



HURRICANE  
**STANDARDS**



2019



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# 1 Program Overview and Definitions

## 1.1 Goals

The FORTIFIED Home™–Hurricane standard provides program requirements for hurricane-prone regions of the United States. This program applies to homes located on Caribbean Islands, Hawaii, and along the Gulf and Atlantic Coasts in areas where the design wind speed is greater than 90 mph as specified in ASCE 7-98 through ASCE 7-05 or 115 mph as specified in ASCE 7-10 through ASCE 7-16. The primary goal is to protect homes and their contents by improving the home's resistance to hurricane winds and wind effects.

## 1.2 Eligible Dwellings

The following is a list of property types that are eligible for a FORTIFIED Home–Hurricane designation. New and existing homes can qualify.

### 1.2.1 Qualifying Homes—Dwelling Type

1. Single-family detached homes
2. Two-family dwelling units (duplex)
3. HUD post-July 1994 Zone II and Zone III manufactured homes
4. Townhouses

### 1.2.2 Definitions and Conditions

- **Single-family detached home**—a freestanding residential building occupied by one family. Limited to three stories above grade. This also includes detached single-family factory-built modular homes that are designed, built, and sited to meet all local building code requirements.
- **Two-family dwelling units (duplex)**—a freestanding residential building occupied by two families. Limited to three stories above grade. Note: The entire two-family building, which includes both dwelling units, must be evaluated under the appropriate FORTIFIED requirements and the entire building must meet all requirements for the designation being considered. Individual units are NOT eligible for designation unless the entire building is being designated.
- **HUD manufactured homes**—a single-family residential home manufactured to HUD's Zone II or Zone III Manufactured Home Construction and Safety Standards adopted after July 1994. The home must be sited on and properly attached to a permanent foundation (see foundation requirements in Section 1.2.3.3). HUD manufactured homes built before July 1994 and Zone I homes built after July 1994 are NOT eligible.



- **Townhouse**—a single-family dwelling unit constructed in a group of three or more attached units in which *each unit extends from foundation to roof and has a yard or public way on not less than two sides*. Limited to three stories above grade. Mixed use (commercial and residential) buildings are NOT eligible. Note: The entire townhouse building, which includes all townhouse units composing the building, must be evaluated under the appropriate FORTIFIED requirements and the entire building must meet all requirements for the designation being considered. Individual townhouse units are NOT eligible for designation unless the entire building is being designated. Example: A four-unit, two-story townhouse with all units attached is eligible for a specific FORTIFIED designation only if the entire building, including each and every townhouse unit, is evaluated and all units meet the requirements for that designation.

## 1.2.3 Foundation Qualification Requirements

### 1.2.3.1 Ineligible Foundations

**Homes on a foundation constructed of unrestrained stacked masonry or stone (a dry-stack foundation) are not eligible for any FORTIFIED designation. Note: Ineligible foundations may be retrofitted in accordance with a professional engineering plan and must comply with Section 1.2.3.2 (below) to be considered eligible.**

### 1.2.3.2 All Elevated-Floor Home-to-Foundation Connections

To be eligible for designation or re-designation under the FORTIFIED program, homes with elevated floors (not slab-on-grade construction) must have adequate positive connections from the floor or wall structure to the supporting foundation. For example, homes on piers or pilings must have connections from the tops of the piers/pilings to the home's floor beams and a home on piers with shallow foundations must have connections that provide a continuous load path to the foundations. All connectors must be free from damage, corrosion-resistant (if applicable) in accordance with Appendix D of this standard, and installed per the connector manufacturer's installation instructions.

### 1.2.3.3 HUD-Code Manufactured Home Foundations

Foundations must be capable of resisting the design wind load requirements with no more than ¼-in. lateral deflection. Requirements specified in the US Department of Housing and Urban Development (HUD) Permanent Foundation Guide for Manufactured Housing (HUD4930.3G) dated September 1996 or later provide useful assistance in identifying suitable foundation options. Based on results of past inspections of home installations that were reported as permanent, the following requirements of the HUD Guide and FORTIFIED requirements are emphasized and are part of the Field Evaluation inspection.



- Screw-in soil anchors are not considered a permanent anchorage and cannot be used as any part of the required permanent foundation unless their heads are restrained from lateral movement by embedment in a reinforced concrete footing or concrete slab.
- All concrete masonry unit (CMU) bearing walls, piers, and columns, as well as any units used as part of systems to resist uplift, overturning, and lateral loads must be composed of reinforced concrete masonry with mortared bed and head joints. Cells with reinforcing must be fully grouted. Dry-stacking of CMU is not allowed.
- All bearing walls, piers, and columns must be installed on and connected to acceptable footings or a concrete slab. Footings and slabs must be protected from the effects of frost heave by extending below the frost line or by using a frost-protected shallow foundation design.
- Walls and piers used as part of the uplift, overturning, or lateral load-resisting system must include adequately sized connections and elements capable of resisting tension or compression loads as appropriate. Straps or cables are acceptable, provided they are connected to the home or its chassis and transfer the design loads to the slab or footings supporting the walls, piers, or columns. Use of frictional resistance between the home or its chassis and the tops of the walls, piers, or columns or between the bottom of the walls, piers, or columns and the footings to resist lateral loads is not allowed.

## 1.3 Available Designations

FORTIFIED Roof™ – New Roof

FORTIFIED Roof™ – Existing Roof

FORTIFIED Silver™ – New Roof

FORTIFIED Silver™ – Existing Roof

FORTIFIED Gold™ – New Roof

FORTIFIED Gold™ – Existing Roof

## 1.4 Goals and Objectives

The overarching goal of the FORTIFIED Home–Hurricane program is to provide a structured, systems-based approach for improving the resistance of homes to damage from hurricanes. To make the program cost effective for the retrofit of existing homes, several levels of designation are included that allow the owner to step into the program while making meaningful improvements in the hurricane resistance of the home at each step. This program was created to primarily address the need to improve the hurricane resistance of existing homes that may have been built to older, weaker building codes or in areas and at a time when there was no building code or adequate enforcement of the code. **Because elevation of an existing home to avoid flood damage is so expensive, this program only addresses wind and wind-driven rain aspects of the hurricane risk. IBHS has long advocated that homes be built at an elevation corresponding to a 1-in-500 chance of flooding per year or a minimum of 3 ft above the base flood elevation (the base flood elevation corresponds to a 1-in-100**

**chance of flooding per year). Best practice for new home construction is to build to these higher elevations.**

The designation steps (FORTIFIED Roof, FORTIFIED Silver, and FORTIFIED Gold) target the most common sources of damage and vulnerability observed as storm intensity increases. This is discussed in more detail in sections describing each designation level (Sections 1.4.1 through 1.4.3). When a new home is being built in an area that has adopted the latest model building codes and opening protection is required, additional elements included for FORTIFIED Silver and FORTIFIED Gold designations are already required by code and the cost differential for getting a FORTIFIED Gold designation over a FORTIFIED Roof designation is not significant. Consequently, if builders of new homes decide to seek a FORTIFIED Home–Hurricane designation in these areas, they usually go for a FORTIFIED Gold designation.

### 1.4.1 FORTIFIED Roof Designation

Achieving a FORTIFIED Roof designation indicates the home has been built or retrofitted to minimize roof damage, attic water intrusion, and associated property damage, disruption and loss in areas affected by Category 1 or weak Category 2 hurricane winds. Roof cover damage and water intrusion into the attic with subsequent collapse of ceilings can also be a significant issue for newer homes built to higher structural standards, particularly if they have aging asphalt shingle roofs or lose part of their roof cover.

This risk reduction is accomplished by:

- I. Improving roof sheathing attachment.
- II. Providing a sealed roof deck.
- III. Reducing chances of attic ventilation system failure.
  - a. Roof vents (ridge and off-ridge vents)
  - b. Gable end wall vents

### 1.4.2 FORTIFIED Silver Designation

Achieving a FORTIFIED Silver designation indicates the home has been built or retrofitted to minimize roof damage and water intrusion into the attic, plus damage from broken windows and failures of doors, weak gable ends, and poorly anchored attached structures such as porch or carport roofs. As wind speeds increase due to storm strength in Category 2 or weak Category 3 levels, failures of these elements become more frequent and their failure can open up the home to wind, wind pressure, and significant water entry. Wind pressure increases resulting from the failure of windows and doors can significantly increase (in some cases doubling) the wind forces working to blow the roof off or blow out exterior walls.

This risk reduction is accomplished by completing all of the FORTIFIED Roof designation requirements plus:

1. Protecting all openings
  - a. Glazed openings (windows, glazed entry doors, skylights, glass block)
  - b. Entry doors
  - c. Garage doors
2. Strengthening gable ends
  - a. Laterally bracing all gable ends greater than 4 ft tall
  - b. Improving the uplift resistance of long gable end overhangs
  - c. Ensuring that gable end sheathing provides, at a minimum, the resistance to wind pressures and debris impact provided by  $\frac{7}{16}$ -in.-thick OSB wood structural panels attached to wood wall framing
3. Improving the anchorage of attached structures (porches and carports)
4. Strengthening long vinyl and aluminum soffits

### 1.4.3 FORTIFIED Gold Designation

Achieving a FORTIFIED Gold designation indicates the home has been built or retrofitted to minimize damage from a Category 3 hurricane.

This risk reduction is accomplished by completing all FORTIFIED Roof and FORTIFIED Silver designation requirements plus:

1. Providing continuous load path connections between roof support members and bearing walls, between bearing and shear walls above and below intermediate floors of multi-story homes, and between bottom floor bearing and shear walls down to the foundation.
2. Adequately securing chimneys to the structure.
3. Ensuring that windows and doors meet appropriate design pressures in addition to being protected from windborne debris.
4. Ensuring that exterior walls are constructed using a wall system that provides, at a minimum, the resistance to wind pressures and debris impact provided by  $\frac{7}{16}$ -in.-thick OSB wood structural panels attached to wood wall framing.

## 1.5 Designation Term Limit

The FORTIFIED Roof, FORTIFIED Silver, and FORTIFIED Gold designations are valid for a period of 5 years. Designations expire on March 31 in the year following the fifth anniversary of the awarding of the designation. Homes may be re-designated for additional 5-year terms by having a re-designation inspection at the end of each term. The re-designation inspection focuses on the roof covering and any substantive changes to systems covered under the FORTIFIED program. Homeowners will receive a notice when re-designation is required.

## 1.6 Definitions

**Acceptable roof cover:** a roof that is not visibly damaged or deteriorated and has at least 5 years of useful life remaining is eligible for acceptance as part of a FORTIFIED Roof – Existing Roof designation. A certified FORTIFIED Evaluator must inspect the roof to determine the condition and remaining useful life of the roof covering. Roof coverings that are damaged or deteriorated, or with less than 5 years remaining useful life as determined by the IBHS-certified evaluator are not eligible for a FORTIFIED Roof – Existing Roof designation. However, if the home is re-roofed in accordance with FORTIFIED Roof – New Roof designation requirements specified in Section 2.2.3, it is eligible for a FORTIFIED Roof – New Roof designation when all additional FORTIFIED Roof requirements are met.

**Bearing point:** the top of a wall that provides vertical support for the roof structure.

**Carport:** an attached carport is a structure whose roof is attached to the building or the roof structure of the dwelling and at least one side of the structure is open. A built-in carport has the roof of the house extending over the area used for parking cars, boats, or other storage.

**Certified FORTIFIED Evaluator:** an individual who has met the professional requirements for certification by IBHS, has completed the FORTIFIED training course, and has achieved a passing score on the designation certification exam.

**Continuous load path:** an engineering term that refers to a series of connections that allow forces, such as those created by high-wind events, to pass from one part of a structure to another and ultimately to the foundation. A continuous load path allows the building to resist the forces created by high winds as a unit. Without a continuous load path, there are “weak links” in a building’s connections. These weak links are where failures are most likely to occur.

**Damaged or deteriorated lumber:** generally, this is lumber that is marked by one or more of the following characteristics: soft or spongy, swelling or buckling, delaminating (plywood), or crumbling and flaking of the wood.

**Design pressure rating:** the allowable wind pressure rating assigned to a window, door, or opening protection product, expressed as both a positive and negative pressure. The design pressure rating is based on specific testing and a required factor of safety.

**Design wind speed:** the wind speed specified in the building code for a given location that is used in accordance with code-accepted procedures to establish wind pressures and associated forces that a building or parts of a building must be capable of resisting.

**Documentation:** evidence that a specific requirement has been met, either in the form of a test report, manufacturer’s installation guidelines, product markings, or other evidence that proves that a specific requirement has been met.

**Drip edge:** metal flashing installed at eaves and along gable rake edges.

**Flashing:** components used to weatherproof or seal roof system edges at perimeters, penetrations, walls, expansion joints, valleys, drains, and other places where the roof covering is interrupted or terminated.

**Gable end:** the vertical triangular wall between the sloping ends of a gable roof and the rectangular wall below.

**Gable rake edge:** the edge of the roof overhang at a gable end.

**Glazed openings:** any opening in a door or wall that contains glass.

**Impact-rated products:** impact-rated products include permanently installed products like doors, windows, sliding glass doors, and skylights that have been tested and approved in accordance with, at a minimum, International Residential Code (IRC) accepted impact resistance and design pressure test standards.

**IRC:** the International Residential Code developed by the International Code Council (ICC).

**Living area:** conditioned space in a home that is protected from the elements by walls, windows, doors, and the roof structure.

**Low slope:** roof surfaces with a slope less than 2:12.

**Mean roof height (MRH):** the average height of the roof, usually calculated as the average of the eave and ridge height of the roof.

**Metal roof:** a roof that uses metal panels installed over and attached to a wood deck as its primary roof covering material.

**Opening protection products:** opening protection products must be tested and approved with, at a minimum, International Residential Code (IRC) accepted test standards for the large missile (missile D: 9-lb 2x4 impacting at 50 ft/sec) impact resistance and minimum design pressure for the site, building size, opening size, and location on the building. Opening protection products include permanently or temporarily installed shutter systems like roll shutters, accordion shutters, colonial shutters, Bahama-style shutters, storm panels, and fabric and screen products.

**Outlooker:** these are usually 2x framing members that extend out over the top of the gable wall to support the sheathing on the overhang. They are typically required when the gable overhang is greater than 12 in.

**Out-of-plane wind loads:** when associated with gable ends or exterior walls, out-of-plane wind loads are wind loads that are perpendicular to the face of the gable end or exterior wall.



**Porch:** a porch is an outdoor or semi-outdoor space with a solid roof directly above it where the roof is attached to an exterior wall or part of the roof of the primary structure. It may have one or more sides that are or once were open or screened. Screen pool enclosures are not considered porches for the purpose of this program.

**Prescriptive retrofit measure:** a detailed retrofit measure provided in this guide, which does not require analysis by an engineer. These measures can be used to strengthen a home to the extent necessary to meet the requirements provided in this standard.

**Qualified roof:** a roof covering meeting high wind resistance criteria appropriate for the design wind speed at the location and installed according to the appropriate manufacturers installation requirements for the design wind speed and application.

**Qualified Sealed Roof Deck (SRD):** protective measures taken in addition to or as part of the underlayment system installed under the primary roof cover (i.e., shingles, tile, or metal roofing) that is designed to stay in place and keep water from entering the home if the primary roof covering is damaged or lost due to high winds.

Protective measures and underlayments that may qualify as a sealed roof deck under FORTIFIED include:

- A self-adhered membrane applied over the entire roof deck.
- A 4-in.-wide self-adhered membrane tape applied over all joints in the roof deck, covered by a roofing felt or synthetic underlayment approved as a substitute for the required roofing felt.
- Two (2) layers of approved felt installed as required in this standard, when the roof cover is asphalt shingles or metal.
- A closed-cell foam applied to all joints in the roof deck from the attic.

**Roofing component:** a roofing product that is incorporated into various roofing assemblies.

**Roof ridge:** the intersection of two roof planes at the peak of the roof.

**Roof span:** the maximum distance perpendicular to the ridge between outside bearing walls providing vertical support for the roof structure. For relatively simple buildings, this is usually the maximum distance (perpendicular to the ridge) between the outer walls that run parallel to the roof ridge.

**Shear walls:** a wall composed of braced panels (also known as shear panels) to counter the effects of lateral load acting on a structure. Wind and earthquake loads are the most common loads that shear walls are designed to resist.



**Shingle roof:** a roof that uses either asphalt or wood shingles installed over a wood deck as its primary roof covering material.

**Steep slope:** roof surfaces with a slope of 2:12 and greater.

**Tile roof:** a roof that uses either concrete or clay tile installed over a wood deck as its primary roof covering material.

**Underlayment:** a material applied to the surface of the roof deck or roof sheathing prior to the installation of the primary roof covering material.

**Wall openings:** windows and all doors, including entry doors, sliding glass doors, and garage doors.

**Wind loads:** pressures exerted on a building due to wind multiplied by the area upon which the pressures act. Wind loads are determined by applicable wind load provisions of ASCE 7 "Minimum Design Loads for Buildings and Other Structures."

## 2 FORTIFIED Roof Designation Requirements

### 2.1 FORTIFIED Roof Performance Criteria

Key performance goals for achieving a FORTIFIED Roof designation are outlined below.

#### 2.1.1 Existing Home; Existing Roof (the existing roof cover is not being replaced). Designation: FORTIFIED Roof – Existing Roof

Improving the existing roof (without replacing the roof cover) is considered appropriate when the home has a relatively new roof or has a roof covering that has a long life expectancy and the roof does not show visible signs of damage or deterioration. This method is not as effective as re-roofing (or installing a roof on a new home) because it does not ensure that a wind-resistant roof cover is in place. However, improving roof sheathing attachment and providing a barrier from inside the attic to help resist water intrusion can also help reduce hurricane-related damage resulting from the loss of some roof covering. If the home is retrofitted to qualify for this option, then the designation will be indicated as FORTIFIED Roof – Existing Roof. If the home qualifies for FORTIFIED Silver or FORTIFIED Gold designation levels, the designations will be indicated as FORTIFIED Silver – Existing Roof or FORTIFIED Gold – Existing Roof.

##### 2.1.1.1 Roof deck and roof cover: threshold requirements for designation

- **Wood structural panel roof sheathing has a minimum thickness of  $\frac{7}{16}$  in.**
- **The existing roof cover does not show visible signs of damage or deterioration.**
- **There is only one layer of roof covering.**
- **There is adequate access to the attic to allow application of closed-cell spray urethane-based foam adhesives along joints between sheathing and roof framing members as well as along all seams between the roof sheathing panels.**
- **Drip edge is installed.**

##### 2.1.1.2 Roof sheathing attachment

The existing roof sheathing attachment provides a factor of safety of 2.0 against ASD roof design wind uplift pressures specified by ASCE 7-05, ASCE-10, or ASCE 7-16 for the building. If LRFD-based wind uplift design loads are used, they shall be increased by 25 percent to assure a similar safety factor over ASD loads. The following restrictions shall be used in determining the adequacy of the existing fastening:

- Size and spacing shall be based on loads calculated for the largest tributary area assigned to any of the panel fasteners.

- NDS allowable withdrawal values (ASD) or ultimate values (LRFD) for smooth-shank fasteners shall be reduced by 50 percent.
- No increase in allowable withdrawal values for load duration effects is allowed.

If the existing fastening is not adequate, a method for enhancing the attachment so that it meets or exceeds the design wind uplift requirements will be required. The prescriptive method described in Section 2.2.1.1 that uses a closed-cell spray foam adhesive is one accepted alternative.

### 2.1.1.3 Sealed roof deck

Unless a qualified sealed roof deck option was applied when the home was roofed or re-roofed, additional protective measures shall be taken to significantly reduce water intrusion through the roof surface if a portion of the primary roof cover is damaged or removed by strong winds. A closed-cell spray foam applied to the bottom surface of the roof deck from within the attic as described in Section 2.2.1.1 is required.

### 2.1.1.4 Drip edge

A drip edge is required at all eaves and gable rake edges. The drip edge is intended to provide an enhanced edge condition for securing the underlayment and to provide a foundation for anchoring the edge of the roof cover.

### 2.1.1.5 Attic ventilation

Any existing attic ventilation system components must be evaluated to ensure they are designed and installed so that the covers and vent elements remain in place when subjected to a design-level event and are resistant to water intrusion during the design event. Florida Building Code TAS 100(A) is the only current standard being recognized for evaluation of water intrusion through ventilation system components.

A properly installed sealed attic system that is designed for the local climate, building materials, and building characteristics and uses closed-cell foam adhesive on the bottom surface of the roof deck is an acceptable approach to preventing water intrusion into the attic and will meet the requirements of Sections 2.1.1.3 and 2.1.1.5. It may also allow the roof system to meet the requirements of Section 2.1.1.2.

## 2.1.2 New Home; New Roof. Designation: FORTIFIED Roof – New Roof

### 2.1.2.1 Roof sheathing and sheathing attachment

Roof sheathing must be capable of resisting the loads and load combinations specified in ASCE 7-05, ASCE 7-10, or ASCE 7-16. The bending and shear capacity requirements shall be calculated using accepted engineering practice and the resistance shall be based on established minimum wood structural panel capacities. **Wood structural panel thickness shall not be less than  $\frac{7}{16}$  in.**

**Best Practices: Use plywood for roof sheathing instead of oriented strand board (OSB).**

Plywood has 30 percent greater impact resistance than OSB, is less susceptible to moisture-related damage, provides more consistent fastener withdrawal capacities for mechanically attached roof coverings, and provides better adhesion to peel-and-stick roof covering products.

Specified roof sheathing attachment shall provide a factor of safety of 2.0 against ASD roof design wind uplift pressures specified by ASCE 7-05, ASCE 7-10, or ASCE 7-16 for the building. If LRFD-based wind uplift design loads are used, they shall be increased by 25 percent to assure a similar safety factor over ASD loads. The following restrictions shall be used in determining fastener size and spacing:

- Size and spacing shall be based on loads calculated for the largest tributary area assigned to any of the panel fasteners.
- NDS allowable withdrawal values (ASD) or ultimate values (LRFD) for smooth-shank fasteners shall be reduced by 50 percent.
- No increase in allowable withdrawal values for load duration effects is allowed.

### 2.1.2.2 Sealed roof deck

Additional protective measures or modifications to typical underlayment installations shall be taken to significantly reduce water intrusion through the roof surface if a portion of the primary roof cover is damaged or removed by strong winds. These protective measures may be applied to the top surface of the roof deck or to the bottom surface from within the attic.

### 2.1.2.3 Drip edge

A drip edge is required along eaves and gable rake edges. The drip edge material, thickness, and fastening schedule shall be appropriate for the design wind speed at the site. The drip edge is intended to provide an enhanced edge condition for securing the underlayment and to provide a foundation for anchoring the edge of the roof cover.

#### 2.1.2.4 Roof cover

The roof cover and its installation requirements shall be appropriate for the design winds at the building site. Edge attachment of underlayment and roof cover shall be adequate to prevent uplift of the roof cover at the eave or gable rake edge during a design-level wind event.

#### 2.1.2.5 Attic ventilation

Any attic ventilation systems used must be designed and installed so that the covers and vent elements remain in place when subjected to a design-level event and are resistant to water intrusion during the design event. Florida Building Code TAS 100(A) is the only current standard being recognized for evaluation of water intrusion through ventilation system components.

A sealed attic system that is properly designed for the local climate, building materials, and building characteristics and uses closed-cell foam adhesive on the bottom surface of the roof deck is an acceptable approach to preventing water intrusion into the attic and will meet the requirements of Sections 2.1.2.2 and 2.1.2.5.

### 2.1.3 Existing Home; New Roof (Re-Roofing). Designation: FORTIFIED Roof – New Roof

#### 2.1.3.1 Minimum roof sheathing thickness: threshold requirement for designation

**To obtain a FORTIFIED designation, wood structural panel roof sheathing must have a minimum thickness of  $\frac{7}{16}$  in.**

#### 2.1.3.2 Roof sheathing and roof framing evaluation and repair

Inspect the roof deck after the old roofing materials have been removed to identify and replace any damaged or deteriorated decking (damage or deterioration could be from moisture, weathering, or insect infestation). Damaged or deteriorated decking would generally be marked by one or more of the following characteristics: soft or spongy wood, wood swelling or buckling, delaminating (plywood), or crumbling and flaking of the wood. Do not cut or notch supporting wood members when removing damaged/deteriorated decking. If a section of the roof deck is damaged or deteriorated, remove and replace the entire damaged sheet or board.

If the roof deck is damaged, there is a possibility that the wood roof framing members (rafters or truss top chords) below the damaged deck are damaged as well. Inspect roof framing members below the removed deck. If more than  $\frac{1}{4}$  in. of the surface is deteriorated or damaged, the members shall be evaluated by a licensed design professional to ensure they have sufficient residual capacity to handle all design loads and shall be repaired or replaced as specified by the



design professional. Prescriptive options outlined in Section 2.2.3.4 are acceptable alternatives provided the damage is within the indicated limits.

### 2.1.3.3 Roof sheathing attachment

Specified roof sheathing attachment (existing and added fasteners) shall provide a factor of safety of 2.0 against ASD roof design wind uplift pressures specified by ASCE 7-05, ASCE 7-10, or ASCE 7-16 for the building. If LRFD-based wind uplift loads are used, they shall be increased by 25 percent to assure a similar safety factor over ASD loads. The following restrictions shall be used in determining size and spacing of additional fasteners:

- Size and spacing shall be based on loads calculated for the largest tributary area assigned to any of the panel fasteners.
- NDS allowable withdrawal values (ASD) or ultimate values (LRFD) for smooth-shank fasteners shall be reduced by 50 percent.
- No increase in allowable withdrawal values for load duration effects is allowed.

**Best Practices: Mechanical attachment is the best long-term solution for keeping sheathing from blowing off.** Questions remain about the long-term effectiveness of closed-cell spray adhesives for uplift resistance. Walking on the roof and aging effects may reduce the adhesion to the structural members. If the roof previously qualified based on use of closed-cell spray adhesives for uplift resistance, make sure the deck is adequately attached with mechanical fasteners when it is re-roofed.

### 2.1.3.4 Sealed roof deck

Additional protective measures or modifications to typical underlayment installations shall be taken to significantly reduce water intrusion through the roof surface if a portion of the primary roof cover is damaged or removed by strong winds. These protective measures may be applied to the top surface of the roof deck or to the bottom surface from within the attic.

**Best Practices: Sealing the roof deck from the top surface is the best long-term solution for keeping water from penetrating the roof deck.** Test results have demonstrated that leaks are more likely with applications installed on the attic side of the sheathing because of access difficulties. Walking on the roof, and aging effects may lead to cracks in the foam along joints between panels. If the roof previously qualified based on use of closed-cell spray adhesives for the sealed roof deck, choose and apply one of the top-applied sealed roof deck options when you re-roof.

### 2.1.3.5 Drip edge

A drip edge is required along eaves and gable rake edges. The drip edge material, thickness, and fastening schedule shall be appropriate for the design wind speed at the site. The drip edge

is intended to provide an enhanced edge condition for securing the underlayment and to provide a foundation for anchoring the edge of the roof cover.

