction. Boca-Raton and Miami-Dade are two examples. For a Hurricane Mitigation Retrofit Q&A for reroofing in Boca-Raton, follow the link at **Ci.Boca-Raton.Fl.US.**
- Follow the links at **Miami-Dade.Gov** for answers to Frequently Asked Questions about the Hurricane Mitigation requirements of Florida Statute 553.844.
- You can follow links at **BOAF.Net** to access non-binding interpretations of the Florida Building Code.

Slide 11: Course Complete
That completes Part I of Wind Mitigation Methodologies! You should now be very familiar with the many techniques for the installation of gable-end bracing, methods of strengthening and fastening roof decking and how to create secondary water barriers for roofs.

In Part II of the course we'll review how to improve roof-to-wall connections, and the importance of a continuous load path. We'll also discuss the pros and cons of many different types of approved opening protection and their approximate costs and installation features.

Let's have one last quick learning exercise to reinforce what you've learned.

Slide 12: Learning Exercise 3
No Narration