### 2.1.3.6 Roof cover

The roof cover and its installation requirements shall be appropriate for the design winds at the building site. Edge attachment of underlayment and roof cover shall be adequate to prevent uplift of the roof cover at the eave or gable rake edge during a design-level wind event.

### 2.1.3.7 Attic ventilation

Any existing attic ventilation system components must be evaluated to ensure they are designed and installed so that the covers and vent elements remain in place when subjected to a design-level event and are resistant to water intrusion during the design event. Florida Building Code TAS 100(A) is the only current standard being recognized for evaluation of water intrusion through ventilation system components.

A properly installed sealed attic system that is designed for the local climate, building materials, and building characteristics and uses closed-cell foam adhesive on the bottom surface of the roof deck is an acceptable approach to preventing water intrusion into the attic and will meet the requirements of Sections 2.1.3.7.

## 2.2 FORTIFIED Roof Prescriptive (Deem to Comply) Options

### 2.2.1 Existing Home; Existing Roof (the existing roof cover is not being replaced). Designation: FORTIFIED Roof – Existing Roof

**The minimum allowable deck thickness for wood structural panels to be eligible for a FORTIFIED designation is  $7/16$  in.**

#### 2.2.1.1 Strengthen roof sheathing attachment and seal roof deck from within attic

Strengthening the attachment of roof sheathing and installation of a sealed roof deck system can be achieved simultaneously by applying an ASTM or TAS tested 2-part, spray polyurethane foam adhesive to the underside of the roof deck as shown in Figure 2-1.

This system can satisfy two FORTIFIED Roof requirements:

1. Sealing the roof deck.

2. Providing adequate roof deck attachment—regardless of the original roof sheathing fastening.

The minimum requirements for spray adhesives are:

- Product must be tested and evaluated in accordance with either ASTM E330, Standard Test Method for Structural Performance of Exterior Windows, Doors, Skylights and Curtain Walls by Uniform Static Air Pressure Difference (applied to roof sheathing), or TAS 202-94, Criteria for Testing Impact and Non-Impact Resistant Building Envelope Components Using Uniform Static Air Pressure. The minimum allowable design uplift pressure must be greater than or equal to 110 psf and the proof test pressure achieved without failure or structural distress must be greater than or equal to 165 psf.
- Adhesive must be a two-component spray polyurethane foam system with a minimum core density of 1.5–3.0 pcf in accordance with ASTM D1622, Standard Test Method for Apparent Density of Rigid Cellular Plastics.
- Spray polyurethane foam adhesive system must be installed by a properly trained and qualified applicator in accordance with the manufacturer's maintenance and installation guidelines.
- Documentation from the installing contractor, on company letterhead, identifying the manufacturer and product used for the improved roof sheathing attachment/sealed roof deck must be provided to the certified FORTIFIED Evaluator to be included with final designation checklist. Documentation should also state that the installation meets the manufacturer's requirements for an allowable design uplift pressure of at least 110 psf (proof test of at least 165 psf).

To provide enhanced roof sheathing attachment and to seal the roof deck, apply a 1.5- to 3-in. fillet of 2-part spray-applied polyurethane foam adhesive to:

- All joints between sheathing
- All intersections between roof sheathing and roof framing members
- All valleys

Spray adhesive application shall comply with the manufacturer's installation requirements and the density shall not be less than that required by the manufacturer to meet a minimum design uplift pressure of 110 psf on the sheathing.



Figure 2- 1. Closed-cell polyurethane foam adhesive applied to the underside of the roof sheathing at the joints between the sheathing panels and along all intersections between roof sheathing and all roof framing members.

**Exception:**

If it can be demonstrated through inspection and documentation that the roof sheathing attachment meets or exceeds minimum fastener type, size, and spacing specified in Section 2.2.2.2 AND that a qualified sealed roof deck system is installed, then the installation of closed-cell foam is not required for the home to obtain the FORTIFIED Roof – Existing Roof designation.

### 2.2.1.2 Improve water intrusion resistance of attic ventilation system

Except for sealing gable rake vents, all other shuttering of openings or plugging of vents should be done on a temporary basis and removed once the storm threat is over so that the attic is once again properly ventilated.

#### 2.2.1.2.1 Improve attachment/replace ridge and off-ridge vents

Ridge vents and off-ridge vents must be TAS 100(A) rated for resisting water intrusion in high winds and must be properly anchored to the roof following the manufacturer's recommended installation for high winds. If it is not possible to verify that they have a TAS 100(A) rating or they are not well attached, they must be replaced/reattached as appropriate.

### 2.2.1.2.2 Gable end vents

Gable end vents (Figure 2-2) are not designed to keep out water driven by hurricane-force winds.



Figure 2-2. Example of a gable end vent.

Three options are offered that can meet the intent of the program. Any other options must be approved in advance.

**Option 1:** It may be possible to add ridge or off-ridge venting (even if you are not re-roofing) that will provide the ventilation otherwise provided by the gable end vent(s). Once this replacement venting is provided, the gable end vent(s) can be removed or permanently blocked.

**Option 2:** When a hurricane threatens, shutter the gable vents from the outside with plywood (Figure 2-3) or some other nonporous flat shutter that will prevent water from entering through the gable end vent. Wood structural panels with a minimum thickness of  $\frac{7}{16}$  in. and a maximum span of 4 ft are permitted as gable end covers. Panels must be pre-cut so they can be attached to the framing surrounding the gable vent. Panels shall be pre-drilled as required for the anchorage method and all required hardware shall be provided. Permanent corrosion-resistant attachment hardware with anchors permanently installed on the building shall be provided. Attachment schedule must be, at a minimum, in accordance with Table 2-1. Seal the shutters to the trim boards around the edges of the gable end vent. Self-adhesive weather stripping can be used to produce the desired seal.



**Option 3:** If installation of shutters from the outside is difficult because of the height or other considerations, but there is access through the attic, the gable vent opening can be shuttered from the inside (Figure 2-4). Follow the requirements for size and anchorage of wood structural panels indicated in Option 1. Note that careful attention needs to be paid to sealing around the shutter and making sure that any water that accumulates in the cavity can drain to the outside of the house and not into the wall below.



Figure 2-3. Outside covering of a gable end vent with plywood.

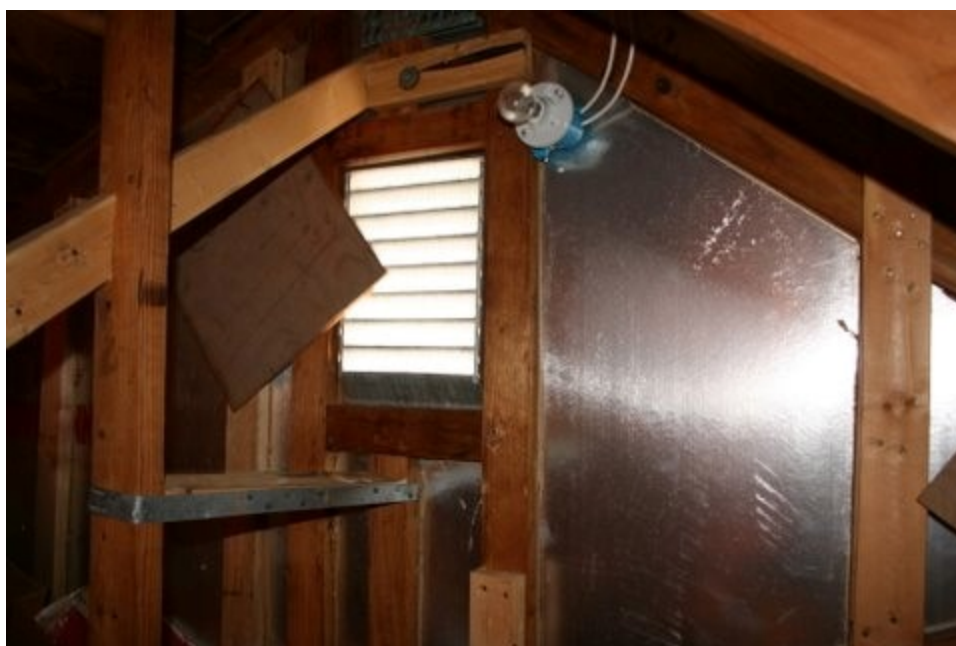


Figure 2-4. Gable end vent ready to be covered with plywood from inside attic.



**Table 2-1. Fastening Schedule for Wood Structural Panel Gable End Vent Cover**

Support Structure Type	Fastener Type and Size	Fastener Spacing (With Critical Edge and End Distance)
<b>Wood</b>	¼-in. diameter lag screws with 2-in. embedment with 1-in.-diameter washer	16 in. o.c. maximum  (1 in. from edge of opening, 2 in. inward from panel edge)
<b>Concrete or Grouted Masonry</b>	¼-in. fastener with 2-in. embedment with 1-in.-diameter washer	16 in. o.c. maximum  (1.5 in. from edge of opening, 2 in. inward from panel edge)

**Notes for Table 2-1:**

- All fasteners shall be corrosion resistant.
- Fasteners shall be installed at opposing ends of the wood structural panel.
- Where screws are attached to masonry or masonry/stucco, they shall be attached using vibration-resistant anchors having a minimum withdrawal capacity of 1,500 lb.
- Min. (2) fasteners per panel side.

### 2.2.1.3 Photovoltaic (PV) systems

#### 2.2.1.3.1 Design guidance

##### 2.2.1.3.1.1 Wind loads

Roof-mounted PV systems shall be designed for component and cladding wind loads for the site in accordance with ASCE 7-16 using an effective wind area based on the dimensions of a single unit frame.

##### 2.2.1.3.1.2 Gravity loads

The roof deck and supporting roof structure must be designed to support all gravity and wind loads resulting from the PV system installation.

##### 2.2.1.3.1.3 Connections and Installation

Connections and installation of appropriately designed PV systems must be field verified by a professional engineer and a letter of compliance from that professional engineer indicating that

connections and installation of the PV System meet the design intent must be submitted to the FORTIFIED Evaluator.

#### **2.2.1.3.1.4 Flashing**

All roof penetrations must be sealed and flashed in accordance with the PV system and roof covering manufacturer's requirements.

## **2.2.2 New Home; New Roof. Designation: FORTIFIED Roof – New Roof**

### **2.2.2.1 Roof deck thickness**

**The minimum allowable deck thickness for wood structural panels to be eligible for a FORTIFIED designation is  $\frac{7}{16}$  in.** However, the deck thickness should meet or exceed requirements of the Wood Frame Construction Manual 2015 Edition or later when those requirements exceed  $\frac{7}{16}$  in. Prescriptive guidance on acceptable wood structural panel thickness for buildings with a mean roof height of 33 ft or less are provided in Table 3.12A of the 2015 edition of the Wood Frame Construction Manual for various design wind speeds and terrain exposures B and C.

**Best practices: Use plywood for roof sheathing instead of oriented strand board (OSB).** Plywood has 30 percent greater impact resistance than OSB, is less susceptible to moisture-related damage, provides more consistent fastener withdrawal capacities for mechanically attached roof coverings, and provides better adhesion to peel-and-stick roof covering products.

**Minimum sheathing requirement for new clay or concrete tile roofs is  $\frac{15}{32}$ -in. plywood.** The Tile Roofing Institute (TRI) and the Florida Roofing and Sheet Metal Contractors Association (FRSA) require not less than  $\frac{15}{32}$ -in.-thick plywood or other decking material that is recognized in a code evaluation report for tile roof installations in high-wind areas. In addition, TRI and FRSA guidance calls for sheathing that is adequate to support the loads involved. The FORTIFIED program has adopted a minimum of  $\frac{15}{32}$ -in. plywood requirement for new construction that will have a clay or concrete tile roof cover, but tile manufacturer installation guidelines and evaluation reports may require a roof deck material greater than  $\frac{15}{32}$ -in. plywood.

### **2.2.2.2 Roof deck attachment**

#### **2.2.2.2.1 Sawn lumber or wood board roof deck**

Wood boards up to 1 in. thick shall be secured with at least two (2) nails, having a minimum diameter of 0.131 in. and a minimum length of 2½ in., (three [3] nails if the board is wider than 8

in.) to each roof framing member it crosses. Framing members must be spaced no more than 24 in. apart. Clipped-head, D-head, or round-head nails are acceptable provided they have the required minimum diameter and length. The nailing requirements are summarized in Table 2-2.

Wood boards greater than 1 in. thick and up to 2 in. thick, shall be secured with at least two (2) nails, having a minimum diameter of 0.131 in. and sufficient length to penetrate a minimum of 1 $\frac{5}{8}$  in. into the roof framing, (three [3] nails if the board is wider than 8 in.) to each framing member it crosses. Framing members must be spaced no more than 24 in. apart. Clipped-head, D-head or round-head nails shall be acceptable provided they have the required minimum diameter and length. The nailing requirements are summarized in Table 2-2.

**Table 2-2. Fasteners Required for Wood Board Decking Attachment**

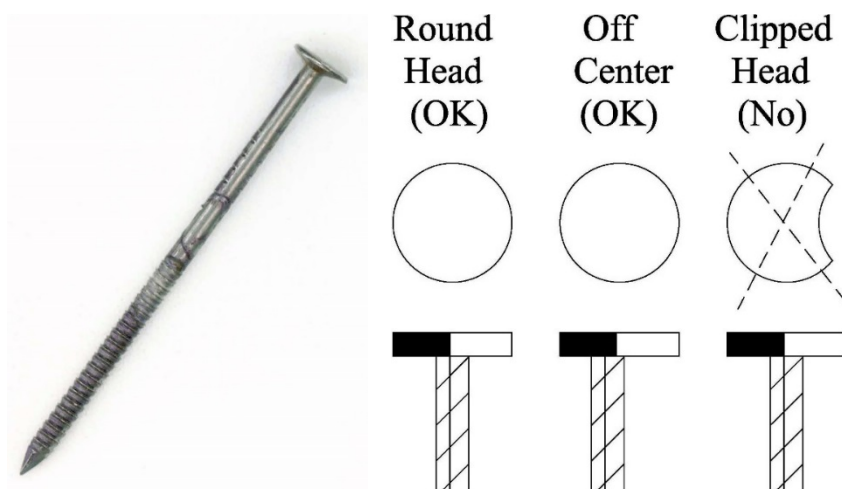
<b>Wood Board/Lumber (Roof Decking) Width</b>	<b>Number and Minimum Dimensions of Nails per Board for Each Framing Member it Crosses</b>	<b>Maximum Spacing of Framing Members</b>
<b>Up to 8 in.</b>	Two (2) 0.131 in. minimum diameter with 1 $\frac{5}{8}$ -in. penetration into roof framing members	24 in.
<b>Larger than 8 in.</b>	Three (3) 0.131 in. minimum diameter with 1 $\frac{5}{8}$ -in. penetration into roof framing members	24 in.

#### **2.2.2.2.2 Structural wood panel roof sheathing (plywood or OSB)**

Testing of wood structural panels connected using smooth- and ring-shank nails of different sizes at various spacing along edge and intermediate members have demonstrated that ring-shank nails provide much more consistent uplift resistance than smooth-shank nails. The following prescriptive nail size and nail spacing options are based on the use of ring-shank nails. To help prevent head pull-through in thin sheathing panels from becoming the limiting factor, full round heads are required.

The specific minimum required dimensions and characteristics for the ring-shank nails (Figure 2-5) to be used for roof sheathing attachment are:

- Full round head diameter (minimum 0.281-in. diameter; no clipped-head nails allowed)
- 2 $\frac{3}{8}$  in. minimum nail length
- 0.113 in. in diameter



**Figure 2-5. Use 8d ring-shank nails when attaching roof sheathing. Research indicates that panels attached with ring-shank nails have about twice the uplift capacity compared to panels attached with the same size smooth-shank nails.**

- Only full round head ring-shank nails are acceptable
- Off-center ring-shank nails with full round heads are acceptable
- Clipped-head ring-shank nails are not acceptable for attachment of structural wood roof sheathing panels

Ring-shank nail spacing shall not be greater than the spacing requirements listed in Table 2-3 for the appropriate design wind speed at the building site. Prescriptive guidance for roof sheathing thickness and attachment based on wind speed is available through the AWC's [Wood Frame Construction Manual](#).

**Table 2-3. Maximum Allowed Ring-Shank Nail Spacing Along Panel Edges and Intermediate Framing for Attaching Roof Deck Wood Structural Panels**

Design Wind Speed		All Roof Areas
ASCE 7-05; IRC 2006; IRC 2009; IRC 2012	ASCE 7-10; ASCE 7-16; IRC 2015; IRC 2018	
110 mph or less	130 mph or less	6 in. o.c.
Greater than 110 mph	Greater than 130 mph	4 in. o.c.

### 2.2.2.3 Sealing the roof deck (roof slopes 2:12 or greater)

All new roof cover installations require a sealed roof deck system that keeps water out of the attic and the interior of the house in the event the roof covering is damaged during a hurricane. The following are qualified methods for sealing the roof deck.

#### 2.2.2.3.1 Options for shingle or metal roof covers (roof slopes 2:12 or greater)

**Sealed Roof Deck Option 1:** Tape seams between roof sheathing that forms the roof deck. There are two material options for taping the seams on the roof deck:

- **Material Option 1:** Apply an ASTM D1970 compliant self-adhering polymer-modified bitumen flashing tape, at least 4 in. wide, directly to the roof deck to seal the horizontal and vertical joints in the roof deck.
- **Material Option 2:** Apply an AAMA 711-13, Level 3 (for exposure up to 80°C/176°F) compliant self-adhering flexible flashing tape at least 3¾ in. wide directly to the roof deck to seal the horizontal and vertical joints in the roof deck.

Any flashing tape used to achieve a sealed roof deck must be fully adhered without voids (e.g., wrinkles) in order to be accepted. In some instances, the ability of self-adhered flashing tapes to adhere to oriented strand board (OSB) sheathing may be compromised by the level of surface texture or wax used in fabricating the OSB panels. In applications where flashing tape adhesion to OSB is marginal, apply a manufacturer-specified compatible primer to the OSB panels where the tape will be applied to ensure the proper attachment of the self-adhering tape to the sheathing. Do not nail or staple the tape to the roof sheathing. Refer to the manufacturer's recommendations for installation and primer requirements (if applicable).

Next, apply a code-compliant ASTM D226 Type II (#30) or ASTM D4869 Type III or Type IV (#30) underlayment over the self-adhering tape. As an alternative, apply a reinforced synthetic roof underlayment which has an ICC approval as an alternate to ASTM D226 Type II felt paper. The synthetic underlayment must have a minimum tear strength of 15 lbf in accordance with ASTM D4533 and a minimum tensile strength of 20 lbf/in. in accordance with ASTM D5035. These underlayments must be attached using annular-ring or deformed-shank roofing fasteners with minimum 1-in.-diameter caps (button cap nails) at 6 in. o.c. spacing along all laps and at 12 in. o.c. vertically and horizontally in the field, or a more stringent fastener schedule if required by the manufacturer for high wind and prolonged exposure installations. Horizontal laps must be a minimum of 4 in. and end laps must be a minimum of 6 in.

Caution: Be sure to check product labelling carefully. Not all products labelled ASTM D4869 are Type III or Type IV. Look for ASTM D4869 felt that is labeled Type III or Type IV. ASTM D4869 Type I or Type II will NOT be accepted.

Installation Notes:

- Best practice for drip edge installation at eaves: Install the drip edge on top of the underlayment at the eaves. Make sure the top surface of the drip edge is clean, free of oil, and, if required by the starter strip manufacturer, primed with ASTM D41 primer. For shingle roof installations, seal the drip edge, underlayment, and starter strip at the eave by either using a self-adhering starter strip or applying an 8-in.-wide layer of compatible flashing cement, maximum thickness  $\frac{1}{8}$  in., over the drip edge and adjacent underlayment. For metal roof covers, apply a compatible manufacturer-approved sealant between the drip edge and adjacent underlayment to prevent water from accumulating under the drip edge. See Section 2.2.2.4 for further drip edge installation requirements.
- Lap underlayment with minimum 6-in. leg “turned up” at wall intersections; lap wall weather barrier over turned-up roof underlayment.



Figure 2-6. Installing a sealed roof deck system; taping the seams of roof sheathing.

**Sealed Roof Deck Option 2:** Install two (2) layers of ASTM D226 Type II (#30) or ASTM D4869 Type III or Type IV (#30) underlayment in a shingle-fashion, lapped 19 in. on horizontal seams (36-in. roll), and 6 in. on vertical seams.





**Caution:** Be sure to check product labelling carefully. Not all products labelled ASTM D4869 are Type III or Type IV. Look for ASTM D4869 felt that is labeled Type III or Type IV. ASTM D4869 Type I or Type II will NOT be accepted.

The starter course of felt is to be installed as described below and shown in Figure 2-7. Cut 17 in. off one side of the roll and install the remaining 19-in.-wide strip of underlayment along the eave, safely tacked in place. Carefully install a 36-in.-wide roll of ASTM D226 Type II (#30) or ASTM D4869 Type III or Type IV (#30) underlayment over the 19-in.-wide course of ASTM D226 Type II (#30) or ASTM D4869 Type III or Type IV (#30) underlayment along the eave. Follow the same procedure for each course, overlapping the sheets 19 in. (leaving a 17-in. exposure). Fasten the bottom edge of the roll (eave edge or horizontal lap) with a row of annular-ring or deformed-shank nails with 1-in.-diameter caps at 6 in. o.c. Since the bottom edge (horizontal lap) of the next layer of underlayment will be fastened approximately 19 in. above the horizontal lap below, install a row of annular-ring or deformed-shank nails with 1-in.-diameter caps with 12 in. o.c. horizontal spacing about 10 in. above the bottom lap. When the installation is completed, the resulting fastening of the two (2) layers of felt should consist of the same fasteners at approximately 6 in. o.c. along all laps and at not more than 12 in. o.c. in the field of the sheet between the side laps. Add fasteners along any exposed vertical laps so that the maximum spacing between fasteners is 6 in. o.c. For sites with design wind speeds less than 140 mph (Vasd: ASCE 7-05; IRC 2006; IRC 2009; and IRC 2012) or less than 160 mph (Vult: ASCE 7-10; IRC 2015; and IRC 2018), use annular-ring or deformed-shank nails with 1-in.-diameter caps (button cap nails). For sites with design wind speeds greater than or equal to 140 mph (Vasd: ASCE 7-05; IRC 2006; IRC 2009; and IRC 2012) or greater than 160 mph (Vult: ASCE 7-10; IRC 2015; and IRC 2018), use annular-ring or deformed-shank nails with 1-in.-diameter thin metal disks (“tincaps”).

#### Installation Notes:

- Best practice for drip edge installation at eaves: Install the drip edge on top of the double layer of underlayment at the eaves. Make sure the top surface of the drip edge is clean, free of oil, and, if required by the starter strip manufacturer, primed with ASTM D41 primer. For shingle roof installations seal the drip edge, underlayment and starter strip at the eave by either using a self-adhering starter strip or applying an 8-in.-wide layer of compatible flashing cement, maximum thickness  $\frac{1}{8}$  in., over the drip edge and adjacent underlayment. For metal roof covers, apply a compatible manufacturer-approved sealant between the drip edge and adjacent underlayment to prevent water from accumulating under the drip edge.
- Lap underlayment with minimum 6-in. leg “turned up” at wall intersections; lap wall weather barrier over turned-up roof underlayment.

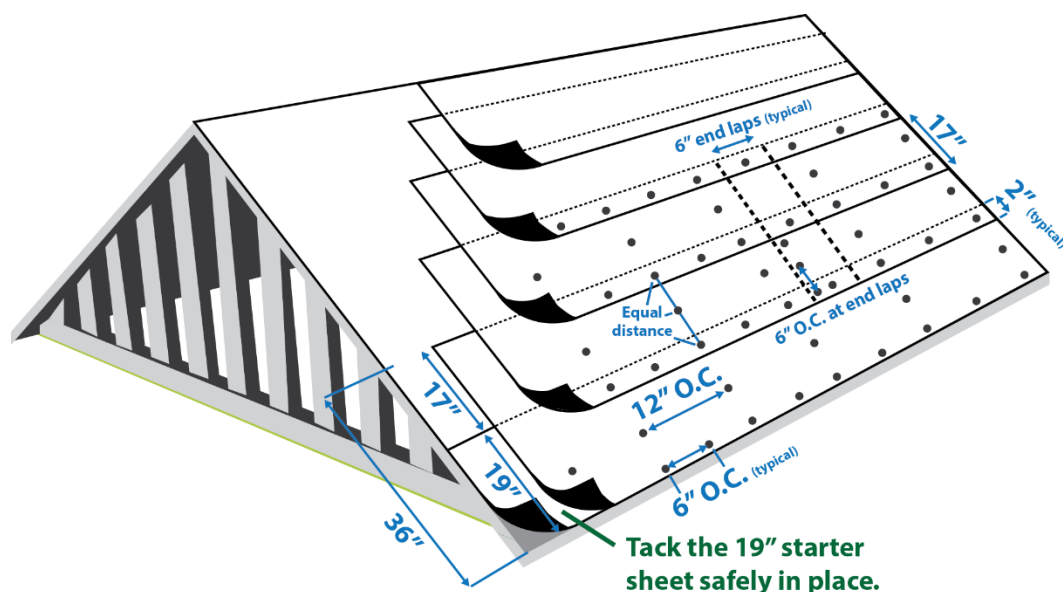


Figure 2-7. Installation of 19 in. starter course general notes.

**Sealed Roof Deck Option 3:** Cover the entire roof deck with a full layer of self-adhering polymer-modified bitumen membrane meeting ASTM D1970 requirements. This approach provides a waterproof membrane over the entire roof and can greatly diminish the potential for leaks. In some instances, the ability of the self-adhered membranes to adhere to oriented strand board (OSB) sheathing may be compromised by the level of surface texture or wax used in fabricating the OSB panels. In applications where membrane adhesion to OSB is marginal, apply a manufacturer-specified compatible primer to the OSB panels to ensure the proper attachment of the self-adhering membrane to the sheathing. Also, roofers are finding that shingles are bonding to many of these self-adhered membranes and this could lead to damage of the sheathing when it comes time to replace the shingles. Consequently, the membrane should be covered with a bond break such as a #15 ASTM D226, Type I underlayment. This underlayment on shingle roofs only needs to be fastened well enough to keep it on the roof surface and provide safety to the roofers until the shingles are applied. **Note: For asphalt shingle installations, hold bond break material back 8 in. from roof edges to allow mastic and starter strip or self-adhered starter strip to be applied directly to drip edge.**

Note: Manufacturers emphasize the need for adequate attic ventilation when this type of membrane is applied over the entire roof. This is particularly important north of the North Carolina/South Carolina border. Also, some local building departments prohibit the use of this system. Check with the local building department for restrictions.

#### Installation Notes:

- Best practice for drip edge installation at eaves: Install drip edge on top of the underlayment. Make sure the top surface of the drip edge is clean, free of oil, and, if required by the starter strip manufacturer, primed with ASTM D41 primer.



For shingle roof installations, seal the drip edge, underlayment, and starter strip at the eave by either using a self-adhering starter strip or applying an 8-in.-wide layer of compatible flashing cement, maximum thickness  $\frac{1}{8}$  in., over the drip edge and adjacent underlayment. For metal roof covers, apply a compatible manufacturer-approved sealant between the drip edge and adjacent underlayment to prevent water from accumulating under the drip edge. See Section 2.2.2.4 for further drip edge installation requirements.

- Lap underlayment with minimum 6-in. leg “turned up” at wall intersections; lap wall weather barrier over turned-up roof underlayment.

### **2.2.2.3.2 Options for concrete and clay tile roof covers (roof slopes 2:12 or greater)**

The following options qualify as sealed roof decks under clay and concrete roof tiles. In option 2, the self-adhering tape provides a required barrier against water intrusion in case the roofing felt begins to lift.

**Sealed Roof Deck Option 1:** Cover the entire roof deck with an approved self-adhering polymer-modified bitumen underlayment complying with ASTM D1970, installed in accordance with both the underlayment manufacturer’s and roof covering manufacturer’s installation instructions for the deck material, roof ventilation configuration, and climate exposure for the roof covering to be installed. In some instances, the ability of the self-adhered membranes to adhere to oriented strand board (OSB) sheathing may be compromised by the level of surface texture or wax used in fabricating the OSB panels. In applications where membrane adhesion to OSB is marginal, apply a manufacturer-specified compatible primer to the OSB panels to ensure the proper attachment of the self-adhering membrane to the sheathing. Note: Some local building departments prohibit the use of this system. Check with the local building department for restrictions. Manufacturers emphasize the need for adequate attic ventilation when this type of membrane is applied over the entire roof. This is particularly important north of the North Carolina/South Carolina border.

#### **Installation Notes:**

- Best practice for drip edge installation at eaves: Install the self-adhered underlayment over the drip edge. Before installing the drip edge, prime the roof deck with a compatible primer or install a separator sheet that extends 2 in. past the deck flange of the drip edge. Make sure the top surface of the drip edge is clean, free of oil, and, if required by the membrane manufacturer, primed with ASTM D41 primer so that the self-adhering membrane adheres to the top of the drip edge. See Section 2.2.2.4 for further drip edge requirements.
- Lap underlayment with minimum 6-in. leg “turned up” at wall intersections; lap wall weather barrier over turned-up roof underlayment.

**Sealed Roof Deck Option 2:** Tape seams between roof sheathing that forms the roof deck. There are two material options for taping the seams on the roof deck.

- **Material Option 1:** Apply an ASTM D1970 compliant self-adhering polymer-modified bitumen flashing tape, at least 4 in. wide, directly to the roof deck to seal the horizontal and vertical joints in the roof deck.
- **Material Option 2:** Apply an AAMA 711-13, Level 3 (for exposure up to 80°C/176°F) compliant self-adhering flexible flashing tape at least 3¾ in. wide directly to the roof deck to seal the horizontal and vertical joints in the roof deck.

Any flashing tape used to achieve a sealed roof deck must be fully adhered without voids (e.g., wrinkles) in order to be accepted. In some instances, the ability of self-adhered flashing tapes to adhere to oriented strand board (OSB) sheathing may be compromised by the level of surface texture or wax used in fabricating the OSB panels. In applications where flashing tape adhesion to OSB is marginal, apply a manufacturer-specified compatible primer to the OSB panels where the tape will be applied to ensure the proper attachment of the self-adhering tape to the sheathing. Do not nail or staple the tape to the roof sheathing. Refer to the manufacturer's recommendations for installation and primer requirements (if applicable).

Next, apply a code-compliant #30 ASTM D226 Type II underlayment/anchor sheet over the self-adhering tape. Attach the underlayment/anchor sheet using annular-ring or deformed-shank roofing fasteners with minimum 1-in.-diameter metal caps at 6 in. o.c. spacing along all laps and at (2) rows in between side laps at a maximum of 12 in. o.c. or a more stringent fastener schedule if required by the manufacturer for high-wind use as an anchor sheet. Horizontal laps must be a minimum of 4 in. and end laps must be a minimum of 6 in.

Finally, apply an approved self-adhering polymer-modified bitumen roof tile cap sheet complying with ASTM D1970 that meets the site design wind speeds over this underlayment **OR** hot-mop an approved tile underlayment over the underlayment/anchor sheet using hot asphalt.

#### Installation Notes:

- Best practice for drip edge installation at eaves: Install the drip edge on top of the ASTM D226 Type II underlayment but under the self-adhering ASTM D1970 cap sheet. Make sure the top surface of the drip edge is clean, free of oil, and, if required by the membrane manufacturer, primed with ASTM D41 primer so that the self-adhering cap sheet adheres to the top of the drip edge. See Section 2.2.2.4 for further drip edge requirements.
- Lap underlayment with minimum 6-in. leg "turned up" at wall intersections; lap wall weather barrier over turned-up roof underlayment.

#### 2.2.2.4 Drip edge

##### Background

Properly attached drip edge metal helps to keep water from running down or getting behind the roof fascia material and it can provide an important anchor for underlayment material around the perimeter of the roof and enhanced anchorage of the perimeter shingles for an asphalt shingle roof cover. Basic code requirements for drip edge installation vary around the United States. Many codes address the most common risks and reflect minimum requirements that focus on simplicity of installation. A common focus is ensuring that water is not trapped behind the drip edge at the eaves. Consequently, many codes require the underlayment be installed over the top of the drip edge. In some of the most vulnerable hurricane-prone areas, codes have focused on the importance of anchoring shingles around the perimeter of the roof and have adopted requirements that drip edge be installed on top of the underlayment to help anchor its edge. They have addressed trapping of water under the drip edge by requiring flashing cement to seal the roof edges including the tops of the drip edge. With the addition of appropriate measures to ensure water is not trapped, local building officials in areas requiring drip edges at eaves be installed under the underlayment may allow the best practice methods outlined in above sections as acceptable alternate methods.

##### Requirements

Provide code-compliant, minimum gauge metal drip edge along all eaves and gable rake edges. Overlap drip edge at joints a minimum of 3 in. Eave drip edges shall extend ½ in. below the bottom of the sheathing and extend back on the roof a minimum of 2 in. Drip edges must be mechanically fastened to the roof deck at a maximum of 4 in o.c. Mechanical fasteners should be applied in an alternating (staggered) pattern along the length of the drip edge with adjacent fasteners placed near opposite edges of the leg/flange of drip edge on the roof. Drip edge shall be installed OVER the underlayment along gable rake edges and at eaves it shall follow the best practices guidance outlined in Sections 2.2.2.3.1 and 2.2.2.3.2 for the sealed roof deck option and roof cover selected.

#### 2.2.2.5 Flashing requirements

##### 2.2.2.5.1 General requirements

Flashings are used to weatherproof or seal roof system edges at perimeters, penetrations, walls, expansion joints, valleys, drains, and other places where the roof covering is interrupted or terminated. Flashings shall be installed in a manner that will prevent moisture from entering the wall or roof, or through moisture-permeable materials at intersections or other penetrations through the roof plane.

The flashing installation requirements found in the local building code, product manufacturer's installation instructions, and the applicable FORTIFIED standards serve as primary compliance methods. The use of FORTIFIED-approved supplemental standards for conditions other than those found in primary standards is permitted (**see Section 2.2.2.5.2 for sources of additional flashing installation guidance**). In all cases, the more restrictive installation methods shall be used for all roof-related flashing, including any associated counter-flashing.

- Use corrosion-resistant metal flashing and fasteners. See Appendix D for Fastener Corrosion Protection Requirements.

### **2.2.2.5.2 Additional flashing installation guidance for various roof systems**

#### **Asphalt Shingle Systems**

The flashing installation requirements found in the local building code, shingle manufacturer's installation instructions, and the applicable FORTIFIED standards serve as primary compliance methods. The use of FORTIFIED-approved supplemental standards for conditions other than those found in primary standards is permitted. In all cases, use the more restrictive installation methods for all roof-related flashing, including any associated counter-flashing. The ARMA Residential Asphalt Roofing Manual; the NRCA Roofing Manual: Architectural Metal Flashing; and the FBC Roofing Application Standard (RAS) No. 115 listed in the Test Protocols for High-Velocity Hurricane Zones, 5th Edition (2014) are FORTIFIED-approved supplemental standards.

Asphalt Roofing Manufacturers Association (ARMA) [www.asphaltroofing.org](http://www.asphaltroofing.org)

National Roofing Contractors Association (NRCA) [www.nrca.net](http://www.nrca.net)

Florida Building Code (FBC) [www.floridabuilding.org](http://www.floridabuilding.org)

#### **Concrete and Clay Tile Roof Systems**

Use the more restrictive of the following installation methods for all roof-related flashing, including any associated counter-flashing: the local building code; the tile manufacturer's installation instructions; the FRSA/TRI Florida High Wind Concrete and Clay Tile Installation Manual 5<sup>th</sup> Edition, Revised; the FBC Roofing Application Standard (RAS) No. 111, 118, 119, or 120 listed in the Test Protocols for High-Velocity Hurricane Zones, 5th Edition (2014); and the applicable FORTIFIED standards; or combination thereof.

Florida Roofing and Sheet Metal Contractors Association (FRSA) [www.floridarooft.com](http://www.floridarooft.com)

Tile Roof Institute (TRI) [tileroofing.org](http://tileroofing.org)



## Metal Roof Shingles or Panels

Install all flashing including any associated counter-flashing in compliance with the local building code; the metal shingle or panel manufacturer's installation instructions; or combination thereof.

## Wood Shingles and Wood Shakes

Install all flashing including any associated counter-flashing in compliance with the local building code; the wood shingle or wood shake manufacturer's installation instructions; the CSSB New Roof Construction Manual; or combination thereof.

Cedar Shake and Shingle Bureau (CSSB) [www.cedarbureau.org](http://www.cedarbureau.org)

### 2.2.2.6 Selecting and installing a qualified steep-slope (2:12 or greater slope) roof covering

Roof coverings and their attachment must be rated for the ASCE 7 design wind speed for the site location of the building and must be installed in accordance with the manufacturer's recommendations for high-wind regions.

#### 2.2.2.6.1 Asphalt shingles

Asphalt shingles, including hip and ridge materials, must meet the shingle testing standard for the appropriate site design wind speed as shown in Table 2-4.

**Table 2-4. Design Wind Speed and Shingle Testing Standards**

Wind Speed ( $V_{asd}$ )	Wind Speed ( $V_{ult}$ )	Shingle Wind Testing Standard/Classification
100 MPH	129 MPH	ASTM D3161 (Class F) or ASTM D 7158 (Class G or H) <sup>1</sup>
110 MPH	142 MPH	
120 MPH	155 MPH	
130 MPH	168 MPH	ASTM D3161 (Class F) or ASTM D 7158 (Class H) <sup>1</sup>
140 MPH	180 MPH	
150 MPH	194 MPH	

<sup>1</sup> The standard calculations contained in ASTM D7158 assume Exposure Category B or C and a building height of 60 ft or less. Additional calculations are required for conditions outside of these assumptions.

Shingles must be installed using the number of fasteners required by the manufacturer for high-wind fastening. In areas where the local building code requires more fasteners than required by the manufacturer, fasteners shall comply with the local building code.

**Installation of Starter Strips at Eaves:** Manufacturer-approved starter strips at eaves shall be installed on an approved sealed roof deck with the drip edge conforming to the requirements of Section 2.2.2.5 and underlayment/drip edge combination installed following the best practices outlined in Section 2.2.2.3.1. The starter strip shall be either:

1. Set in a minimum 8-in.-wide strip of compatible flashing cement. Maximum thickness of flashing cement shall be  $\frac{1}{8}$  in. Fasten starter strips parallel to the eaves along a line above the eave line according to the manufacturer's specifications. Position fasteners to ensure they will not be exposed under the cutouts in the first course. Starter strips and shingles must not extend more than  $\frac{1}{4}$  in. beyond the drip edge.
2. Shingle manufacturer-approved ASTM D1970 fully adhered (peel-and-stick) starter strip with asphaltic adhesive strip at eave—installed so that starter strip adheres to and covers the drip edge top surface.

**Installation of Shingles at Gable Rakes (Drip Edge Installed Over Underlayment):** Shingles installed at gable rake edges shall be installed according to one of the following three options.

1. Shingles at rakes shall be set in a minimum 8-in.-wide strip of compatible flashing cement. Maximum thickness of flashing shall be  $\frac{1}{8}$  in. Fasten shingles at rakes according to the manufacturer's specifications.
2. Manufacturer-approved starter strips at rakes shall be set in an 8-in.-wide strip of compatible flashing cement. Maximum thickness of flashing cement shall be  $\frac{1}{8}$ -in. Fasten starter strips parallel to the rakes according to the manufacturer's specifications. Position fasteners to ensure they will not be exposed. Starter strips and shingles must not extend more than  $\frac{1}{4}$  in. beyond the drip edge.
3. Shingle manufacturer-approved ASTM D1970 fully adhered (peel-and-stick) starter strip with asphaltic adhesive strip at rake—installed so that starter strip adheres to and covers the drip edge top surface. Starter strips and shingles must not extend more than  $\frac{1}{4}$  in. beyond the drip edge.

**Attachment of Shingles at Intersections and Valleys:** Shingles installed at all intersections and both sides of open valleys shall be set in a minimum 8-in.-wide strip of flashing cement. Maximum thickness of flashing cement shall be  $\frac{1}{8}$  in. Cut side of closed valleys shall be set in a minimum 2-in.-wide,  $\frac{1}{8}$ -in.-thick strip of flashing cement. Woven valleys to be according to the manufacturer's specifications.

### **2.2.2.6.2 Clay and concrete tiles**

Clay and concrete roof tile systems and their attachment must meet the requirements of the site design wind speed and exposure category. Clay and concrete roof tiles must be installed in accordance with the manufacturer's product approval for the site design wind speed, roof height, and Exposure Category. FRSA/TRI installation guidelines, "Florida High Wind Concrete and Clay Tile Installation Manual Fifth Edition, Revised, FRSA/TRI April 2012 (04-12)" provide additional guidance for installation incorporating ASCE 7-10 wind loads for mechanically attached tile. Roof tiles may be installed with roof tile adhesives that are recognized and installed in accordance with an ICC-ES Evaluation Report, a Florida Product Approval, a Miami-Dade County Notice of Acceptance (NOA), or a Texas Department of Insurance (TDI) Evaluation Report. Mortar-set tile or mortar-set hip and ridge tiles are not permitted. Hip and ridge boards or metal must be attached to the roof framing to resist the uplift pressure for the site design wind speed and exposure or in accordance with the tile manufacturer's product approval. Hip and ridge tiles must be secured to the hip and ridge boards or metal with mechanical fasteners and/or an approved roof tile adhesive. ASCE 7-16 wind loads are not addressed in the FRSA/TRI Installation (Fifth Edition Revised) guidelines. In jurisdictions that require ASCE 7-16 wind loads, follow the tile manufacturer installation guidance and product approvals for the design wind pressures, and, if the roof tile is installed with adhesives, the adhesive manufacturer's product approval for those wind pressures.

The clay and concrete tiles must be installed over minimum  $15/32$ -in.-thick plywood and one of the acceptable sealed roof deck underlayment options.

Note: FRSA/TRI Installation guidelines, "Florida High Wind Concrete and Clay Roof Tile Installation Manual Fifth Edition Revised, FRSA/TRI April 2012" are available for purchase from the Tile Roofing Institute or the Florida Roofing, Sheet Metal & Air Conditioning Contractors Association, Inc.

### **2.2.2.6.3 Metal shingles and panels**

Metal panel roofing systems and their attachment must be installed in accordance with the manufacturer's installation instructions and shall provide uplift resistance equal to or greater than the design uplift pressure for the roof based on the site design wind speed and exposure category. The metal panels must be installed over continuous decking and one of the acceptable sealed roof deck underlayment options.

### **2.2.2.6.4 Other steep-slope roof coverings**

For all other roof coverings, the designer must provide documentation showing the roof covering and the attachments were designed for the component and cladding wind pressures corresponding to the site design wind speed. All roof coverings, regardless of type, must be installed in accordance with the manufacturer's installation guidelines for the appropriate design wind speed and be installed over an acceptable sealed roof deck.

### 2.2.2.7 Selecting and installing a qualified low-slope (less than 2:12 slope) roof covering

These requirements apply to residential low-slope roof systems installed over wood roof decks with a roof slope less than 2:12 (10 degrees). Low-slope roof systems must meet the required design pressures for the site and the locations on the building. Roofing manufacturer's tested uplift design pressures must have a factor of safety of 2.0; roof system design pressures listed in an ICC Evaluation Service Report, Florida Product Approval, or Miami-Dade Notice of Acceptance (NOA) have the 2.0 factor of safety already applied. These reports can be used to validate compliance with the project site-specific design pressure requirements. The report documents can be difficult to navigate; consequently, the roofing manufacturer technical services department is the best resource to help identify the correct system for the home.

#### 2.2.2.7.1 Common types of systems

**Built-up roof (BUR) systems:** Built-up roof (BUR) systems are composed of multiple layers of reinforcing membranes held together with hot bitumen, solvent-based adhesives, torch welding, and self-adhered plies that create a finished membrane. The number of plies in a cross section is the number of membrane layers on a roof. The term "two-ply" denotes a two-layer membrane construction. When installed directly over the wood deck, the base sheet (also known as an anchor sheet) can either be mechanically fastened or attached with an adhesive foam or be a self-adhered product.

**Modified bitumen roof systems:** Modified bitumen roof systems are a form of BUR system that uses multiple layers of reinforcing membranes with a granulated or uncoated finish cap sheet that includes added modifiers to give plastic or rubber-like properties. Modified bitumen roof systems usually consist of two- or three-ply systems.

**Single-ply roofing membranes:** Single-ply roofing membranes are flexible sheets of compounded synthetic materials that are generally mechanically attached or fully adhered to rigid insulation or a cover board. There are two categories of single-ply membranes: thermoplastic membranes such as TPO (thermoplastic olefin), PVC (polyvinyl chloride), and KEE (ketone ethylene ester), and thermoset membranes such as EPDM (ethylene propylene diene monomer).

#### 2.2.2.7.2 Roof cover selection example

Select appropriate design uplift pressure for roof system: Most low-slope roofs found on single-family residential buildings are relatively small and the complexities associated with varying attachment methods or capacities are more likely to cause confusion and errors than to save construction costs. Consequently, it is generally best to simply pick a system and installation method that is adequate for the highest design pressures expected on the low-slope roof. Table 2-5 provides the highest design wind uplift pressures for low-slope roofs based on ASCE 7-10

and (ASCE 7-16) for single-family residential buildings with mean roof height of 30 ft or less. Values are listed for each of the common terrain exposure categories (suburban, open country, and water). Best practice is to use the ASCE 7-16 values as they represent the research on design loads for low-slope roofs. The ASCE 7-10 values are the ones used in the 2012, 2015, and 2018 editions of the IRC.

**Table 2-5. Maximum ASCE 7-10 (ASCE 7-16) Low-Slope Roof Allowable Stress Design Wind Uplift Pressures for Various Design Wind Speeds (Roof Height of 30 ft or less)**

<b>Design Wind Speed</b>	<b>Exposure B (Residential Neighborhood) – psf ASCE 7-10 (ASCE 7-16)</b>	<b>Exposure C (Open Area) – psf ASCE 7-10 (ASCE 7-16)</b>	<b>Exposure D (Close to Water) – psf ASCE 7-10 (ASCE 7-16)</b>
<b>115</b>	36 (41)	50 (57)	60 (68)
<b>120</b>	39 (45)	55 (62)	65 (74)
<b>130</b>	46 (52)	64 (73)	76 (87)
<b>140</b>	53 (61)	75 (85)	88 (100)
<b>150</b>	61 (70)	86 (97)	102 (115)
<b>160</b>	70 (79)	98 (111)	116 (131)
<b>170</b>	79 (89)	110 (125)	130 (148)
<b>180</b>	88 (100)	124 (140)	146 (166)

Selection of an adequate roof cover assembly:

1. From **Table 2-5**, determine the highest uplift pressure required for the home based on the design wind speed at the site and the terrain exposure.
2. Select a roofing system manufacturer and a method of application (self-adhered, mechanically fastened, hot-mopped, single-ply, etc.). Make sure the system has an approved application that is adequate for the design uplift pressure.
3. Make sure you select a system that's appropriate for the roof deck. Most residential flat roof assemblies are applied over a wood deck without insulation; make sure the system you choose is compatible with your roof deck.
  - **Note: The ICC Evaluation Service Report, Florida Product Approval, Texas Department of Insurance (TDI) Evaluation Report, and Miami-Dade Notice of Acceptance (NOA) already have the required 2.0 factor of safety incorporated in the listed design pressures.**

#### **Installation:**

1. Ensure the roof deck is properly attached to satisfy the FORTIFIED requirements in Section 2.2.2.2.

2. Apply base/anchor sheet, intermediate plies, cap sheet, and roof coating as required by the system approval. Do not substitute materials; use the components and fasteners as listed in the system approval.
3. Follow roofing manufacturers' installation guidelines for edge details, parapet details, skylight curb details, pitch transitions, wall connections where roofs meet upper stories, and penetrations for vent stacks or hardware mounts.

### 2.2.2.8 Attic ventilation system resistance to wind-driven water intrusion

Experience from recent hurricanes has demonstrated that structural enhancements alone are not enough to significantly reduce storm damage. Even when the structural elements remain intact, wind-driven water intrusion can cause catastrophic damage to the interior of a home and the home's contents. Testing at the IBHS Research Center has demonstrated that damage to the roof cover and sheathing is typically the largest source of hurricane-related water intrusion that is not due to storm surge or flooding. Roof-related water intrusion is addressed through the enhanced attachment of the roof sheathing and sealing the roof deck. Components of the attic ventilation system can also be important sources of water intrusion. Gable end vents are not designed to keep wind-driven water out of the attic; failures of ridge vents, off-ridge vents, and blown-out soffit covers can result in significant water intrusion in the attic space. The following requirements address additional vulnerabilities to wind-driven water intrusion.

#### 2.2.2.8.1 Ridge and off-ridge vents

Ridge vents and off-ridge vents must be TAS 100(A) rated for resisting water intrusion in high winds and must be properly attached to the roof following the manufacturer's recommended installation for high winds. If off-ridge vents or ventilators require modification/mitigation actions, such as removing part of the device and capping the hole, when a hurricane threatens, the homeowner must be made aware of this requirement. IBHS recommends against using ventilation system components that require roof access to remove it or prepare it when a hurricane threatens.

#### 2.2.2.8.2 Gable end vents

Gable end vents are not designed to resist wind-driven water intrusion unless they have a Florida Building Code TAS 100(A) product approval. Consequently, **IBHS recommends against including gable end vents in new homes built in hurricane-prone regions.** If gable end vents must be used in order to meet code-required attic ventilation requirements, they shall be either TAS 100(A) approved products installed according to the manufacturer's guidance as documented in the TAS 100(A) product approval or be provided with removable or operable shutters that will seal the vent(s) when a hurricane threatens. If removable shutters are provided, permanent anchors for mounting the shutters shall be installed and shutters shall be flat stock that will seal against the gable vent trim, pre-cut, pre-drilled, labeled, and easy to



install when a hurricane threatens. The homeowner must be made aware that installation of these shutters is to be temporary and that they must be removed once the hurricane threat has passed.

### 2.2.2.9 Photovoltaic (PV) systems

#### 2.2.2.9.1 Design guidance

##### 2.2.2.9.1.1 *Wind loads*

Roof-mounted PV systems shall be designed for component and cladding wind loads for the site in accordance with ASCE 7-16 using an effective wind area based on the dimensions of a single unit frame.

##### 2.2.2.9.1.2 *Gravity loads*

The roof deck and supporting roof structure must be designed to support all gravity and wind loads resulting from the PV system installation.

#### 2.2.2.9.2 Connections and installation

Connections and installation of appropriately designed PV systems must be field verified by a professional engineer and a letter of compliance from that professional engineer indicating that connections and installation of the PV system meet the design intent must be submitted to the FORTIFIED Evaluator.

#### 2.2.2.9.3 Flashing

All roof penetrations must be sealed and flashed in accordance with the PV system and roof covering manufacturers' requirements.

## 2.2.3 Existing Home; New Roof (Re-Roofing). Designation: FORTIFIED Roof – New Roof

### 2.2.3.1 Roof deck thickness

The minimum allowable deck thickness for wood structural panels to be eligible for a FORTIFIED designation is  $\frac{7}{16}$  in.

### 2.2.3.2 Addressing deteriorated or damaged roof decking on an existing home

#### 2.2.3.2.1 Evaluate roof deck and remove damaged or deteriorated decking

Inspect the roof deck after the old roofing materials have been removed to identify and replace any damaged or deteriorated decking (damage or deterioration could be from moisture, weathering, or insect infestation). Damaged or deteriorated decking would generally be marked by one or more of the following characteristics: soft or spongy wood, wood swelling or buckling, delaminating (plywood), or crumbling and flaking of the wood. Do not cut or notch supporting wood members when removing damaged/deteriorated decking. If the roof deck is damaged, there is a possibility that the wood roof framing members (rafters or truss top chords) below the damaged deck are damaged as well.

#### 2.2.3.2.2 Requirements for replacement of roof decking

1. If a section of the roof deck is damaged or deteriorated, remove and replace the entire damaged sheet or board.
2. Inspect the roof framing members below the removed decking. If more than  $\frac{1}{4}$  in. of the surface is deteriorated or damaged, follow the requirements for deteriorated or damaged wood roof framing members (see section 2.2.3.4).

**Best Practice (Recommendation):** Add a minimum 2- x 4-in. scab, (A), to the side of existing roof framing member along the edges of new decking such that the new decking can be fastened to the added 2- x 4-in. scab instead of the existing roof framing member (to prevent the additional roof deck fasteners from damaging the existing framing members). Fasten the new 2- x 4-in. scab to existing framing member with 16d nails (or 3-in.-long, #8 wood screws) at 4 in. o.c. (See Figure 2-8).

Fasten the new decking to the supporting roof framing members and the newly added 2- x 4-in. scab if any, (A), in accordance with Table 2-6 (boards) or Table 2-7 (sheathing) as appropriate.

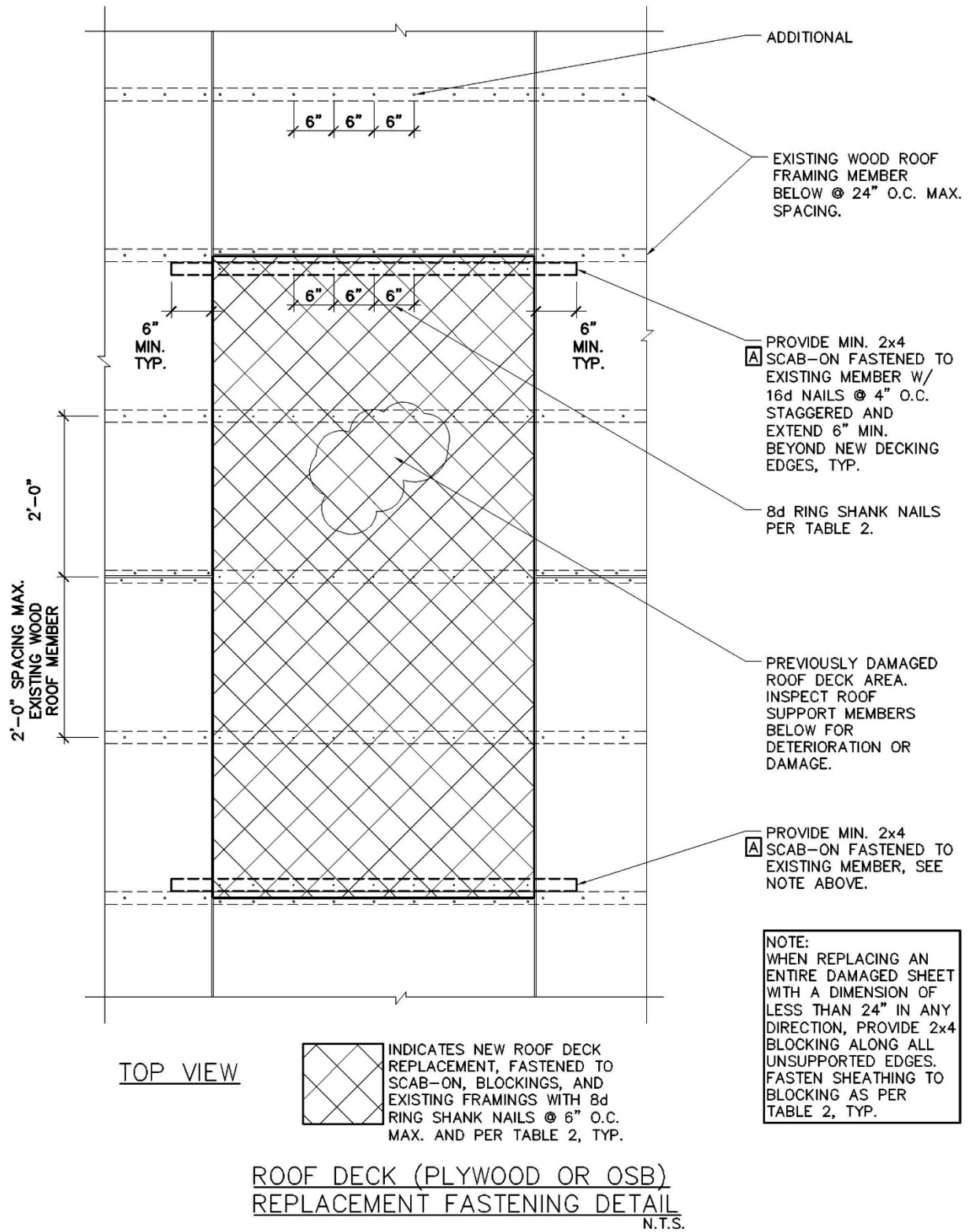


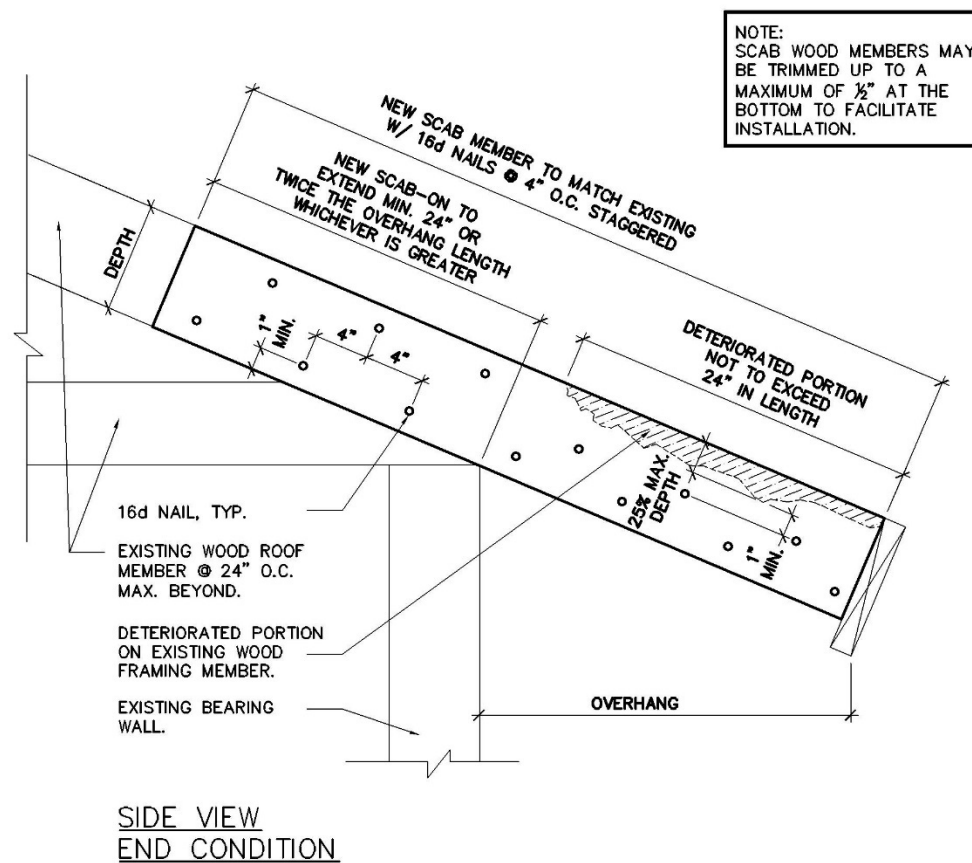
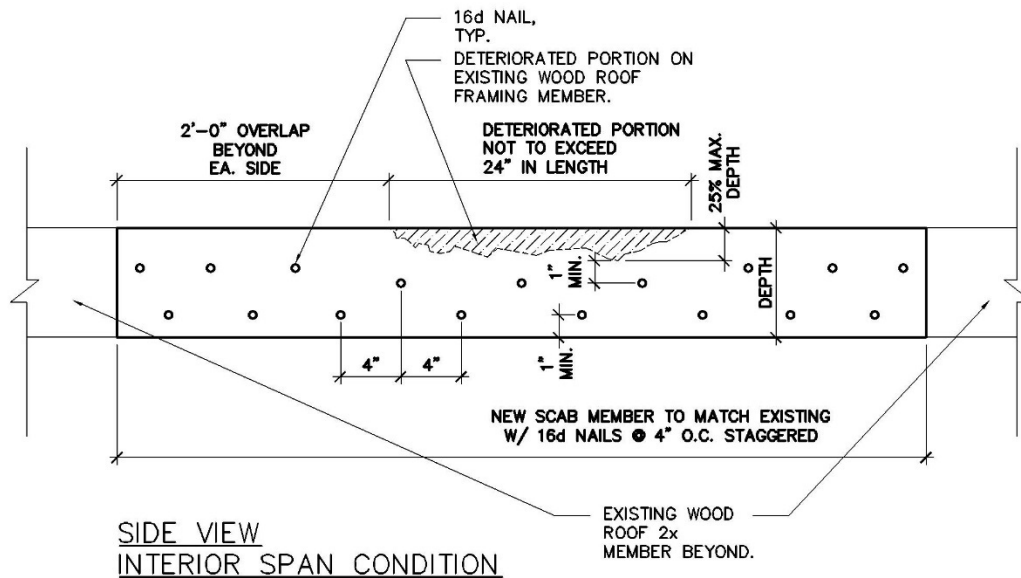
Figure 2-8. Roof deck replacement best practice detail.

### 2.2.3.3 Deteriorated or damaged wood roof framing

If the roof deck is damaged, there is a possibility that the wood roof framing members below the damaged decking are deteriorated or damaged as well. The guidelines listed below provide guidance for repairing wood roof framing members with relatively minor damage/deterioration as described. If the damage is greater than the conditions listed, consult a licensed professional engineer to provide engineering details to repair the damage.

1. The damaged or deteriorated portion of a roof framing member must meet all of the following conditions in order to be repaired instead of being replaced:
  - a. The roof framing member must be nominal 2-in.-thick lumber and be spaced no more than 24 in. o.c.
  - b. Damaged/deteriorated area must be less than 25 percent of roof framing member depth.
  - c. Damaged/deteriorated area must not exceed 25 percent of member length up to an absolute maximum length of 2 ft.
  - d. Damaged/deteriorated area must be a minimum of 6 in. away from any mechanical connections (truss/rafter hangers, truss connector plates, etc.).
2. If all conditions in Section 1 are met, a scab can be used to repair the damaged roof framing member. The scab should match the size of the damaged roof framing member. For example, a 2- x 4-in. roof truss top chord with damage meeting the conditions listed would require a 2- x 4-in. scab; a 2- x 10-in. rafter with damage meeting the conditions would require a 2- x 10-in. scab. Each scab member must be a continuous piece, extend beyond the damaged portion, as shown in Figure 2-9, and be fastened to the existing roof framing member with (2) rows of 16d nails (or 3-in., #8 wood screws) at 4 in. o.c. The scab may be trimmed up to ½ in. to facilitate installation.
3. The roof decking should be fastened to the new scab as indicated in Table 2-6 (boards) or Table 2-7 (sheathing) as appropriate.

Note: When the fascia or sub-fascia is the roof framing member that is damaged or deteriorated, remove and replace the damaged/deteriorated section plus at least 2 ft beyond that section on each side.



NEW SCAB MEMBER DETAIL FOR DETERIORATED OR DAMAGED WOOD FRAMING MEMBER

N.T.S.

Figure 2-9. New scab member fastening detail.

## 2.2.3.4 Strengthening roof sheathing attachment (re-nailing the roof deck)

### 2.2.3.4.1 Sawn lumber or wood board roof decking

- Add fasteners as required to ensure that roof decking consisting of sawn lumber or wood boards up to 1 in. thick are secured with at least two (2) nails, having a minimum diameter of 0.131 in. and a minimum length of 2½ in., (three [3] nails if the board is wider than 8 in.) to each roof framing member it crosses. Framing members must be spaced no more than 24 in. apart. Clipped-head, D-head, or round-head nails shall be acceptable provided they have the required minimum diameter and length. The nailing requirements are summarized in Table 2-6.
- For wood boards greater than 1 in. thick and up to 2 in. thick, add fasteners as required to ensure that the decking is secured with at least two (2) nails, having a minimum diameter of 0.131 in. and sufficient length to penetrate a minimum of 1⅝ in. into the roof framing, (three [3] nails if the board is wider than 8 in.) to each framing member it crosses. Framing members must be spaced no more than 24 in. apart. Clipped-head, D-head, or round-head nails shall be acceptable provided they have the required minimum diameter and length. The nailing requirements are summarized in Table 2-6.

**Table 2-6. Fasteners Required for Wood Board Decking Attachment**

<b>Wood Board/Lumber (Roof Decking) Width</b>	<b>Number and Minimum Dimensions of Nails per Board for Each Framing Member it Crosses</b>	<b>Maximum Spacing of Framing Members</b>
Up to 8 in.	Two (2) 0.131 in. minimum diameter with 1⅝-in. penetration into roof framing members	24 in.
Larger than 8 in.	Three (3) 0.131 in. minimum diameter with 1⅝-in. penetration into roof framing members	24 in.

### 2.2.3.4.2 Structural wood panel (plywood or oriented strand board [OSB]) roof sheathing

The number and spacing of additional fasteners needed to adequately strengthen the connection of structural wood panel roof sheathing depends on the size, type, and spacing of the existing fasteners. With these considerations in mind, the re-nailing requirements outlined in Table 2-7 are based on using ring-shank nails with full round heads as the additional nails. The specific required minimum dimensions and characteristics for the additional ring-shank nails to be used to strengthen the roof deck attachment (see Figure 2-10) are:

- Full round head diameter (minimum 0.281-in. diameter; no clipped-head nails allowed)
- 2⅜ in. minimum nail length
- 0.113 in. in diameter



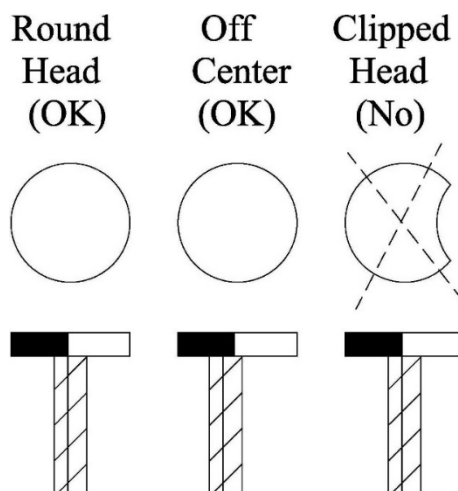


Figure 2-10. Use 8d ring-shank nails as the added fasteners when re-nailing roof sheathing. Research indicates that ring-shank nails have about twice the uplift capacity of the same size smooth-shank nails.

- Only full round-head ring-shank nails are acceptable.
- Off-center ring-shank nails with full round heads are acceptable.
- Clipped-head ring-shank nails are not acceptable for structural wood panels.

**Table 2-7 : Additional Fasteners at Panel Edges and Intermediate Framing for Roof Deck**

Wind Speed	Existing Fasteners	Existing Spacing	Required Additional Fastening	
			Within 48 in. of all roof edges and ridges	All other locations
<b>100 mph (Vasd)/ 130 mph (Vult)</b>  <b>OR LESS</b>	Staples or 6d nails	Any	Add 8d ring-shank nails at 6 in. o.c. spacing along panel edges and intermediate framing	
	8d smooth-shank nails	6 in. o.c. or less along panel edges and intermediate framing	Add 8d ring-shank nails at 6 in. o.c. spacing along intermediate framing; no additional fasteners required at panel edges	No additional fasteners required
	8d smooth-shank nails	Greater than 6 in. o.c.	Add 8d ring-shank nails such that there is 6 in. o.c. spacing between existing and additional fasteners along panel edges; 6 in. o.c. spacing between additional fasteners along intermediate framing	Add 8d ring-shank nails such that there is 6 in. o.c. spacing between existing and additional fasteners along panel edges and along intermediate framing
	8d ring-shank nails	12 in. o.c. or less	Add 8d ring-shank nails such that there is 6 in. o.c. spacing between existing and additional fasteners along panel edges and intermediate framing	Add 8d ring-shank nails such that there is 6 in. o.c. spacing between existing and additional fasteners along panel edges and along intermediate framing
<b>GREATER THAN</b>  <b>100 mph (Vasd) or 130 mph (Vult)</b>	Staples or 6d nails	Any	Add 8d ring-shank nails at 4 in. o.c. spacing along panel edges and intermediate framing	
	8d smooth-shank nails	6 in. o.c. or less along panel edges and intermediate framing	Add 8d ring-shank nails such that there is 4 in. o.c. spacing between existing and additional fasteners along panel edges and 4 in. o.c. between additional fasteners along intermediate framing	No additional fasteners required along panel edges, 6 in. o.c. spacing between additional fasteners along intermediate framing
	8d smooth-shank nails	6 in. o.c. or greater	Add 8d ring-shank nails such that there is 4 in. o.c. spacing between existing and additional fasteners along panel edges and 4 in. o.c. between additional fasteners along intermediate framing	Add 8d ring-shank nails such that there is 6 in. o.c. spacing between existing and additional fasteners along panel edges and 6 in. o.c. spacing between additional fasteners along intermediate framing
	8d ring-shank nails	12 in. o.c. or less	Add 8d ring-shank nails such that there is 4 in. o.c. spacing between existing and additional fasteners along panel edges and along intermediate framing	Add 8d ring-shank nails such that there is 6 in. o.c. spacing between existing and additional fasteners along panel edges and along intermediate framing

**Notes:**

1. Roof sheathing panels must be minimum of  $\frac{7}{16}$  in. thick.
2. Roof framing members must be spaced at maximum of 24 in. o.c. and have a minimum 2 in. nominal thickness.
3. Existing 8d nails to be a minimum of 0.131 in. in diameter and 2½ in. long.
4. All additional fasteners are to be 8d ring-shank nails (0.113 in. x 2½ in. with full round head).
5. Roof pitch must be 2:12 or greater.

### 2.2.3.5 Sealing the roof deck (roof slopes 2:12 or greater)

All new roof cover installations require a sealed roof deck system that keeps water out of the attic and the interior of the house in the event the roof covering is damaged during a hurricane. The following are qualified methods for sealing the roof deck.

#### 2.2.3.5.1 Options for shingle or metal roof covers (roof slopes 2:12 or greater)

**Sealed Roof Deck Option 1:** Tape seams between roof sheathing that forms the roof deck. There are two material options for taping the seams on the roof deck:

- **Material Option 1:** Apply an ASTM D1970 compliant self-adhering polymer-modified bitumen flashing tape, at least 4 in. wide, directly to the roof deck to seal the horizontal and vertical joints in the roof deck.
- **Material Option 2:** Apply an AAMA 711-13, Level 3 (for exposure up to 80°C/176°F) compliant self-adhering flexible flashing tape at least 3¾ in. wide directly to the roof deck to seal the horizontal and vertical joints in the roof deck.

Any flashing tape used to achieve a sealed roof deck must be fully adhered without voids (e.g., wrinkles) in order to be accepted. In some instances, the ability of self-adhered flashing tapes to adhere to oriented strand board (OSB) sheathing may be compromised by the level of surface texture or wax used in fabricating the OSB panels. In applications where flashing tape adhesion to OSB is marginal, apply a manufacturer-specified compatible primer to the OSB panels where the tape will be applied to ensure the proper attachment of the self-adhering tape to the sheathing. Do not nail or staple the tape to the roof sheathing. Refer to the manufacturer's recommendations for installation and primer requirements (if applicable).

Next, apply a code-compliant ASTM D226 Type II (#30) or ASTM D4869 Type III or Type IV (#30) underlayment over the self-adhering tape. As an alternative, apply a reinforced synthetic roof underlayment which has an ICC approval as an alternate to ASTM D226 Type II felt paper. The synthetic underlayment must have a minimum tear strength of 15 lbf in accordance with ASTM D4533 and a minimum tensile strength of 20 lbf/in. in accordance with ASTM D5035. These underlayments must be attached using annular-ring or deformed-shank roofing fasteners with minimum 1-in.-diameter caps (button cap nails) at 6 in. o.c. spacing along all laps and at 12 in. o.c. vertically and horizontally in the field or a more stringent fastener schedule if required by the manufacturer for high-wind and prolonged exposure installations. Horizontal laps must be a minimum of 4 in. and end laps must be a minimum of 6 in.

**Caution:** Be sure to check product labelling carefully. Not all products labelled ASTM D4869 are Type III or Type IV. Look for ASTM D4869 felt that is labeled Type III or Type IV. ASTM D4869 Type I or Type II will NOT be accepted.

Installation Notes:

- Best practice for drip edge installation at eaves: Install the drip edge on top of the underlayment at the eaves. Make sure the top surface of the drip edge is clean, free of oil, and, if required by the starter strip manufacturer, primed with ASTM D41 primer. For shingle roof installations, seal the drip edge, underlayment, and starter strip at the eave by either using a self-adhering starter strip or applying an 8-in.-wide layer of compatible flashing cement, maximum thickness  $\frac{1}{8}$  in., over the drip edge and adjacent underlayment. For metal roof covers, apply a compatible manufacturer-approved sealant between the drip edge and adjacent underlayment to prevent water from accumulating under the drip edge. See Section 2.2.3.6 for further drip edge requirements.
- Lap underlayment with minimum 6-in. leg “turned up” at wall intersections; lap wall weather barrier over turned-up roof underlayment.



**Figure 2-11.** Installing a sealed roof deck system; taping the seams of roof sheathing.

**Sealed Roof Deck Option 2:** Install two (2) layers of ASTM D226 Type II (#30) or ASTM D4869 Type III or Type IV (#30) underlayment in a shingle-fashion, lapped 19 in. on horizontal seams (36-in. roll), and 6 in. on vertical seams.

**Caution:** Be sure to check product labelling carefully. Not all products labelled ASTM D4869 are Type III or Type IV. Look for ASTM D4869 felt that is labeled Type III or Type IV. ASTM D4869 Type I or Type II will NOT be accepted.



The starter course of felt is to be installed as described below and shown in Figure 2-12. Cut 17 in. off one side of the roll and install the remaining 19-in.-wide strip of underlayment along the eave, safely tacked in place. Carefully install a 36-in.-wide roll of ASTM D226 Type II (#30) or ASTM D4869 Type III or Type IV (#30) underlayment over the 19-in.-wide course of ASTM D226 Type II (#30) or ASTM D4869 Type III or Type IV (#30) underlayment along the eave. Follow the same procedure for each course, overlapping the sheets 19 in. (leaving a 17 in. exposure). Fasten the bottom edge of the roll (horizontal lap) with a row of annular-ring or deformed-shank nails with 1-in.-diameter caps at 6 in. o.c. Since the bottom edge (horizontal lap) of the next layer of underlayment will be fastened approximately 19 in. above the horizontal lap below, install a row of annular-ring or deformed-shank nails with 1-in.-diameter caps with 12 in. o.c. horizontal spacing about 10 in. above the bottom lap. When the installation is completed, the resulting fastening of the two (2) layers of felt should consist of the same fasteners at approximately 6 in. o.c. along all laps and at not more than 12 in. o.c. in the field of the sheet between the side laps. Add fasteners along any exposed vertical laps so that the maximum spacing between fasteners is 6 in. o.c. For sites with design wind speeds less than 140 mph (Vasd: ASCE 7-05; IRC 2006; IRC 2009; and IRC 2012) or less than 160 mph (Vult: ASCE 7-10; IRC 2015; and IRC 2018), use annular-ring or deformed-shank nails with 1-in.-diameter caps (button cap nails). For sites with design wind speeds greater than or equal to 140 mph (Vasd: ASCE 7-05; IRC 2006; IRC 2009; and IRC 2012) or greater than 160 mph (Vult: ASCE 7-10; IRC 2015; and IRC 2018), use annular-ring or deformed-shank nails with 1-in.-diameter thin metal disks (“tincaps”).

#### Installation Notes:

- Best practice for drip edge installation at eaves: Install the drip edge on top of the double layer of underlayment at the eaves. Make sure the top surface of the drip edge is clean, free of oil, and, if required by the starter strip manufacturer, primed with ASTM D41 primer. For shingle roof installations, seal the drip edge, underlayment, and starter strip at the eave by either using a self-adhering starter strip or applying an 8-in.-wide layer of compatible flashing cement, maximum thickness  $\frac{1}{8}$  in., over the drip edge and adjacent underlayment. For metal roof covers, apply a compatible manufacturer- approved sealant between the drip edge and adjacent underlayment to prevent water from accumulating under the drip edge. See Section 2.2.3.6 for further drip edge requirements.
- Lap underlayment with minimum 6-in. leg “turned up” at wall intersections; lap wall weather barrier over turned-up roof underlayment.

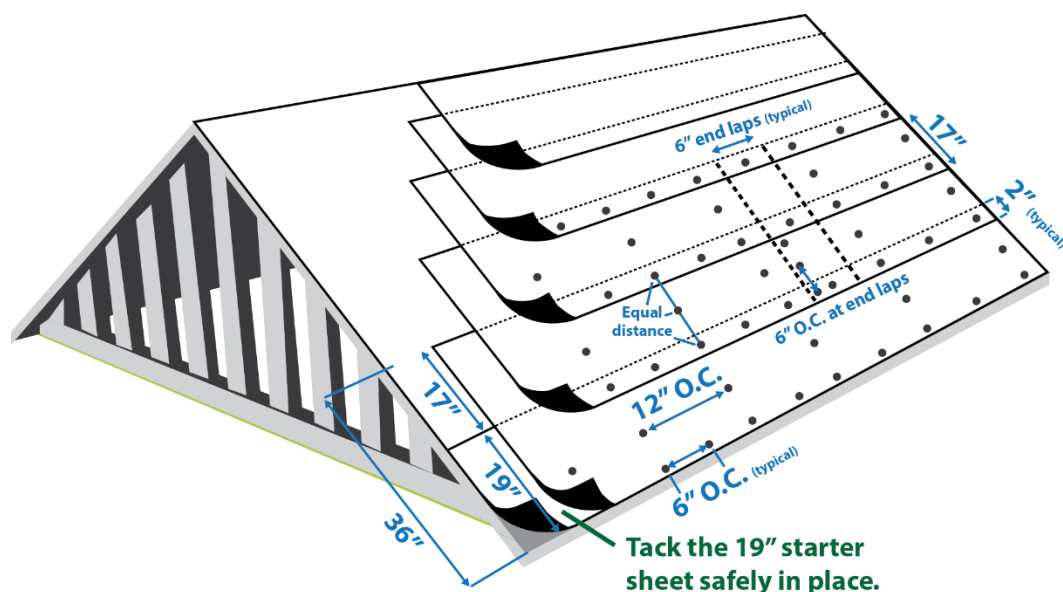


Figure 2-12. Installation of 19 in. starter course general notes.

**Sealed Roof Deck Option 3:** For homes located south of the North Carolina/South Carolina border, cover the entire roof deck with a full layer of self-adhering polymer-modified bitumen membrane meeting ASTM D1970 requirements. This approach provides a waterproof membrane over the entire roof and can greatly diminish the potential for leaks. In some instances, the ability of the self-adhered membranes to adhere to oriented strand board (OSB) sheathing may be compromised by the level of surface texture or wax used in fabricating the OSB panels. In applications where membrane adhesion to OSB is marginal, apply a manufacturer-specified compatible primer to the OSB panels to ensure the proper attachment of the self-adhering membrane to the sheathing. Also, roofers are finding that shingles are bonding to many of these self-adhered membranes and this could lead to damage of the sheathing when it comes time to replace the shingles. Consequently, the membrane should be covered with a bond break such as a #15 ASTM D226, Type I underlayment. This underlayment on shingle roofs only needs to be fastened well enough to keep it on the roof surface and provide safety to the roofers until the shingles are applied. **Note: For asphalt shingle installations, hold bond break material back 8 in. from roof edges to allow mastic and starter strip or self-adhered starter strip to be applied directly to drip edge.**

Note: Manufacturers emphasize the need for adequate attic ventilation when this type of membrane is applied over the entire roof. This is particularly important north of the North Carolina/South Carolina border. Also, some local building departments prohibit the use of this system. Check with the local building department for restrictions.

#### Installation Notes:

- Best practice for drip edge installation at eaves: Install drip edge on top of the underlayment. Make sure the top surface of the drip edge is cleaned, free of oil,





and, if required by the starter strip manufacturer, primed with ASTM D41 primer. For shingle roof installations, seal the drip edge, underlayment, and starter strip at the eave by either using a self-adhering starter strip or applying an 8-in.-wide layer of compatible flashing cement, maximum thickness  $\frac{1}{8}$  in., over the drip edge and adjacent underlayment. For metal roof covers, apply a compatible 4-in.-wide self-adhesive tape to the top of the drip edge and adjacent underlayment to prevent water from accumulating under the drip edge. See Section 2.2.3.6 for further drip edge requirements.

- Lap underlayment with minimum 6-in. leg “turned up” at wall intersections; lap wall weather barrier over turned-up roof underlayment.

#### **2.2.3.5.2 Options for concrete and clay tile roof covers (roof slopes 2:12 or greater)**

The following options qualify as sealed roof decks under clay and concrete roof tiles. In option 2, the self-adhering tape provides a required barrier against water intrusion in case the roofing felt begins to lift.

**Sealed Roof Deck Option 1:** Cover the entire roof deck with an approved self-adhering polymer-modified bitumen underlayment complying with ASTM D1970, installed in accordance with both the underlayment manufacturer’s and roof covering manufacturer’s installation instructions for the deck material, roof ventilation configuration, and climate exposure for the roof covering to be installed. In some instances, the ability of the self-adhered membranes to adhere to oriented strand board (OSB) sheathing may be compromised by the level of surface texture or wax used in fabricating the OSB panels. In applications where membrane adhesion to OSB is marginal, apply a manufacturer-specified compatible primer to the OSB panels to ensure the proper attachment of the self-adhering membrane to the sheathing. Note: Some local building departments prohibit the use of this system. Check with the local building department for restrictions. Manufacturers emphasize the need for adequate attic ventilation when this type of membrane is applied over the entire roof. This is particularly important north of the North Carolina/South Carolina border.

##### **Installation Notes:**

- Best practice for drip edge installation at eaves: Install the self-adhered underlayment over the drip edge. Before installing the drip edge, prime the roof deck with a compatible primer or install a separator sheet that extends 2 in. past the deck flange of the drip edge. Make sure the top surface of the drip edge is clean, free of oil, and, if required by the membrane manufacturer, primed with ASTM D41 primer so that the self-adhering membrane adheres to the top of the drip edge. See Section 2.2.2.6 for further drip edge requirements.

- Lap underlayment with minimum 6-in. leg “turned up” at wall intersections; lap wall weather barrier over turned-up roof underlayment.

**Sealed Roof Deck Option 2:** Tape seams between roof sheathing that forms the roof deck. There are two material options for taping the seams on the roof deck.

- **Material Option 1:** Apply an ASTM D1970 compliant self-adhering polymer-modified bitumen flashing tape, at least 4 in. wide, directly to the roof deck to seal the horizontal and vertical joints in the roof deck.
- **Material Option 2:** Apply an AAMA 711-13, Level 3 (for exposure up to 80°C/176°F) compliant self-adhering flexible flashing tape at least 3¾ in. wide directly to the roof deck to seal the horizontal and vertical joints in the roof deck.

Any flashing tape used to achieve a sealed roof deck must be fully adhered without voids (e.g., wrinkles) in order to be accepted. In some instances, the ability of self-adhered flashing tapes to adhere to oriented strand board (OSB) sheathing may be compromised by the level of surface texture or wax used in fabricating the OSB panels. In applications where flashing tape adhesion to OSB is marginal, apply a manufacturer-specified compatible primer to the OSB panels where the tape will be applied to ensure the proper attachment of the self-adhering tape to the sheathing. Do not nail or staple the tape to the roof sheathing. Refer to the manufacturer’s recommendations for installation and primer requirements (if applicable).

Next, apply a code-compliant #30 ASTM D226 Type II underlayment/anchor sheet over the self-adhering tape. Attach the underlayment/anchor sheet using annular-ring or deformed-shank roofing fasteners with minimum 1-in.-diameter metal caps at 6 in. o.c. spacing along all laps and at (2) rows in between side laps at a maximum of 12 in. o.c. or a more stringent fastener schedule if required by the manufacturer for high-wind use as an anchor sheet. Horizontal laps must be a minimum of 4 in. and end laps must be a minimum of 6 in.

Finally, apply an approved self-adhering polymer-modified bitumen roof tile cap sheet complying with ASTM D1970 that meets the site design wind speeds over this underlayment **OR** hot-mop an approved tile underlayment over the underlayment/anchor sheet using hot asphalt.

#### Installation Notes:

- Best practice for drip edge installation at eaves: Install the drip edge on top of the ASTM D226 Type II underlayment but under the self-adhering ASTM D1970 cap sheet. Make sure the top surface of the drip edge is clean, free of oil, and, if required by the membrane manufacturer, primed with ASTM D41 primer so that the self-adhering cap sheet adheres to the top of the drip edge. See Section 2.2.2.4 for further drip edge requirements.

- Lap underlayment with minimum 6-in. leg “turned up” at wall intersections; lap wall weather barrier over turned-up roof underlayment.

### 2.2.3.6 Drip edge

**Background:** Properly attached drip edge metal helps to keep water from running down or getting behind the roof fascia material and it can provide an important anchor for underlayment material around the perimeter of the roof and enhanced anchorage of the perimeter shingles for an asphalt shingle roof cover. Basic code requirements for drip edge installation vary around the United States. Many codes address the most common risks and reflect minimum requirements that focus on simplicity of installation. A common focus is ensuring that water is not trapped behind the drip edge at the eaves. Consequently, many codes require the underlayment be installed over the top of the drip edge. In some of the most vulnerable hurricane-prone areas, codes have focused on the importance of anchoring shingles around the perimeter of the roof and have adopted requirements that drip edge be installed on top of the underlayment to help anchor its edge. They have addressed trapping of water under the drip edge by requiring flashing cement to seal the roof edges including the tops of the drip edge. With the addition of appropriate measures to ensure water is not trapped, local building officials in areas requiring drip edges at eaves be installed under the underlayment may allow the best practice methods outlined in above sections as acceptable alternate methods.

**Requirements:** All drip edge shall be new code-compliant metal that meets or exceeds the minimum thickness required by the code. Install drip edge along all eaves and gable rake edges. Overlap drip edge at joints a minimum of 3 in. Eave drip edges shall extend ½ in. below sheathing and extend back on the roof a minimum of 2 in. Drip edges must be mechanically fastened to the roof deck at maximum of 4 in o.c. Mechanical fasteners should be applied in an alternating (staggered) pattern along the length of the drip edge with adjacent fasteners placed near opposite edges of the leg/flange of drip edge on the roof. Drip edge shall be installed OVER the underlayment along gable rake edges and at eaves it shall follow the best practices guidance outlined in Sections 2.2.3.5.1 and 2.2.3.5.2 for the sealed roof deck option and roof cover selected.

### 2.2.3.7 Flashing requirements

#### 2.2.3.7.1 General requirements

Flashings are used to weatherproof or seal roof system edges at perimeters, penetrations, walls, expansion joints, valleys, drains, and other places where the roof covering is interrupted or terminated. Flashings shall be installed in a manner that will prevent moisture from entering the wall or roof, or through moisture-permeable materials at intersections or other penetrations through the roof plane.

The flashing installation requirements found in the local building code, product manufacturer's installation instructions, and the applicable FORTIFIED standards serve as primary compliance methods. The use of FORTIFIED-approved supplemental standards for conditions other than those found in primary standards is permitted (see Section 2.2.3.7.2 for sources of additional flashing installation guidance). In all cases, the more restrictive installation methods shall be used for all roof-related flashing, including any associated counter-flashing.

- Use corrosion-resistant metal flashing and fasteners. See Appendix D for Fastener Corrosion Protection Requirements.

### **2.2.3.7.2 Additional flashing installation guidance for various roof systems**

#### **Asphalt Shingle Systems**

The flashing installation requirements found in the local building code, shingle manufacturer's installation instructions, and the applicable FORTIFIED standards serve as primary compliance methods. The use of FORTIFIED-approved supplemental standards for conditions other than those found in primary standards is permitted. In all cases, use the more restrictive installation methods for all roof-related flashing, including any associated counter-flashing. The ARMA Residential Asphalt Roofing Manual; the NRCA Roofing Manual: Architectural Metal Flashing; and the FBC Roofing Application Standard (RAS) No. 115 listed in the Test Protocols for High-Velocity Hurricane Zones, 5th Edition (2014) are FORTIFIED-approved supplemental standards.

Asphalt Roofing Manufacturers Association (ARMA) [www.asphaltroofing.org](http://www.asphaltroofing.org)

National Roofing Contractors Association (NRCA) [www.nrca.net](http://www.nrca.net)

Florida Building Code (FBC) [www.floridabuilding.org](http://www.floridabuilding.org)

#### **Concrete and Clay Tile Roof Systems**

Use the more restrictive of the following installation methods for all roof-related flashing, including any associated counter-flashing: the local building code; the tile manufacturer's installation instructions; the FRSA/TRI Florida High Wind Concrete and Clay Tile Installation Manual 5<sup>th</sup> Edition, Revised; the FBC Roofing Application Standard (RAS) No. 111, 118, 119, or 120 listed in the Test Protocols for High-Velocity Hurricane Zones, 5th Edition (2014); and the applicable FORTIFIED standards; or combination thereof.

Florida Roofing and Sheet Metal Contractors Association (FRSA) [www.floridarooft.com](http://www.floridarooft.com)

Tile Roof Institute (TRI) [tileroofing.org](http://tileroofing.org)

#### **Metal Roof Shingles or Panels**

Install all flashing including any associated counter-flashing in compliance with the local building code; the metal shingle or panel manufacturer's installation instructions; or combination thereof.

## Wood Shingles and Wood Shakes

Install all flashing including any associated counter-flashing in compliance with the local building code; the wood shingle or wood shake manufacturer's installation instructions; the CSSB New Roof Construction Manual; or combination thereof.

Cedar Shake and Shingle Bureau (CSSB) [www.cedarbureau.org](http://www.cedarbureau.org)

### 2.2.3.8 Selecting and installing a qualified steep-slope (2:12 or greater slope) roof covering

Roof coverings and their attachment must be rated for the ASCE 7 design wind speed for the site location of the building and must be installed in accordance with the manufacturer's recommendations for high-wind regions.

#### 2.2.3.8.1 Asphalt shingles

Asphalt shingles, including hip and ridge materials, must meet the shingle testing standard for the appropriate site design wind speed as shown in Table 2-8.

**Table 2-8. Design Wind Speed and Shingle Testing Standards**

Wind Speed ( $V_{asd}$ )	Wind Speed ( $V_{ult}$ )	Shingle Wind Testing Standard/Classification
100 MPH	129 MPH	ASTM D3161 (Class F) or ASTM D 7158 (Class G or H) <sup>1</sup>
110 MPH	142 MPH	
120 MPH	155 MPH	
130 MPH	168 MPH	ASTM D3161 (Class F) or ASTM D 7158 (Class H) <sup>1</sup>
140 MPH	180 MPH	
150 MPH	194 MPH	

<sup>1</sup> The standard calculations contained in ASTM D7158 assume Exposure Category B or C and a building height of 60 ft or less. Additional calculations are required for conditions outside of these assumptions.

Shingles must be installed using the number of fasteners required by the manufacturer for high-wind fastening. In areas where the local building code requires more fasteners than required by the manufacturer, fasteners shall comply with the local building code.



**Installation of Starter Strips at Eaves:** Manufacture-approved starter strips at eaves shall be installed on an approved sealed roof deck with the drip edge conforming to the requirements of Section 2.2.2.5 and underlayment/drip edge combination installed following the best practices outlined in Section 2.2.2.3.1. The starter strip shall be either:

1. Set in a minimum 8-in.-wide strip of compatible flashing cement. Maximum thickness of flashing cement shall be  $\frac{1}{8}$  in. Fasten starter strips parallel to the eaves along a line above the eave line according to the manufacturer's specifications. Position fasteners to ensure they will not be exposed under the cutouts in the first course. Starter strips and shingles must not extend more than  $\frac{1}{4}$  in. beyond the drip edge.
2. Shingle manufacturer-approved ASTM D1970 fully adhered (peel-and-stick) starter strip with asphaltic adhesive strip at eave—installed so that starter strip adheres to and covers the drip edge top surface.

**Installation of Shingles at Gable Rakes (Drip Edge Installed Over Underlayment):** Shingles installed at gable rake edges shall be installed according to one of the following three options.

1. Shingles at rakes shall be set in a minimum 8-in.-wide strip of compatible flashing cement. Maximum thickness of flashing shall be  $\frac{1}{8}$  in. Fasten shingles at rakes according to the manufacturer's specifications.
2. Manufacture-approved starter strips at rakes shall be set in an 8-in.-wide strip of compatible flashing cement. Maximum thickness of flashing cement shall be  $\frac{1}{8}$  in. Fasten starter strips parallel to the rakes according to the manufacturer's specifications. Position fasteners to ensure they will not be exposed. Starter strips and shingles must not extend more than  $\frac{1}{4}$  in. beyond the drip edge.
3. Shingle manufacturer-approved ASTM D1970 fully adhered (peel-and-stick) starter strip with asphaltic adhesive strip at rake—installed so that starter strip adheres to and covers the drip edge top surface. Starter strips and shingles must not extend more than  $\frac{1}{4}$  in. beyond the drip edge.

**Attachment of Shingles at Intersections and Valleys:** Shingles installed at all intersections and both sides of open valleys shall be set in a minimum 8-in.-wide strip of flashing cement. Maximum thickness of flashing cement shall be  $\frac{1}{8}$  in. Cut side of closed valleys shall be set in a minimum 2-in.-wide,  $\frac{1}{8}$ -in.-thick strip of flashing cement. Woven valleys to be according to the manufacturer's specifications.

## **2.2.3.8.2 Clay and concrete tiles**

Clay and concrete roof tile systems and their attachment must meet the requirements of the site design wind speed and exposure category. Clay and concrete roof tiles must be installed in accordance with the manufacturer's product approval for the site design wind speed, roof



height, and exposure category. FRSA/TRI installation guidelines, “Florida High Wind Concrete and Clay Tile Installation Manual Fifth Edition, Revised, FRSA/TRI April 2012 (04-12)” provide additional guidance for installation incorporating ASCE 7-10 wind loads for mechanically attached tile. Roof tiles may be installed with roof tile adhesives that are recognized and installed in accordance with an ICC-ES Evaluation Report, a Florida Product Approval, a Miami-Dade County Notice of Acceptance (NOA), or a Texas Department of Insurance (TDI) Evaluation Report. Mortar-set tile or mortar-set hip and ridge tiles are not permitted. Hip and ridge boards or metal must be attached to the roof framing to resist the uplift pressure for the site design wind speed and exposure or in accordance with the tile manufacturer’s product approval. Hip and ridge tiles must be secured to the hip and ridge boards or metal with mechanical fasteners and/or an approved roof tile adhesive. ASCE 7-16 wind loads are not addressed in the FRSA/TRI Installation (Fifth Edition Revised) guidelines. In jurisdictions that require ASCE 7-16 wind loads, follow the tile manufacturer installation guidance and product approvals for the design wind pressures, and, if the roof tile is installed with adhesives, the adhesive manufacturer’s product approval for those wind pressures.

The clay and concrete tiles must be installed over minimum  $15/32$ -in.-thick plywood and one of the acceptable sealed roof deck underlayment options.

Note: FRSA/TRI Installation guidelines, “Florida High Wind Concrete and Clay Roof Tile Installation Manual Fifth Edition Revised, FRSA/TRI April 2012” are available for purchase from the Tile Roofing Institute or the Florida Roofing, Sheet Metal & Air Conditioning Contractors Association, Inc.

#### **2.2.3.8.3 Metal shingles and panels**

Metal panel roofing systems and their attachment must be installed in accordance with the manufacturer’s installation instructions and shall provide uplift resistance equal to or greater than the design uplift pressure for the roof based on the site design wind speed and exposure category. The metal panels must be installed over continuous decking and one of the acceptable sealed roof deck underlayment options.

#### **2.2.3.8.4 Other steep-slope roof coverings**

For all other roof coverings, the designer must provide documentation showing the roof covering and the attachments were designed for the component and cladding wind pressures corresponding to the site design wind speed. All roof coverings, regardless of type, must be installed in accordance with the manufacturer’s installation guidelines for the appropriate design wind speed and be installed over an acceptable sealed roof deck.

#### **2.2.3.9 Selecting and installing a qualified low-slope (less than 2:12 slope) roof covering**

These requirements apply to residential low-slope roof systems installed over wood roof decks

with a roof slope less than 2:12 (10 degrees). Low-slope roof systems must meet the required design pressures for the site and the locations on the building. Roofing manufacturer's tested uplift design pressures must have a factor of safety of 2.0; roof system design pressures listed in an ICC Evaluation Service Report, Florida Product Approval, Texas Department of Insurance (TDI) Product Evaluation or Miami-Dade Notice of Acceptance (NOA) have the 2.0 factor of safety already applied. These reports can be used to validate compliance with the project site-specific design pressure requirements. The report documents can be difficult to navigate; consequently, the roofing manufacturer technical services department is the best resource to help identify the correct system for the home.

### 2.2.3.9.1 Common types of systems

**Built-up roof (BUR) systems:** Built-up roof (BUR) systems are composed of multiple layers of reinforcing membranes held together with hot bitumen, solvent-based adhesives, torch welding, and self-adhered plies that create a finished membrane. The number of plies in a cross section is the number of membrane layers on a roof. The term "two-ply" denotes a two-layer membrane construction. When installed directly over the wood deck, the base sheet (also known as an anchor sheet) can either be mechanically fastened or attached with an adhesive foam or be a self-adhered product.

**Modified bitumen roof systems:** Modified bitumen roof systems are a form of BUR system that uses multiple layers of reinforcing membranes with a granulated or uncoated finish cap sheet that includes added modifiers to give plastic or rubber-like properties. Modified bitumen roof systems usually consist of two- or three-ply systems.

**Single-ply roofing membranes:** Single-ply roofing membranes are flexible sheets of compounded synthetic materials that are generally mechanically attached or fully adhered to rigid insulation or a cover board. There are two categories of single-ply membranes: thermoplastic membranes such as TPO (thermoplastic olefin), PVC (polyvinyl chloride), and KEE (ketone ethylene ester), and thermoset membranes such as EPDM (ethylene propylene diene monomer).

### 2.2.3.9.2 Roof cover selection example

Select appropriate design uplift pressure for roof system: Most low-slope roofs found on single-family residential buildings are relatively small and the complexities associated with varying attachment methods or capacities are more likely to cause confusion and errors than to save construction costs. Consequently, it is generally best to simply pick a system and installation method that is adequate for the highest design pressures expected on the low-slope roof. Table 2-9 provides the highest design wind uplift pressures for low-slope roofs based on the last two editions of the American Society of Civil Engineers design standard ASCE 7-10 and (ASCE 7-16) for single-family residential buildings with mean roof height of 30 ft or less. Values are listed for each of the common terrain exposure categories (suburban, open country, and water). Best



practice is to use the ASCE 7-16 values as they represent the research on design loads for low-slope roofs. The ASCE 7-10 values are the ones used in the 2012, 2015, and 2018 editions of the IRC.

**Table 2-9. Maximum ASCE 7-10 (ASCE 7-16) Low-Slope Roof Allowable Stress Design Wind Uplift Pressures for Various Design Wind Speeds (Roof Height of 30 ft or less)**

Design Wind Speed	Exposure B (Residential Neighborhood) – psf ASCE 7-10 (ASCE 7-16)	Exposure C (Open Area) – psf ASCE 7-10 (ASCE 7-16)	Exposure D (Close to Water) – psf ASCE 7-10 (ASCE 7-16)
<b>115</b>	36 (41)	50 (57)	60 (68)
<b>120</b>	39 (45)	55 (62)	65 (74)
<b>130</b>	46 (52)	64 (73)	76 (87)
<b>140</b>	53 (61)	75 (85)	88 (100)
<b>150</b>	61 (70)	86 (97)	102 (115)
<b>160</b>	70 (79)	98 (111)	116 (131)
<b>170</b>	79 (89)	110 (125)	130 (148)
<b>180</b>	88 (100)	124 (140)	146 (166)

Selection of an adequate roof cover assembly:

1. From **Table 2-9**, determine the highest uplift pressure required for the home based on the design wind speed at the site and the terrain exposure.
2. Select a roofing system manufacturer and a method of application (self-adhered, mechanically fastened, hot-mopped, single-ply, etc.). Make sure the system has an approved application that is adequate for the design uplift pressure.
3. Make sure you select a system that's appropriate for the roof deck. Most residential flat roof assemblies are applied over a wood deck without insulation; make sure the system you choose is compatible with your roof deck.
  - **NOTE: The ICC Evaluation Service Report, Florida Product Approval, Texas Department of Insurance (TDI) Evaluation Report, and Miami-Dade Notice of Acceptance (NOA) already have the required 2.0 factor of safety incorporated in the listed design pressures.**

## Installation

1. Ensure the roof deck is properly attached to satisfy the FORTIFIED requirements in Section 2.2.3.4.
2. Apply base/anchor sheet, intermediate plies, cap sheet, and roof coating as required by the system approval. Do not substitute materials; use the components and fasteners as listed in the system approval.

Follow roof manufacturer's installation guidelines for edge details, parapet details, skylight curb details, pitch transitions, wall connections where roofs meet upper stories, and penetrations for vent stacks or hardware mounts.

### 2.2.3.10 Improve water intrusion resistance of attic ventilation system

All shuttering of openings or plugging of vents should be done on a temporary basis and removed once the storm threat is over so that the attic is once again properly ventilated.

#### 2.2.3.10.1 Improve attachment/replace ridge and off-ridge vents

Ridge vents and off-ridge vents must be TAS 100(A) rated for resisting water intrusion in high winds and must be properly anchored to the roof following the manufacturer's recommended installation for high winds. If it is not possible to verify that they have a TAS 100(A) rating or they are not well attached, they must be replaced/reattached as appropriate.

#### 2.2.3.10.2 Gable end vents

Gable end vents (Figure 2-13) are not designed to keep out water driven by hurricane-force winds.



Figure 2-13. Example of a gable end vent.

Three options are offered that can meet the intent of the program. Any other options must be approved in advance.

**Option 1:** When you are re-roofing, it may be possible to have the roofer add ridge or off-ridge venting that will provide the ventilation otherwise provided by the gable end vent(s). Once this venting is provided, the gable end vent(s) can be removed or permanently blocked.

**Option 2:** When a hurricane threatens, shutter the gable vent(s) from the outside with plywood (Figure 51) or some other nonporous flat shutter that will prevent water from entering through the gable end vent. Wood structural panels with a minimum thickness of  $\frac{7}{16}$  in. and a maximum span of 4 ft are permitted as gable end covers. Panels must be pre-cut so that they can be attached to the framing surrounding the gable vent. Panels shall be pre-drilled as required for the anchorage method and all required hardware shall be provided. Permanent corrosion-resistant attachment hardware with anchors permanently installed on the building shall be provided. Attachment schedule must be, at a minimum, in accordance with Table 2-10. Seal the shutters to the trim boards around the edges of the gable end vent. Self-adhesive weather stripping can be used to produce the desired seal.

**Option 3:** If installation of shutters from the outside is difficult because of the height or other considerations, but there is access through the attic, the gable vent opening can be shuttered from the inside (Figure 2-14). Follow the requirements for size and anchorage of wood structural panels indicated in Option 1. Note that careful attention needs to be paid to sealing around the shutter and making sure that any water that accumulates in the cavity can drain to the outside of the house and not into the wall below.



Figure 2-14. Outside covering of a gable end vent with plywood.





Figure 2-15. Gable end vent ready to be covered with plywood from inside attic.

Table 2-10. Fastening Schedule for Wood Structural Panel Gable End Vent Cover

Support Structure Type	Fastener Type and Size	Fastener Spacing (With Critical Edge and End Distance)
Wood	¼-in.-diameter lag screws with 2-in. embedment with 1-in.-diameter washer	16 in. o.c. maximum  (1 in. from edge of opening, 2 in. inward from panel edge)
Concrete or Grouted Masonry	¼-in. fastener with 2-in. embedment with 1-in.-diameter washer	16 in. o.c. maximum  (1.5 in. from edge of opening, 2 in. inward from panel edge)

Notes for Table 2-10:

- All fasteners shall be corrosion resistant.
- Fasteners shall be installed at opposing ends of the wood structural panel.
- Where screws are attached to masonry or masonry/stucco, they shall be attached using vibration-resistant anchors having a minimum withdrawal capacity of 1,500 lb.
- Min. (2) fasteners per panel side.



### 2.2.3.11 Photovoltaic (PV) systems

#### 2.2.3.11.1 Design guidance

##### 2.2.3.11.1.1 *Wind loads*

Roof-mounted PV systems shall be designed for component and cladding wind loads for the site in accordance with ASCE 7-16 using an effective wind area based on the dimensions of a single unit frame.

##### 2.2.3.11.1.2 *Gravity loads*

The roof deck and supporting roof structure must be designed to support all gravity and wind loads resulting from the PV system installation.

#### 2.2.3.11.2 Connections and installation

Connections and installation of appropriately designed PV systems must be field verified by a professional engineer and a letter of compliance from that professional engineer indicating that connections and installation of the PV system meet the design intent must be submitted to the FORTIFIED Evaluator.

#### 2.2.3.11.3 Flashing

All roof penetrations must be sealed and flashed in accordance with the PV system and roof covering manufacturer's requirements.

## 3 FORTIFIED Silver Designation Requirements

### 3.1 Introduction

Protecting openings from windborne debris and the substantial additional forces generated by hurricane winds when windows and doors are breached is critical as a storm's intensity increases. In addition, strengthening gable end walls, assuring eave and gable end soffits are well attached, and assuring attached, covered structures are adequately anchored to better resist wind-generated uplift loads are important steps for protecting a home and its contents.

When windows and doors of a home are breached, the wind pressure that would have been applied to the external surface of the window or door is applied to the inside of the home. When the breach is on the windward side of the home, pressures build up in the home much like blowing up a balloon. This internal pressure tends to act uniformly over the ceiling and internal wall surfaces which, when combined with upward (roof) and outward (side and rear wall) external wind forces, can dramatically increase the uplift loads trying to lift the roof off the walls and outward forces trying to push out the walls.

If the home does not have hurricane clips, straps, or anchors tying the roof structure of attached porches and carports to the supporting structure and the foundation, strong winds can rip these structures loose, creating windborne debris and opening up the home to wind and water.

Inadequately braced and improperly anchored tall gable end walls are vulnerable to failure during hurricanes. If the house has a gable end wall that is not properly braced, anchored, and sheathed, its failure can open up the end of the house, allowing wind and water to enter the home.

Eave soffits that are not well attached are vulnerable to failure during hurricanes. Eave soffits that blow off can lead to water intrusion through the soffit area. Perforated gable end soffits that provide attic ventilation can lead to water intrusion through the attic.

The FORTIFIED Silver designation addresses all these concerns, in an effort to strengthen the entire building envelope. This holistic approach is what enables the FORTIFIED program to deliver meaningful risk reduction.

A prerequisite to a FORTIFIED Silver designation is completion of FORTIFIED Roof designation requirements (either without roof covering replacement or with roof covering replacement).

## 3.2 FORTIFIED Silver Performance Criteria

Note that the FORTIFIED Silver designation builds on the FORTIFIED Roof designation. It does not replace the requirements for FORTIFIED Roof—it adds to them. Key additional performance goals for achieving a FORTIFIED Silver designation are outlined below.

### 3.2.1 Windows, Entry Doors, and Garage Doors

#### 3.2.1.1 Glazed openings

All glazed openings (windows, patio doors, skylights, glass block, etc.) must be able to resist or be protected from windborne debris. The level of debris impact protection required for areas where the ASCE 7-05 design wind speed ( $V_{asd}$ ) is greater than or equal to 110 mph and the ASCE 7-10 and ASCE 7-16 (Vult) design wind speed is greater than or equal to 130 mph is the large missile G (9-lb 2x4 impacting end on at 50 ft/sec) as defined in ASTM E1996 and ASTM E1886 and AAMA 506.

All glazed opening protection systems must be rated for the design pressures appropriate for the exposure category, design wind speed, window size, and window location on the building. Products must be tested, at a minimum, in accordance with International Residential Code (IRC) accepted standards (or with locally adopted standards, if they are more restrictive) and installed in accordance with the manufacturer's instructions.

For areas where the ASCE 7-05 design wind speed ( $V_{asd}$ ) is greater than 90 but less than 110 mph or the ASCE 7-10, ASCE 7-16 design wind speed (Vult) is greater than 115 mph but less than 130 mph, protective systems that provide at least the level of protection of wood structural panels with a minimum thickness of  $\frac{7}{16}$  in. and maximum span of 8 ft are permitted to be used as opening protection. Panels must be pre-cut and pre-drilled as required for the anchorage method used and all required hardware shall be provided. Permanent corrosion-resistant attachment hardware with anchors permanently installed on the building must be provided. The attachment method must be, at a minimum, in accordance with Table 2-10.

#### 3.2.1.2 Entry doors

All entry doors must be pressure and impact rated or protected by a system that is pressure and impact rated. At least one exterior entry door must be operable from inside the living space when opening protection is in place. The level of debris impact protection required for areas where the ASCE 7-05 design wind speed ( $V_{asd}$ ) is greater than or equal to 110 mph and the ASCE 7-10 and ASCE 7-16 (Vult) design wind speed is greater than or equal to 130 mph is the large missile G (9-lb 2x4 impacting end on at 50 ft/sec) as defined in ASTM E1996 and ASTM E1886 and AAMA 506.

All entry doors and entry door protection systems must be rated for the design pressures appropriate for the exposure category, design wind speed, door size, and door location on the building. Products must be tested, at a minimum, in accordance with International Residential Code (IRC) accepted standards (or with locally adopted standards, if they are more restrictive) and installed in accordance with the manufacturer's instructions.

### 3.2.1.3 Garage doors

All garage doors must be protected from wind pressure damage. In addition, garage doors with glazed openings must also be protected from windborne debris.

1. **For garage doors without glazed openings (windows):** Provide a garage door assembly (door and all associated hardware and components) that meets the design wind pressure for the site or protect the garage door with an impact-rated shutter/screen product that meets the design wind pressure for the site.
2. **For garage doors with glazed openings (windows):** If the garage door has windows, the door and windows, as an assembly, must be rated for the design pressure and impact or the garage door shall be protected with an impact-rated shutter/screen product that meets the design wind pressure for the site.

All entry doors and entry door protection systems must be rated for the design pressures appropriate for the exposure category, design wind speed, door size, and door location on the building. Products must be tested, at a minimum, in accordance with International Residential Code (IRC) accepted standards (or with locally adopted standards, if they are more restrictive) and installed in accordance with the manufacturer's instructions.

Where impact protection is required, the level of debris impact protection required shall be the large missile G (9-lb 2x4 impacting end on at 50 ft/sec) as defined in ASTM E1996 and ASTM E1886 and AAMA 506.

## 3.2.2 Gable Ends

### 3.2.2.1 Gable end wall strength

Gable end walls shall resist the design wind loads based on exposure category, design wind speed, elevation, and location on the building.

#### 3.2.2.1.1 Gable end wall sheathing

Gable end wall sheathing shall have sufficient strength and fastening to resist wall design wind pressures specified in ASCE 7-05, ASCE 7-10, or ASCE 7-16. The wall system shall, at a

minimum, provide the resistance to wind pressures and debris impact of a  $7/16$  OSB wood structural panel attached to wood wall framing.

#### **3.2.2.1.2 Gable end bracing**

Gable end bracing shall address the bending capacity of the gable wall, bracing of the gable wall at its top and bottom, and connection of the bottom of the gable wall to the wall below.

#### **3.2.2.2 Gable end overhangs**

Gable end overhangs must be constructed and attached to gable framing to resist appropriate wind uplift loads. Gable rake soffit vents become a problem when porous soffit panels or screen vents are installed on the bottom surface of the roof overhang at the gable end and there is nothing to block the wind-driven rain coming through the vents from entering the attic.

##### **3.2.2.2.1 Gable end overhang construction**

Gable end overhangs shall be designed and constructed to resist uplift wind loads. Most current high-wind wood frame construction guides do not require additional framing members to support the overhang until the length of the overhang exceeds 12 in. When overhangs exceed 12 in., most standards and guides require outlookers to support the cantilevered overhang sheathing. Outlookers are usually 2x framing members that extend out past the top of the gable end wall to support the roof deck overhang and are oriented with their larger dimension perpendicular to the roof sheathing. Wind uplift pressures on outlookers at the edge of gable end roofs are some of the highest pressures the structure experiences during high-wind events. It's important to be sure that the outlookers are adequately sized, spaced, and attached to the supports to prevent a failure of outlookers or outlooker connections leading to loss of roof sheathing at the edge of the roof.

##### **3.2.2.2.2 Gable end rake soffits**

Attic vents installed in gable end rake soffits are particularly susceptible to wind-driven water intrusion because of the large amount of water that accumulates on the gable wall when it faces into the wind. Consequently, the FORTIFIED Home–Hurricane program requires gable end soffits to be unvented.

#### **3.2.3 Uplift Resistance of Attached Structures (Porches and Carports)**

Attached structures shall have a continuous load path with adequate capacity to resist the design wind uplift loads on the structure determined using ASCE 7 provisions for the building configuration, exposure category, enclosure category, design wind speed, elevation and location on the structure. The design shall follow accepted engineering design principles and

procedures. Specific issues to be addressed include uplift capacities of all connections between the roof and the foundation and the adequacy of the weight of the structure and foundation to resist the uplift.

### 3.2.4 Vinyl and Aluminum Soffit Attachment

Vinyl and aluminum soffits must be installed in accordance with the manufacturer's installation instructions and shall not exceed 12 in. between support members.

## 3.3 Prescriptive (Deem to Comply) Options

### 3.3.1 Opening Protection

#### 3.3.1.1 Windows, skylights, glass block

There are two solutions for glazed opening protection:

1. Installation of impact-rated products.  
**OR**
2. Installation of opening protection products.

Impact-rated products include permanently installed items, such as entry doors, windows, sliding glass doors, and skylights that have been tested in accordance with, at a minimum, International Residential Code (IRC) accepted impact resistance and design pressure test standards (or with locally adopted standards, if they are more restrictive).

Opening protection products also must be tested with, at a minimum, International Residential Code (IRC) accepted test standards for impact resistance and design pressure (or with locally adopted standards, if they are more restrictive). Opening protection products include permanently or temporarily installed shutter systems such as roll, accordion, colonial, and Bahama-style shutters; storm panels; and fabric and screen products.

Note: While opening protection products are commercially available for most openings, there are no universally available opening protection products for skylights. Replacement or removal of existing skylights that do not meet approved impact protection requirements of the International Residential Code (IRC) are the only options to provide windborne debris protection. Skylight replacement units must meet, at a minimum, the International Residential Code (IRC) accepted test standards for impact resistance and design wind pressure (or with locally adopted standards, if they are more restrictive).

All glazed opening protection (impact-rated products and opening protection products) must meet two criteria:



1. **Design pressure rating:** Glazed opening protection must be rated for the design pressures appropriate for the exposure category, wind speed, window size, and window location on the building. Products must be tested, at a minimum, in accordance with International Residential Code (IRC) accepted standards (or with locally adopted standards, if they are more restrictive) and installed in accordance with the manufacturer's instructions. Acceptable International Residential Code (IRC) design pressure test standards for windows and glass doors include AAMA/WDMA/CSA 101/I.S.2/A440, ASTM E330 (products must be tested to 1.5 times design pressure). The Florida Building Code Testing Application Standard TAS 202 is also acceptable for the FORTIFIED program. See Appendix C for wind design pressures for windows, doors, and garage doors.
2. **Impact rating:** International Residential Code (IRC) accepted test standards for impact resistance include the Large Missile Test (Missile D) of ASTM E1996 and ASTM E1886 and AAMA 506. The Florida Building Code Testing Application Standards TAS 201 and TAS 203 are also acceptable for the FORTIFIED program.

All installations must be in accordance with the manufacturer's instructions.

Note: Documentation of glazed opening protection design pressure rating and impact rating is required to validate that these criteria are met and must be provided to the certified FORTIFIED Evaluator to be included with the final designation checklist.

For additional information about opening protection systems, IBHS's *Selection Guide for Shutters & Other Protective Barriers* provides a comprehensive list of shutter materials, cost estimates, and the pros and cons to consider when choosing opening protection products.

### Exception

Although a FORTIFIED Silver designation requires opening protection for all openings, FORTIFIED provides an exception to the tested windborne debris impact protection standards by allowing the use of wood structural panels as opening protection only in locations with a design wind speed less than 130 mph (Vult) or 110 mph (Vasd). In areas with less than those design wind speeds (non-windborne-debris regions), wood structural panels with a minimum thickness of  $\frac{7}{16}$  in. and a maximum span of 44 in. between lines of fasteners are permitted to be used for opening protection.

Panels shall be precut to overlap the wall such that they extend a minimum of 2 in. (50.8 mm) beyond the lines of fasteners and attach to the framing surrounding the opening containing the product with the glazed opening. Panels shall be predrilled as required for the attachment method and secured with corrosion-resistant attachment hardware permanently installed on the building. Panels shall be fastened at 16 in. o.c. along the edges of the opposing long sides of the panel with  $\frac{1}{4}$ -in. lag screws with at least 2 in. embedment in the wood wall framing or concrete/masonry wall substrate. Hex nuts, washered wing-nuts, or bolts used to attach the

wood structural panels to the anchors shall be minimum ¼-in. hardware and shall be installed with or have integral washers with a minimum 1-in. outside diameter.

### 3.3.1.2 Entry doors

There are two options for entry door protection:

1. Install an entry door that is impact rated and meets the appropriate design wind pressure (see Appendix C for design wind pressures).
- OR**
2. Entry doors that are not impact rated must be protected by a wind pressure- and impact-rated protective system.

Impact-rated doors and impact-rated protective systems used to protect non-impact-rated doors must be tested and approved in accordance with, at a minimum, International Residential Code (IRC) accepted impact resistance and design pressure test standards (or with locally adopted standards, if they are more restrictive). Acceptable IRC design pressure test standards include AAMA/WDMA/CSA 101/I.S.2/A440 and ASTM E330 (products must be tested to 1.5 times design pressure). The Florida Building Code Testing Application Standard TAS 202 is also acceptable for the FORTIFIED program. Acceptable IRC impact resistance standards include the large missile test (Missile D) of ASTM E1996 and ASTM E1886. The Florida Building Code Testing Application Standards TAS 201 and TAS 203 are also acceptable. All installations must be in accordance with the manufacturer's instructions.

Note: Documentation of opening protection design pressure rating and impact rating is required to validate that these criteria are met and must be provided to the certified FORTIFIED Evaluator to be included with the final designation checklist.

### 3.3.1.3 Garage doors

All garage doors must be protected from wind pressure damage. In addition, garage doors with glazed openings must also be protected from windborne debris.

1. **For garage doors without glazed openings (windows):** Provide a garage door assembly (door and all associated hardware and components) that meets the design wind pressure for the site or protect the garage door with an impact-rated shutter/screen product that meets the design wind pressure for the site.
2. **For garage doors with glazed openings (windows):** If the garage door does not have windows, then the garage door is only required to meet the design wind pressure requirements for the site. If the garage door has windows, the door must be rated for the design pressure and the entire door must be rated for both pressure and impact or the garage door shall be protected with an impact-rated shutter/screen product that meets the design wind pressure for the site.

Note: See Appendix C for design wind pressures requirements for garage doors.

Garage doors and garage door shutter or screen products must be tested and approved in accordance with, at a minimum, International Residential Code (IRC) accepted impact resistance and design pressure test standards (or with locally adopted standards, if they are more restrictive). Acceptable IRC impact resistance test standards include the Large Missile Test (Missile D) of ASTM E1996 and ASTM E1886. The Florida Building Code Testing Application Standards TAS 201 and TAS 203, and ANSI/DASMA 115 (garage doors only) are also acceptable. Acceptable IRC design pressure test standards include ANSI/DASMA 108 (garage doors only) or ASTM E330 (products must be tested to 1.5 times design pressure). The Florida Building Code Testing Application Standard TAS 202 is also acceptable. All installations must be in accordance with the manufacturer's instructions.

Note: Documentation of opening protection design pressure rating and impact rating is required to validate that these criteria are met and must be provided to the certified FORTIFIED Evaluator to be included with the final designation checklist.

## 3.3.2 Gable Ends

### 3.3.2.1 Gable end strength

#### 3.3.2.1.1 Gable end sheathing

Gable end walls must be constructed using a wall system that provides, at a minimum, the resistance to wind pressures and debris impact provided by  $\frac{7}{16}$ -in.-thick OSB wood structural panels attached to wood wall framing.

Typical gable wall systems that do not comply include fiberboard or foam sheathing covered with vinyl or aluminum siding, tarpaper or roof felt covered with vinyl or aluminum siding, brick veneer more than 4 ft tall over fiberboard, foam sheathing, tarpaper, or roofing felt. Required sheathing may be installed on the outside of the framing by removing and replacing the wall covering or from the inside of the attic either as strips installed between the gable wall framing members or as larger panels attached to the inside surface of the framing members. If the required sheathing is installed as strips between the gable wall framing members, it should be installed flush with the outer edge of the framing and anchored using wood backing members that run continuously from top to bottom or with periodic blocking provided the edges of the sheathing panels are caulked to the framing members using an AFG-01 approved subfloor adhesive. If the sheathing panels are attached to the inside surface of the gable wall framing members, a continuous drainage plane should be added, if not already present, with flashing and drainage holes at the bottom to direct any water out of the intersection between the gable wall and the wall below.

### 3.3.2.1.2 Gable end bracing

#### 3.3.2.1.2.1 *Prescriptive method*

Prescriptive methods for retrofitting gables 4 ft tall and taller are detailed in Appendix A. These methods are intended for applications where the gable end wall framing is provided by a wood gable end truss or a conventionally framed rafter system. These prescriptive methods of retrofitting are intended to increase the resistance of existing gable end construction to out-of-plane wind loads. Figure 3-1 shows a typical gable end failure when the roof deck bracing at the top of the wall was lost.

Four issues are addressed:

1. Strengthening the vertical framing members of the gable end with the use of retrofit studs.
2. Bracing the top and bottom of the gable end so the lateral loads are transmitted into the roof and ceiling diaphragms through horizontal braces.
3. Making connections between horizontal braces and retrofit studs using metal straps and fasteners.
4. Connecting the bottom of the gable end to the wall below using metal bracket connectors.



Figure 3-1. A gable end failure where the wall lost support along its top edge and is folded outward.

Minimum requirements for use of prescriptive methods detailed in Appendix A:

1. Minimum ceiling diaphragm must be ½-in. drywall, ¾-in.-thick plywood, or plaster installed over wood lath.
2. Minimum roof diaphragm must be 7/16-in. plywood or OSB.
3. Gable ends must have structural wall sheathing (minimum of 7/16-in. plywood or OSB or equivalent).

Cases that are not covered in this retrofit guidance require that a licensed professional engineer design a gable end bracing system that will meet wind forces appropriate for the location.

Note: Gable ends that are not covered in this retrofit guidance include:

1. Gable end walls on rooms with vaulted or cathedral ceilings.
2. Gable ends taller than 16 ft and/or have irregular shape.

For instructions and specifications for strengthening and bracing gable ends, see Appendix A, “Gable End Wall Bracing Retrofit.”

### **3.3.2.1.2.2 Engineered method**

Site-specific gable end bracing designed by a professional engineer must be based on site-specific conditions and shall be documented on the Gable End Bracing Compliance Form and signed by the engineer responsible for the design.

### **3.3.2.2 Gable end overhangs**

#### **3.3.2.2.1 Gable end overhang construction**

Gable end overhangs shall be designed and constructed to resist uplift wind loads. Most current high-wind wood frame construction guides do not require additional framing members to support the overhang until the length of the overhang exceeds 12 in. When overhangs exceed 12 in., most standards and guides require outlookers to support the cantilevered overhang sheathing. Outlookers are usually 2x framing members that extend out past the top of the gable end wall to support the roof deck overhang. Wind uplift pressures on outlookers at the edge of gable end roofs are some of the highest pressures the structure experiences during high-wind events. It's important to be sure that the outlookers are adequately sized, spaced, and attached to the supports to prevent a failure of outlookers or outlooker connections leading to loss of roof sheathing at the edge of the roof. Figure 3-2 shows gable end roof sheathing damage from a hurricane; this damage was a result of the failure of outlooker connections to the top of the gable end wall.

The FORTIFIED Home–Hurricane program requires strapping of outlookers to the top of the gable wall framing and making sure that the connection of the end of the outlooker at the first truss or rafter in from the gable end is adequate. When outlookers are needed, best practice is to drop the height of the gable truss or gable wall framing so that outlookers can be oriented



with their larger cross-sectional dimension perpendicular to the sheathing it is supporting. The outlookers and/or gable end wall or truss must not be notched. Blocking should be installed between the outlookers and attached to the top of the gable wall truss or framed wall top plate. The outlookers should be strapped to the top of the gable wall truss or framed wall top plate and to the first truss or rafter in from the gable end wall. Figures 3-3 and 3-4 provide illustrations of options for achieving adequate outlooker construction. Other options will require design by a licensed professional engineer that addresses wall strength, outlooker strength, and outlooker connections necessary to meet the appropriate design loads (live, dead, and wind loads) for the site and framing conditions. Signed and sealed copies of the engineering design details will be required to achieve a designation.



**Figure 3-2. Gable end roof sheathing damage resulting from failure of outlooker connectors.**



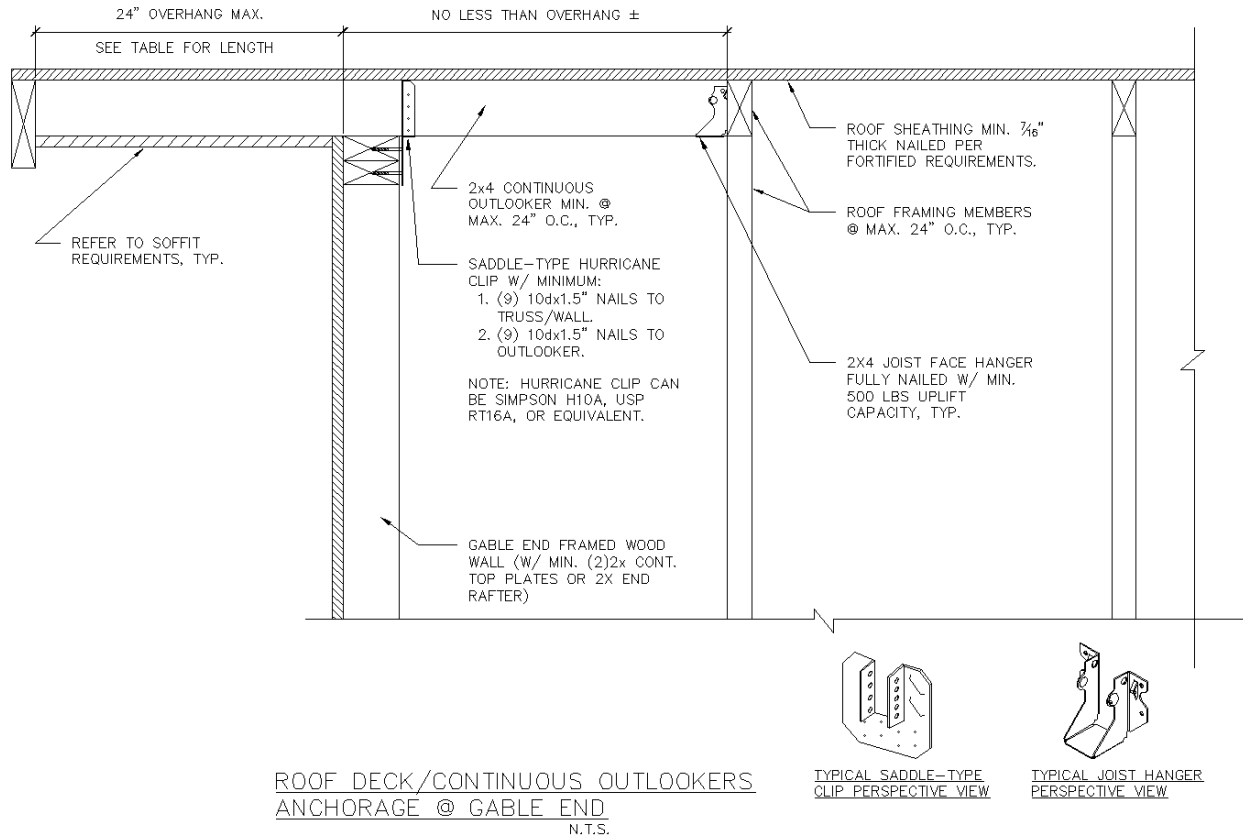


Figure 3-3. Typical outlooker anchorage at framed gable end wall.

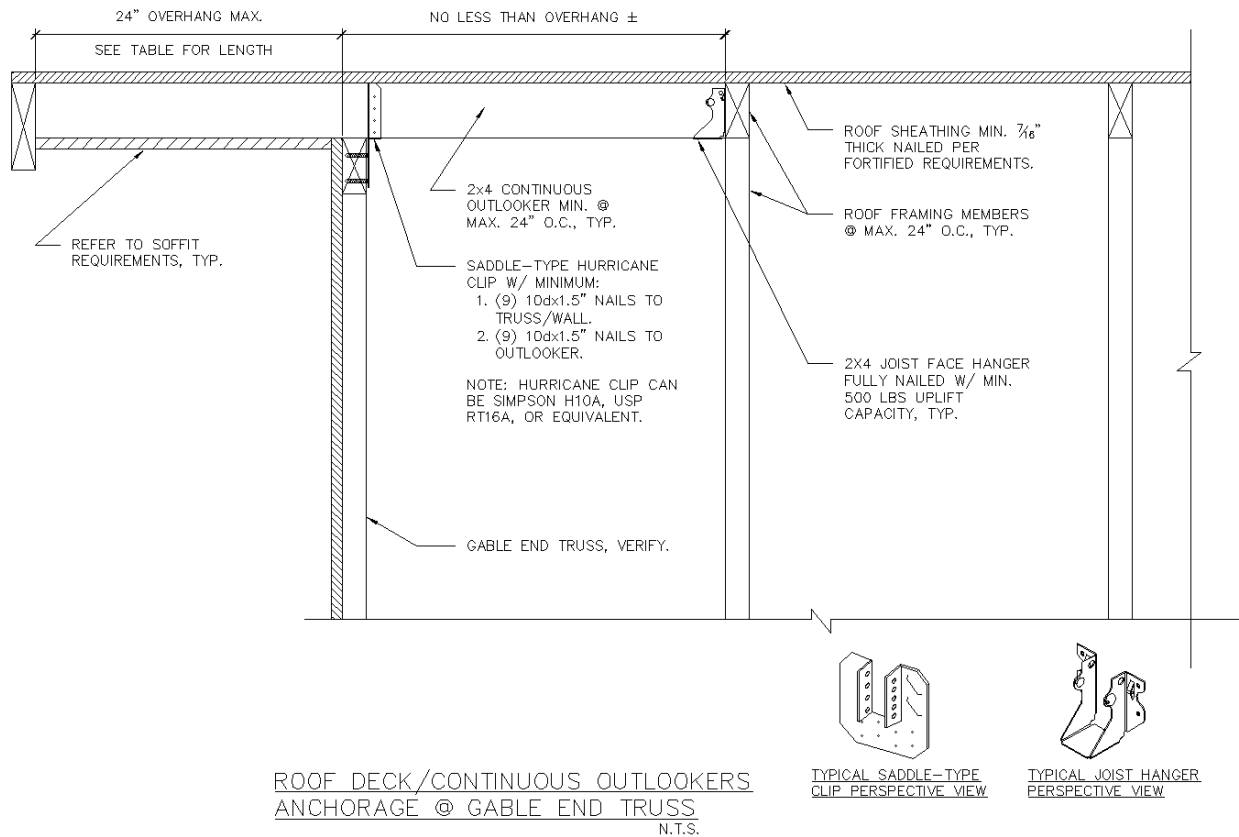


Figure 3-4. Typical gable end trusses and outlooker anchorage.

Table 3-1: Maximum Overhang Length (in.)

Outlooker 2x4 Framing @ 24 in. o.c. (Simpson 10A or USP RT16A)

Wind Speed (mph)		Exposure B	Exposure C	Exposure D
ASCE 7-10 Ultimate	ASCE 7-05 Allowable	Suburban, Residential	Bay Front, Open Terrain	Oceanfront Only
130	101	24	24	24
140	108	24	24	24
150	116	24	24	22
160	124	24	24	18
170	132	24	20	14
180	139	24	20	14



### 3.3.2.2.2 Gable end rake soffits

Gable end rake soffit vents become a problem when porous soffit panels or screen vents are installed on the bottom surface of the roof overhang at the gable end and there is nothing to block the wind-driven rain coming through the vents from entering the attic. This usually happens when the gable overhang is supported by outlookers as shown in Figure 3-5. (In Figure 3-5, the outlookers are the short framing members that extend out over the top of the gable wall to support the sheathing on the overhang; they are typically required when the gable overhang is greater than 12 in.)

The building code generally requires 1 sq ft of venting for every 150 sq ft of attic floor area. In some cases, the gable rake soffit venting may have been installed to help meet the code-specified vent area requirements. Because gable ends facing into hurricane winds tend to collect a lot of water and significant amounts of that water can be forced into the attic if gable rake venting exists, even when the porous soffit covers stay in place. IBHS requires that this pathway for water and air into the attic be blocked if it exists. If your home has a vented gable rake soffit, a builder/contractor who is knowledgeable about attic ventilation requirements or a design professional should be consulted to determine whether this venting is required or can simply be blocked. Often the vented soffit material is used for the gable rake soffit simply because the vented soffit was used along the eaves to provide intake ventilation and, since the gable is often blocked with framing material, is not actually providing ventilation along the gable. No action is necessary if that's the case.

If the gable rake soffit vents are not required to comply with roof ventilation requirements, there are two options:

1. Remove the vented soffit material and reinstall a non-porous soffit material to the bottom of the outlookers in accordance with the manufacturer's installation guidelines for high-wind areas.
2. Plug the gaps from the inside with metal flashing and sealant. The flashing should be well attached and completely seal the openings. Use sealant around the edges. See Figure 3-6 for an illustration of this technique. An alternative would be to use wood blocking with caulk adhesive all around in lieu of the metal flashing.

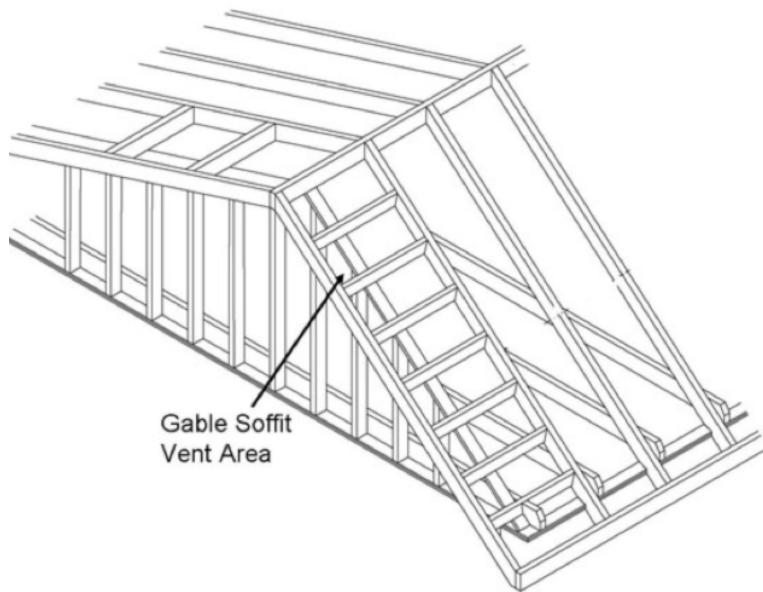


Figure 3-5. Gable rake soffit vent locations.



Figure 3-6. Blocking of gable rake soffit vents using metal flashing.



### 3.3.3 Attached Structures (Porches and Carports)

These covered, attached structures are usually supported by horizontal beam members sitting on vertical columns, which are then connected to foundation systems.

Improving the anchorage of these structures requires three steps:

1. Provide metal connectors between the supporting roof members and the horizontal beams (See Figure 3-7). It may be necessary to remove soffit/ceiling material for access to reinforce the connection. The uplift load on this connection can be determined by completing the Uplift Worksheet.
  - Wood-to-wood connections: The saddle-type hurricane clip (e.g., H10 or HS10 type clips) may be installed on either side of the beam when the determined uplift force is less than 800 lb and must be installed on both sides of the beam when the determined uplift is greater than 800 lb.
2. Provide a metal connector at the top of each beam-to-column connection. The uplift load required for this connection can be determined by completing the Uplift Worksheet. Select one of the connections shown in Figure 3-8. The determined uplift force must be smaller than the stated allowable uplift capacity corresponding to the selected connection.
  - The metal connector must be rated for exterior weather exposure and the installation must be in accordance with the manufacturer's recommendations.
3. Provide a metal connector at each column-to-foundation connection. The uplift load required for this connection can be determined by completing Uplift Worksheet. Select one of the connections shown in Figure 3-9 so the determined uplift force is less than the corresponding allowable uplift capacity.
  - The metal connector must be rated for exterior weather exposure and the installation must be in accordance with the manufacturer's recommendations. Provide a moisture barrier between the bottom of metal connector and the concrete.

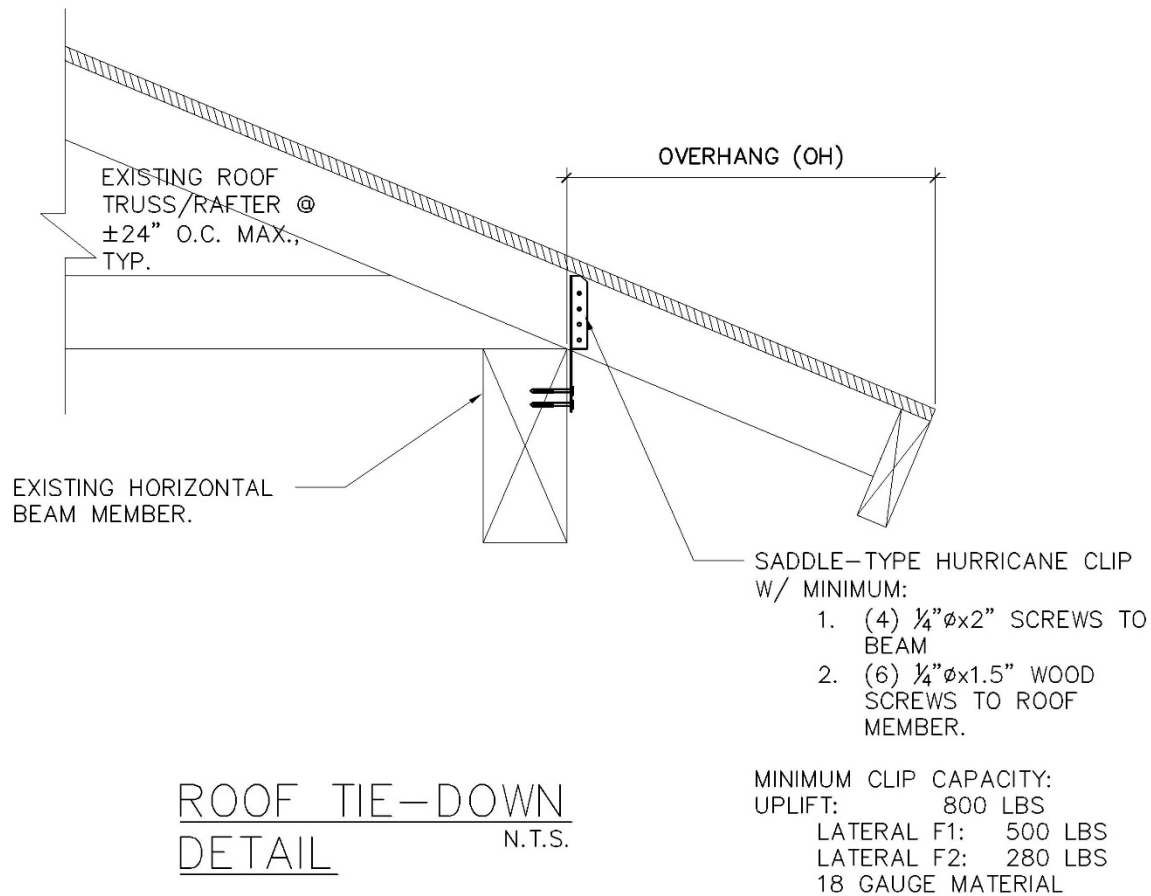


Figure 3-7: Connection retrofit typical roof member to beam.



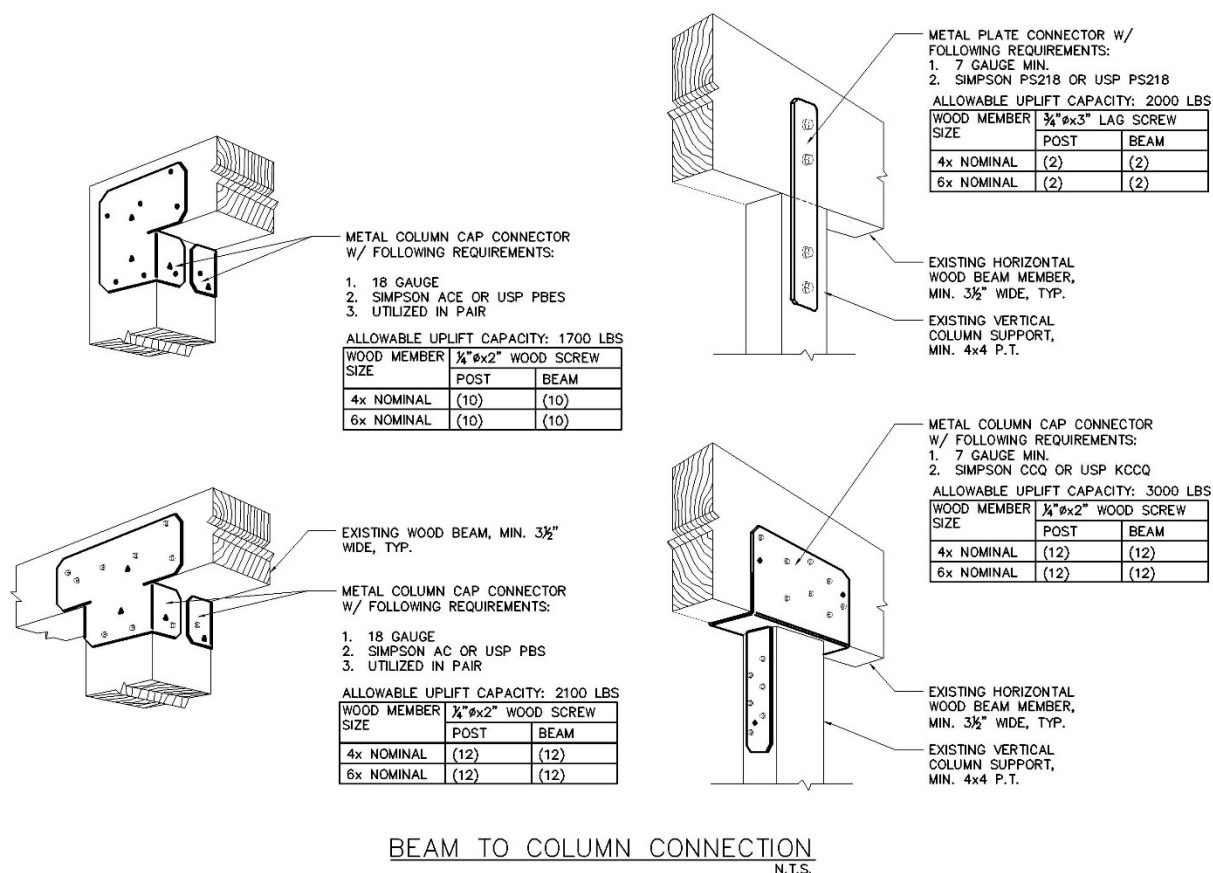


Figure 3-8. Typical beam-to-column connection retrofit.

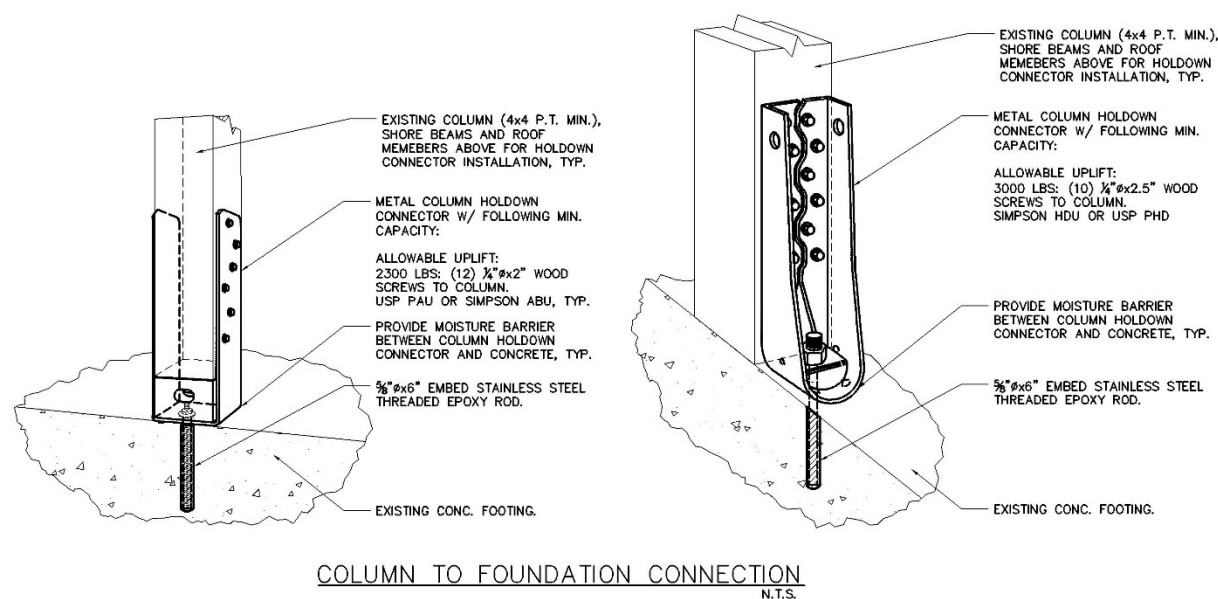


Figure 3-9. Typical column-to-footing retrofit connection.

### 3.3.3.1 Porch/carport uplift worksheet

Use the following guidelines to determine how much uplift resistance is required to provide adequate carport/porch column connections at both the top and bottom. A continuous load path must be achieved from the roof framing members to the supporting beam, from the beam to the column, and then from the column to the foundation.

1. Measure how far the porch roof sticks out from the wall,  $D = \underline{\hspace{1cm}}$  ft.
2. Measure the width of the porch parallel to the house wall,  $W = \underline{\hspace{1cm}}$  ft.
3. Measure the roof member spacing,  $S = \underline{\hspace{1cm}}$  ft.
4. Measure the roof overhang distance,  $OH = \underline{\hspace{1cm}}$  ft.
5. Count the number of columns supporting the roof (whole number =  $N$ ). (Count each end wall as a single column that supports the roof, maximum 1 at each end.)
6. Column support area can be calculated as following: Inside Column Area ( $A$ )=  $D/2 \times W/((N-1))$  Corner Column Area ( $A$ )=  $D/2 \times W/(2(N-1))$
7. Select the appropriate net uplift pressure (wind pressure minus weight) for the design wind speed at your house from the Uplift Pressure Table (Table 3-2) below,  $P = \underline{\hspace{1cm}}$  psf.
8. The roof member uplift force can be calculated as follows:  $P_{up} = P * (D/2 + OH) * S$   
=  $\underline{\hspace{1cm}}$  lb.
9. The uplift force on the beam-to-column and column-to-foundation can be calculated by multiplying the net uplift pressure times the typical area,  $P * A = \underline{\hspace{1cm}}$  lb.

This is the uplift on each column, on the connection at the top of the column, and also on the connection at the bottom of the column. If the column is heavy (e.g., concrete or masonry) then you can reduce the force on the connection at the bottom of the column by the weight of the column.

**Table 3-2. Typical roof uplift pressure, exposure C, and mean roof height of 15 ft**

Wind Speed ASD (ULT) (mph)	Uplift Pressure (lb per sq ft = psf)	Weight of Roof (psf)	Net Uplift Pressure on Roof (psf)
<b>110 (142)</b>	39	10	29
<b>120 (155)</b>	47	10	37
<b>130 (168)</b>	55	10	45
<b>140 (180)</b>	64	10	54
<b>150 (194)</b>	73	10	63

### 3.3.3.1.1 Example calculations and considerations

Example Calculation and Observations: A porch is 8 ft deep and 25 ft wide with four columns along the outside edge of the porch as shown in Figure 3-10. Consequently;  $D = 8$  ft;  $W = 25$  ft;  $N = 4$ ;  $S = 2$  ft;  $OH = 1.5$  ft inside column area  $(A) = (8/2) \times [25 / (4-1)] = 33.4$  sq ft; corner column area  $(A) = (8/2) \times [25/2(4-1)] = 16.7$  sq ft. If the design wind speed is 130 ( $V_{asd}$ ; 168  $V_{ult}$ ) mph, the net uplift pressure on the roof ( $P$ ) is 45 psf.

Then  $P \cdot A$  is 1,503 lb for inside columns and 752 lb for corner columns. The uplift force at the roof member and beam intersection is:  $P_{up} = 45 \cdot (8/2 + 1.5) \cdot 2 = 495$  lb.

The supporting foundation may be required to be verified to sufficiently resist the uplift forces.

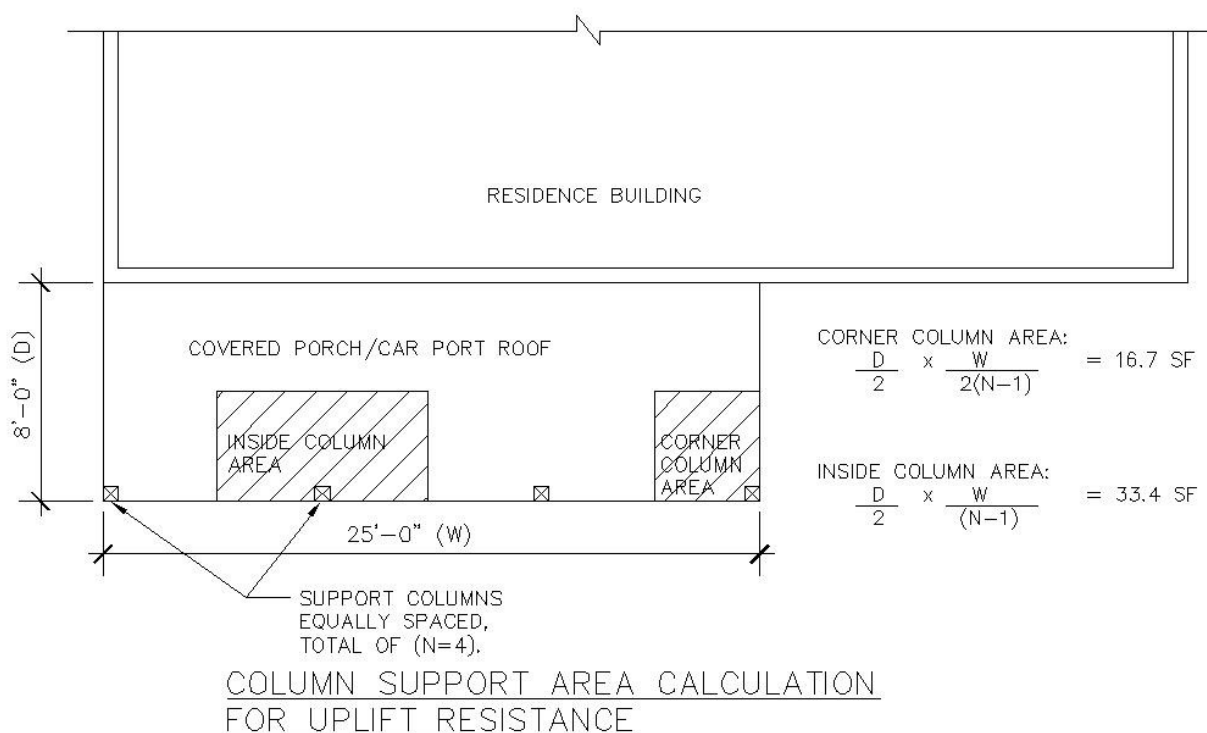


Figure 3-10. Sketch of Porch for Example Calculations Showing Tributary Areas for Column Uplift Loads.

### 3.3.4 Vinyl and aluminum horizontal soffit vent installations

Soffit ventilation is a common element of a properly designed attic ventilation system. While soffit vents do generally allow some water entry into the attic, the amount of water intrusion dramatically increases if the soffit covers blow off during a hurricane (Figure 3-11). The key goal of the following guidance and options is to help ensure that the soffit cover will remain in place

during a design-level or higher hurricane event. Properly installed vinyl and aluminum soffits that are supported every 12 in. should stay in place under most conditions; however, it is not uncommon for vinyl and aluminum soffits to be installed in tracks that are poorly connected to the fascia, roof structure, and walls.

Vinyl or aluminum soffits that are installed in new homes must be limited to 12 in. between support members and installed in accordance with the soffit manufacturer's instructions.



**Figure 3-11. The loss of soffit material allows water to be blown into the attic.**

Part of the assessment conducted by a certified FORTIFIED Evaluator on existing homes is the assessment of the condition and extent (width perpendicular to the wall) of the soffit. In some cases, it may be possible to strengthen a weak soffit installation and re-use the existing soffit cover provided it is in good condition. To be in good condition, soffit materials must not appear to be brittle, deteriorated, cracked, torn, or damaged. If soffit material is not in good condition or if aluminum soffit material is used within 3,000 ft of the coast, it must be removed and new soffit vent panels installed following manufacturer installation requirements for the appropriate soffit design wind pressures (Table 3-3).

The following options describe ways to meet the FORTIFIED requirements for soffit cover installations. These methods focus on vinyl and aluminum soffit covers because they have exhibited the most frequent failures. Plywood and cement board soffit material that does not exhibit attachment problems including bowing and gaps (openings along edges) is unlikely to fail in a windstorm.

Note: Cladding (such as soffits) pressure ratings are generally given in terms of Allowable Stress Design (ASD) pressures.

Required ASD soffit design wind pressures (+/-) in pounds per sq ft (psf) for the appropriate wind speed (MPH) and corresponding soffit height (FT) as shown in Table 3-3.

**Table 3-3 : ASD Design Wind Pressure Requirement For Soffit Panels**  
**ASCE 7-05 (Vasd) and ASCE 7-10 (Vult)**

Height \ MPH	Vasd = 110 Vult = 142	120 155	130 170	140 180	150 190
<b>15 FT</b>	+26.4 / -35.2	+31.4 / -41.1	+36.8 / -49.3	+42.7 / -57.2	+49.0 / -65.6
<b>20 FT</b>	+28.2 / -37.5	+33.4 / -44.8	+39.2 / -52.5	+45.5 / -60.9	+52.2 / -69.9
<b>25 FT</b>	+29.4 / -39.3	+35.0 / -46.9	+41.1 / -55.0	+47.7 / -63.7	+54.7 / -73.2
<b>30 FT</b>	+30.5 / -40.7	+36.3 / -48.6	+42.6 / -57.0	+49.4 / -66.1	+56.7 / -75.9
<b>35 FT</b>	+31.6 / -42.2	+37.6 / -50.3	+44.1 / -59.0	+51.2 / -68.5	+58.7 / -78.6

Required wind pressure (+/-) in pounds per sq ft (psf) for the appropriate wind speed (MPH) in corresponding soffit height (FT). Listed design wind pressures are for Exposure C in end/corner zones. For Exposure B design pressures, multiply the listed design pressures by 0.83 for 15 ft height; 0.78 for 20 ft height; 0.75 for 25 ft height; 0.72 for 30 ft height; and 0.69 for 35 ft height. For exposure D design pressures, multiply listed design pressures by 1.21.

**Option 1—Replacing soffit materials:** One option that is always available is to remove the existing soffit material, install backup framing that may have been omitted in the original installation, and make sure the new installation of soffit materials meets the manufacturer's recommendations for high-wind installations that correspond to the wall design pressures for the building and specific site exposure.

**Option 2—Remove and reinstall soffit materials:** In the following outline of actions to be taken, the letters in parentheses refer to the letters in Figure 3-12.

A. If the soffit manufacturer is not known:

1. Remove the existing soffit panels (A) and label them so they can be reinstalled in the same locations. Note: Lengths of soffits may vary around the house, so it may be difficult to install some of the panels in a different location. Furthermore, it is likely



- that some or all of the material will need to be replaced, so make sure it can be matched before it is removed. Any damaged soffit material should be replaced.
2. If required, install wood support (D). Make sure all wood supports are attached with 16d nails, #8 x 3 in., or 1/4-in.-diameter screws that have a minimum length of 2 3/4 in. (1 1/4-in. embedment) and that the supports have a maximum spacing of 24 in. as listed in Figure 3-12.
  3. Install intermediate support (B) and/or end support (C). Note: The end support for the soffit may be provided by the sub-fascia (depending on the configuration) in lieu of installing (C) at the end of the overhang.
  4. Attach new soffit panels (A) with fasteners to wood support members (B) and (C) as specified in Figure 3-12.
- B. If the soffit manufacturer is known: refer to the manufacturer's documentation for installation details and requirements for soffit support and panel attachment for the appropriate design wind pressure and product model.

One source for this information is the Florida Building Code Product Approval website which provides information on soffit manufacturer's installation guidelines for specific design wind pressures.



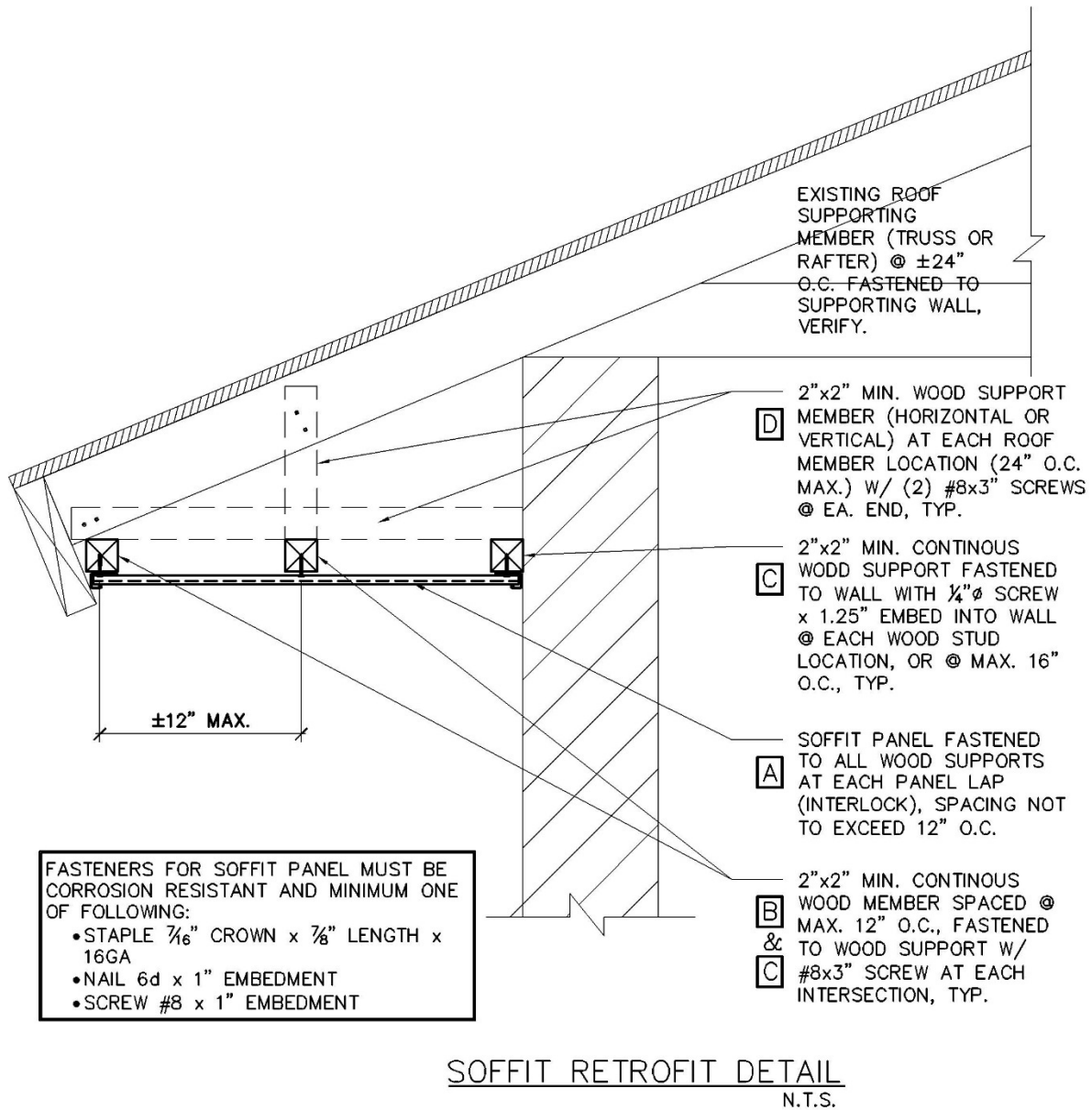


Figure 3-12. Typical soffit panels attachment detail.

## 4 FORTIFIED Gold Designation Requirements

### 4.1 Introduction

For a home to perform well when subjected to a significant hurricane event, it needs:

- A roof system that stays intact and, together with its ventilation system, keeps wind-driven water out;
- Windows and doors, including garage doors and sliders, that stay in place, are not breached by wind pressure or windborne debris, and keep the wind and water out as much as possible;
- Well-anchored attached structures, gable ends, and roof overhangs (especially at any gable ends); and
- A well-connected structural system where all the parts work together to keep the home intact—a continuous load path from the roof to the foundation and all parts in between.

Achievement of a FORTIFIED Gold designation is a recognition that measures have been taken, in addition to the FORTIFIED Roof and FORTIFIED Silver mitigation measures, to make sure that the structure of the home is well connected and weak links likely to result in structural damage have been strengthened. It doesn't mean that come what may the home will not suffer any damage. What it does mean is that the home has a good fighting chance of surviving a strong storm, protecting your valuables, and reducing the time it takes to recover after the storm.

As a program originally designed to help owners of existing homes reduce their vulnerability to hurricane damage, the FORTIFIED Gold-level strengthening is the most expensive and most disruptive. Most owners of older existing homes will likely not try to reach this level unless they are undertaking a major renovation, re-siding the home, or repairing after major damage. However, for new homes and relatively new homes built in areas with strong modern building codes that are being well enforced, the continuous load path should be well developed and the cost differential to attain a FORTIFIED Gold designation is minimal. In those areas, a FORTIFIED Gold designation means that another set of eyes are looking at the home to help ensure that key windstorm-resistant features are being built into the home. A FORTIFIED Gold designation requires design professional involvement in the development of the design plans for new homes and the analysis of the home and development of any retrofits for an existing home.

## 4.2 Performance Criteria

### 4.2.1 Continuous Load Path Development

Provide a continuous load path for transmitting design-level uplift and lateral loads through the structure until its weight and the weight of the foundations are sufficient to resist those loads with appropriate safety margins.

### 4.2.2 Securing Chimneys

Ensure that other attached structures such as chimneys are adequately connected to the home to prevent structural failure.

### 4.2.3 Wind Pressure Resistance of Windows and Doors

Ensure that windows are protected from windborne debris and are appropriately rated for wind pressure so that they are less likely to fail from wind pressures and to leak.

### 4.2.4 Wall Impact Resistance

Ensure that all exterior walls are constructed using a wall system that provides, at a minimum, the resistance to wind pressures and debris impact provided by  $\frac{7}{16}$ -in.-thick OSB wood structural panels attached to wood wall framing.

## 4.3 Options for New Construction

### 4.3.1 Continuous Load Path Development

In some of the areas subject to the highest hurricane design wind speeds, it is becoming more common to find engineers involved in the design of larger, more complex homes. For wood frame construction, which makes up the bulk of residential construction in the United States, wind design generally follows the American Wood Council's (AWC) Wood Frame Construction Manual (WFCM). The AWC has also developed prescriptive guides for buildings that fall within certain limitations for size and height that are well illustrated and much simpler to use than the base WFCM. These guides are available as free downloads from their website.

The cold-formed steel industry has also prepared a guide with prescriptive guidance for building homes with their products in hurricane-prone regions. The American Iron and Steel Institute (AISI) has published the Standard for Cold-Formed Steel Framing—Prescriptive Method For One- and Two-Family Dwellings (AISI S230).

For new homes, a design professional registered in the state where the home is located must incorporate the continuous load path in the home's design plans. Verification is required through the design professional completing and signing the Continuous Load Path Compliance Form. Elements that must be considered to qualify as an adequate continuous load path:

- Roof framing in conformance with IRC/IBC or with sound engineering practices
- Floor framing in conformance with IRC/IBC or with sound engineering practices
- Wall framing in conformance with IRC/IBC or with sound engineering practices
- Continuous load path connections:

A continuous and adequate load path from the roof to the foundation of the home must be identified and specified. The building must have positive connections from the roof to the foundation as a means of transmitting the appropriate wind uplift and lateral shear loads safely to the ground.

- ☐ Roof-to-wall connections to resist uplift and applicable shear forces must be identified.
- ☐ Wall above-to-below connections to resist cumulative uplift and applicable shear forces must be identified.
- ☐ Ground wall-to-foundation connection to resist cumulative uplift and applicable shear forces must be identified.
- ☐ Chimney framing and its connection to roof support members must be specified.

## 4.4 Options for the Continuous Load Path Retrofit of Existing Homes

### 4.4.1 Basic Requirements for the Retrofit of Existing Homes

Retrofitting an existing home structure to meet the FORTIFIED Gold requirements can be a fairly complicated undertaking that may fall outside the homeowner's budget and time constraints. Much depends on the existing condition of the home and the accessibility of the structural components requiring investigation and retrofit.

The process begins with the homeowner contracting a design professional to engage in site inspection(s) to identify the structural components that need retrofits to meet the current building code, minimum structural safety requirements, and FORTIFIED Roof, FORTIFIED Silver, and FORTIFIED Gold requirements. The following elements are to be inspected and, if found inadequate, retrofitted to bring them to a status meeting the conditions described below.

#### I. Roof Construction and Framing

- ☐ Roof framing member can be either wood trusses or rafters:
  - i. Wood engineered trusses framing:
    - ☐ Truss framing does not exceed 24 in. o.c.



- ☐ Existing truss members appear to be in sound condition and supporting appropriate roof loads:
    - a) Wood members of any truss are not deteriorated or damaged.
    - b) All truss connector plates at each joint of any truss member are in good condition.
  - ☐ Alteration and/or repair of any truss members has been fully investigated and certified by a design professional to ensure such member(s) can safely carry the appropriate gravity and uplift loads.
  - ii. Roof rafter and ceiling joist framing:
    - ☐ Roof rafter and ceiling joist member size, spacing, span, and framing shall comply with, at a minimum, IRC requirements for the appropriate lumber species and grade. Roof rafter framing shall conform to one of the following two construction methods listed in the IRC:
      - **Method 1:** Braced rafter construction
      - **Method 2:** Collar ties or ridge straps construction
        - a) Roof rafter collar ties or ridge straps to resist wind uplift shall be connected in the upper third of the attic space in accordance with IRC requirements.
    - ☐ When ceiling joists or rafter ties are not provided for a section of or an entire roof rafter framing area, the ridge formed by these rafters shall be supported by a wall or girder designed in accordance with accepted engineering practice. The gravity and uplift loads carried by these walls or girders shall be safely transmitted down to the foundation support.
  - ☐ Roof sheathing thickness and material are appropriate for the span between truss framing members to carry required loads but is not less than  $\frac{7}{16}$  in. OSB/plywood.
  - ☐ Roof sheathing is fastened to all roof framing members and along all perimeters with fastener size and spacing to sufficiently resist appropriate wind uplift pressures and horizontal shear diaphragm forces.
  - ☐ Roof framing member bearing at each support wall, beam, or column shall have a sufficient connection to resist the appropriate gravity and wind uplift forces.
  - ☐ Roof framing member bearing at top of all exterior bearing walls shall have sufficient capacity to provide lateral support to brace the wall from both positive and negative wind pressures.
  - ☐ Each roof framing member to another roof framing member intersection shall have a connection with sufficient capacity to resist both the appropriate gravity and wind uplift forces.
  - ☐ Support girders or beams shall be capable of accommodating all loads imposed.
  - ☐ Each bearing support of the girder or beam shall have a connection with sufficient capacity to resist the appropriate gravity and wind uplift forces.
- II. Wall Construction and Framing**
- ☐ Wall framing system\* shall be capable of accommodating all external loads imposed at each level of building:



\* Wall framing system can be either shear wall, moment-resisting frame, or combination.

i. Basement walls or below grade portion of any walls

- ☐ Wall framing shall resist lateral earth pressure due to “saturated” soil condition and/or lateral wind pressures on partially exposed wall portion.
- ☐ Wall framing shall have capacity to simultaneously carry gravity loads from above and resist stated lateral pressures.
- ☐ Top and bottom of the wall framing shall be mechanically fastened to structural framing members to resist lateral force due to above stated forces. For example: bottom of wall shall be fastened to the foundation and top of wall shall be fastened to a floor framing system with sufficient horizontal diaphragm capacity.
- ☐ Portion of walls in contact with soil shall be protected by water-resistant materials.

ii. Exterior bearing walls

- ☐ Wall framing system must resist all imposed loads (wind, gravity) and be capable of transmitting the resulting loads to the foundation.
  - Forces acting perpendicular to wall surface (wind pressure acting perpendicular to wall height)
  - Forces acting parallel to length of wall segment (base shear or shear diaphragm)
- ☐ Wall framing system shall be capable of supporting gravity loads from each floor framing system above plus the roof framing system and applicable lateral loads.
- ☐ Structural framing around wall opening shall be sufficient to carry above stated loads. Example: column on each side of opening, beam spanning over the opening, and the connection of beam to column at each side shall be sufficient to accommodate gravity, uplift, and applicable lateral loads.
- ☐ Top and bottom of the wall framing system shall be mechanically fastened to structural framing members to resist lateral wind pressures and uplift forces.
- ☐ Bottom of the wall framing system shall be mechanically fastened to the support structural member/system below to resist base shear forces resulting from summation of shear wall or moment-resisting system loads of all floor level(s) above plus the its current floor level.
- ☐ Wall framing system at each level shall provide sufficient lateral stability for the overall structure resulting from all applicable lateral loads.

iii. Interior bearing walls

- ☐ Interior bearing wall framing system shall resist all applicable loads imposed.





- ☐ Top of wall framing system shall provide sufficient bearing surface for roof or floor framing members and shall be connected to each supported framing members to resist applicable uplift and lateral forces.
- ☐ Bottom of wall framing system shall be properly supported by a structural framing system such as foundation, floor framing, or bearing wall. Bottom of wall framing system shall be connected to support systems below to transmit applicable gravity, uplift, and lateral forces to support system below.

### **III. Floor Construction and Framing**

- ☐ The floor framing system must support all applicable IRC live loads, all imposed dead loads, plus any interior bearing walls or columns resting on it.
- ☐ Floor framing systems shall resist horizontal shear diaphragm resulting from applicable lateral forces.
- ☐ Floor framing system shall be properly supported and sufficiently connected to safely transmit all applicable gravity, uplift, and lateral forces to structural support system below.

### **IV. Continuous Load Path Verification**

A continuous and adequate load path from the roof to the foundation of the home must exist. The building must have positive connection from the roof to foundation as a means to transmit wind uplift and lateral shear loads safely to the ground. This includes providing roof-to-wall connection hardware with required uplift and shear resistance as determined by the professional designer.

- ☐ Roof-to-wall connections shall resist uplift and applicable shear forces.
- ☐ Wall above-to-below shall have sufficient connection to resist cumulative uplift and shear forces.
- ☐ Ground wall-to-foundation connection must resist cumulative uplift and shear forces.

### **V. Foundation Support System Verification**

- ☐ Existing foundation support system must resist gravity loads, uplift, and lateral shear forces to provide building stability.

Verification of the continuous load path requirement for a FORTIFIED Gold designation is accomplished through completion of Continuous Load Path Compliance Forms by a registered design professional. Both Continuous Load Path Compliance Forms (the engineering form indicating that the connections meet the load requirements and the installation form indicating that the appropriate connections are installed) must be completed by the design professional.

## 4.4.2 Securing Chimneys

Chimney framing that extends above the roof deck must be properly anchored to prevent the chimney from collapsing during high winds. Chimney collapse can lead to interior water intrusion and damage, as well as damage to other structures in the area. A prescriptive retrofit measure for strengthening chimneys located within the interior of the roof extending less than 5 ft above the roof deck is provided. Chimneys that extend greater than 5 ft above the roof deck or that are located along the edge of the roof are beyond the scope of the prescriptive strengthening solution and require engineering review and detailing by a professional engineer.

### Prescriptive Retrofit Description

Chimney structures are vulnerable when the vertical framing members are just nailed to the top of roof deck without adequate anchorage to roof members below. A prescriptive solution for strengthening a chimney structure with this condition is outlined below. See Figure 4-1 for illustrative details.

For strengthening chimneys extending 5 ft or less above the roof that are located within the interior of the roof:

1. Each corner of the chimney structure must have a tension strap that is fastened to the corner stud and continues downward to the roof support members below. The tension strap must have a minimum tension capacity of 700 lb at each end.
2. The chimney framing shall be sheathed with minimum  $\frac{7}{16}$ -in. structural panel on exterior four sides.
3. The base perimeters of chimney framing must be continuously supported by minimum 2- x 4-in. blocking fastened to roof framing members with joist hangers.

### When the Chimney Does Not Fit the Limitations

Chimney framing that extends greater than 5 ft above the roof and/or is located along the edge of building requires evaluation and detailing by a licensed professional structural engineer.

The licensed professional engineer should provide detailing similar to Figure 4-1. The engineered details must incorporate the following design parameters:

1. Chimney wall framing adequacy.
2. Overall over-turning stability and base shear requirement.
3. Roof support members adequacy and bracing requirement.
4. Specific attachment schedule of chimney structure to the existing structure.

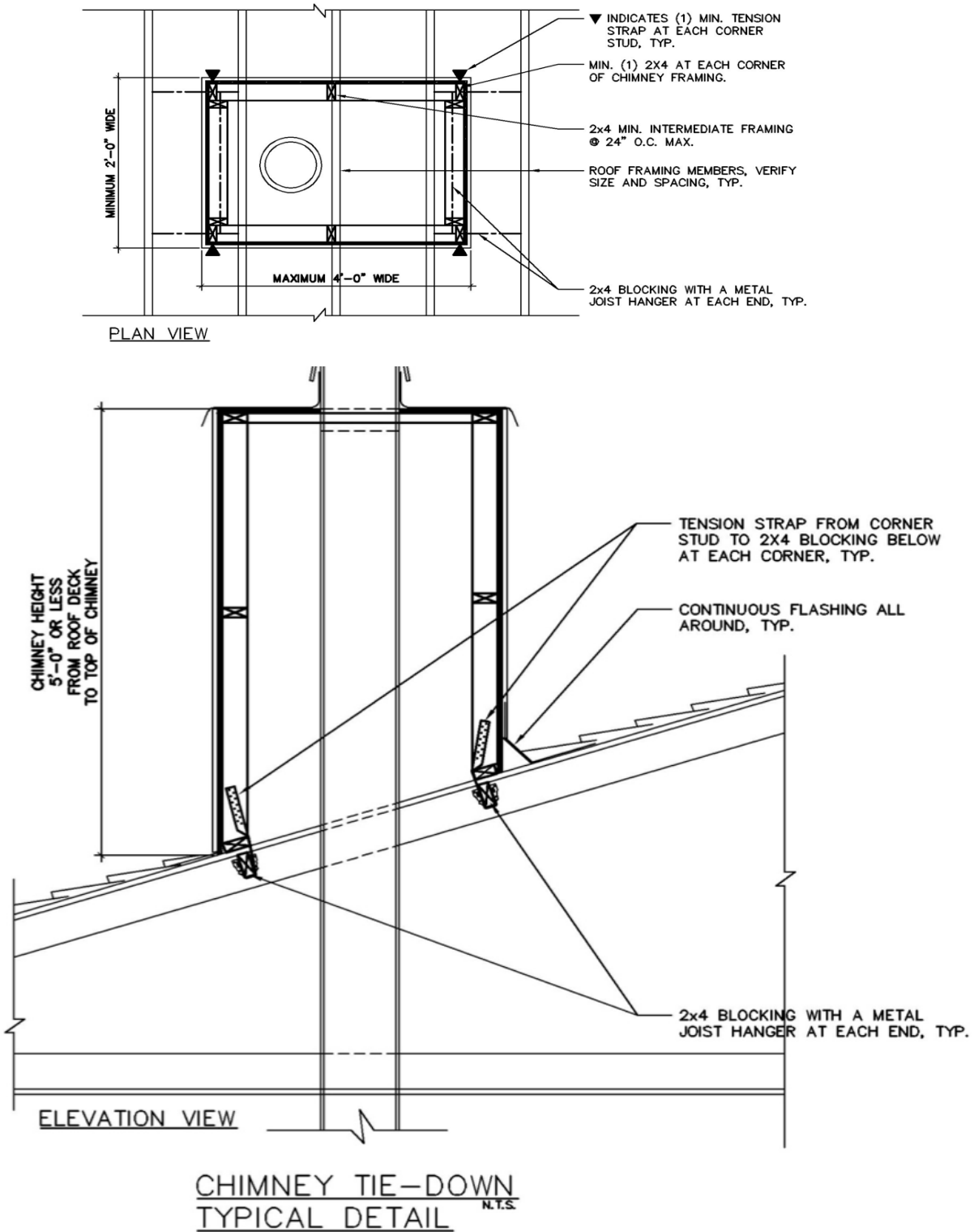


Figure 4-1. Typical tie-down for chimney framing.

### 4.4.3 Windows and Doors

Most shutter systems have gaps that are large enough to allow the hurricane-induced external pressures to build up on the windows and doors being protected. There have been numerous cases where windows or doors have failed due to wind pressure despite the fact that they were protected by shutters.

For the FORTIFIED Silver designation, it is sufficient to protect windows and doors to prevent pressurization of the house. For the FORTIFIED Gold designation, however, design pressure ratings for all windows and doors must meet the design wind pressures for the location and exposure (see Appendix C for design pressures).

If the existing windows and doors do not meet the appropriate design pressure requirements, they must be replaced with units that do. In addition, the windows and doors must be protected from windborne debris by either being impact rated or being protected by an impact-rated protective system (as required for FORTIFIED Silver designation).

#### Acceptable Pressure Ratings

**Windows, skylights, glass blocks, and glass doors:** Windows and glass doors must be rated for the design pressures appropriate for the exposure category, wind speed, window size, and window location on the building (see Appendix C). Products must be tested, at a minimum, in accordance with International Residential Code (IRC) accepted standards (or with locally adopted standards if they are more restrictive) and installed in accordance with the manufacturer's instructions. Acceptable International Residential Code (IRC) design pressure test standards for windows and glass doors include AAMA/WDMA/CSA 101/I.S.2/A440, ASTM E330 (products must be tested to 1.5 times design pressure). The Florida Building Code Testing Application Standard TAS 202 is also acceptable for the FORTIFIED program.

**Entry doors:** Entry doors must be tested and approved in accordance with, at a minimum, International Residential Code (IRC) design pressure test standards (or with locally adopted standards if they are more restrictive). Acceptable IRC design pressure test standards include AAMA/WDMA/CSA 101/I.S.2/A440 and ASTM E330 (products must be tested to 1.5 times design pressure). The Florida Building Code Testing Application Standard TAS 202 is also acceptable for the FORTIFIED program.

**Garage doors:** Garage doors must be tested and approved in accordance with, at a minimum, International Residential Code (IRC) accepted design pressure test standards (or with locally adopted standards if they are more restrictive). Acceptable IRC design pressure test standards include ANSI/DASMA 108 or ASTM E330 (products must be tested to 1.5 times design pressure). The Florida Building Code Testing Application Standard TAS 202 is also acceptable for the FORTIFIED program. All installations must be in accordance with the manufacturer's instructions.

## 5 Appendices

### 5.1 Appendix A: Gable End Wall Bracing Retrofit

#### Introduction

Gable ends are those upper triangular walls that rest on rectangular walls. They don't have horizontal eaves. The triangles may be of various proportions and may be triangles with a section cutoff. Figures 1 through 6 show a variety of gable ends. The only gable ends for which retrofitting is addressed in this guide are those that include an attic. It does not address gable end walls where the room behind the wall has a cathedral or vaulted ceiling. Gable ends taller than 4 ft but shorter than 16 ft are the ones that can to be retrofitted with prescriptive method under this section.



Figure 1. House with large and small gable ends.



Figure 2. Large gable at end with partially exposed gable where house is wider.



Figure 3. Gable end with attached chimney.



Figure 4. Cut-off gable over garage with covered entry to side.





Figure 5. Gable end with intersecting shed roof.



Figure 6. Gable end over garage and living area.

**Wind Forces on Gable Ends:** Hurricane wind force both push (inward acting) and pull (outward acting) on houses. It is critical to brace the gable end in both directions. It is prudent to retrofit the largest gable ends and work down towards the smaller ones.

**Typical Traditional Construction Practices:** Gable end walls were not necessarily built to withstand the pressures that hurricanes can impose. Gable ends in some instances may not have structural wall sheathing; in such case, existing exterior material must be removed and replaced with structural sheathing (minimum of  $\frac{7}{16}$ -in. plywood or OSB or equivalent.)

**Types of Failures:** Basically there are three things to be concerned about with gable end walls.

1. First, the most common type of failure is loss of roof sheathing from the gable end that results in the gable wall losing its bracing along the top edge. This type of failure is shown in Figure 7.
2. The second most common type of gable end failure is at the connection between the rectangular and triangular walls as shown in Figure 8 and 9.
3. The third potential weak link is the actual framing members that make up the gable end wall structure. In many houses, these members may be a truss or 2x lumber framing.





Figure 7. The most common gable end failure is one where the wall loses support along its top edge because sheathing is blown off. The wall may fold outward or be blown inward.



Figure 8. The second most common type of gable end failure is at the connection between the rectangular and triangular walls. Here the failure is just starting.



Figure 9. The more usual result of wall connection failures is a missing gable end wall and the wall below.

**Gable Ends Not Covered in this Retrofit Guide:** Gable end walls on rooms with vaulted or cathedral ceilings, while common (particularly when facing the coast or water), pose special problems for retrofitting. Unless care was taken in the design and construction of these walls to provide the kind of bracing they need to stand up to strong winds, they are very likely to fail. The structural solutions usually involve beams that either span across the width of the wall or columns that span from floor to ceiling.

Gable ends taller than 16 ft and/or have irregular shape must require a licensed engineer to investigate to derive bracing requirement to meet the appropriate local wind forces.

## SECTION A101 GENERAL

**A101.1 Intent and purpose.** The provisions of this subsection provide prescriptive solutions for the retrofitting of gable ends of buildings. The retrofit measures are not intended to provide strengthening of buildings equal to the structural provisions of the latest building code requirements for new buildings. Design for compliance of new buildings and additions to existing buildings shall conform to the requirements of the appropriate adopted local building code.

**A101.2 Scope.** The following prescriptive methods are intended for applications where the gable end wall framing is provided by a wood gable end wall truss or a conventionally framed rafter system. The retrofits are appropriate for wall studs oriented with their broad face parallel to or perpendicular to the gable wall surface. An overview perspective drawing of the retrofit is shown in Figure A104.1.

## SECTION A102 DEFINITIONS

**ANCHOR BLOCK.** A nominal 2-in.-thick by at least 4-in.-wide piece of lumber secured to horizontal braces and filling the gap between existing framing members for the purpose of restraining horizontal braces from movement perpendicular to the framing members.

**COMPRESSION BLOCK.** A nominal 2-in.-thick by at least 4-in.-wide piece of lumber used to restrain in the compression mode (force directed towards the interior of the attic) an existing or retrofit stud. It is attached to a horizontal brace and bears directly against the existing or retrofit stud.

**CONVENTIONALLY FRAMED GABLE END.** A conventionally framed gable end with studs whose faces are perpendicular to the gable end wall.

**HORIZONTAL BRACE.** A nominal 2-in.-thick by at least 4-in.-wide piece of lumber used to restrain both compression and tension loads applied by a retrofit stud. It is typically installed horizontally on the top of floor framing members (truss bottom chords or ceiling joists) or on the bottom of pitched roof framing members (truss top chord or rafters).

**RETROFIT STUD.** A nominal 2-in. lumber member used to structurally supplement an existing gable end wall stud.

**RIGHT ANGLE GUSSET BRACKET.** A 14 gage or thicker metal right angle bracket with a minimum load capacity perpendicular to the plane of either face of 350 lb when connected to wood or concrete with manufacturer-specified connectors.

**STUD-TO-PLATE CONNECTOR.** A manufactured metal connector designed to connect studs to plates with a minimum uplift capacity of 500 lb.

**TRUSS GABLE END.** An engineered factory-made truss or site-built truss that incorporates factory-installed or field-installed vertical studs with their faces parallel to the plane of the truss

and spaced no greater than 24 in. o.c. Web or other diagonal members other than top chords may or may not be present. Gable end trusses may be of the same height as nearby trusses or may be drop chord trusses in which the top chord of the truss is lower by the depth of the top chord or outlookers.

## SECTION A103 MATERIALS OF CONSTRUCTION

**A103.1 Existing materials.** All existing wood materials that will be part of the retrofitting work (trusses, rafters, ceiling joists, top plates, wall studs, etc.) shall be in sound condition and free from defects or damage that substantially reduce the load-carrying capacity of the member. Any wood materials found to be damaged or deteriorated shall be strengthened or replaced with new materials to provide a net dimension of sound wood equivalent to its undamaged original dimensions.

**A103.2 New Materials.** All materials approved by this code, including their appropriate allowable stresses, shall be permitted to meet the requirements of this chapter.

**A103.3 Dimensional Lumber.** All dimensional lumber for braces, studs, and blocking shall conform to applicable standards or grading rules. Dimensional lumber shall be identified by a grade mark of a lumber grading or inspection agency that has been approved by an accreditation body that complies with DOC PS 20. All new dimensional lumber to be used for retrofitting purposes shall be a minimum grade and species of #2 spruce-pine-fir or shall have a specific gravity of 0.42 or greater. In lieu of a grade mark, a certificate of inspection issued by a lumber grading or inspection agency meeting the requirements of this code shall be accepted.

**A103.4 Metal Plate Connectors, Straps, and Anchors.** Metal plate connectors, straps, and anchors shall have product approval. They shall be approved for connecting wood-to-wood or wood-to-concrete as appropriate. Straps and tie plates shall be manufactured from galvanized steel with a minimum thickness provided by 20 gauge. Tie plates shall have holes sized for 8d nails.

**A103.5 Twists in straps.** Straps shall be permitted to be twisted 90 degrees in addition to a 90-degree bend where they transition between framing members or connection points.

**A103.6 Fasteners.** Fasteners meeting the requirements of Sections A103.6.1 and A103.6.2 shall be used and shall be permitted to be screws or nails meeting the minimum length requirement shown in figures and specified in tables.

**A103.6.1 Screws.** Screws shall be a minimum #8 size with head diameters no less than 0.3 in. Screw lengths shall be no less than indicated in the Figures and in Tables. Permissible screws include deck screws, wood screws, or sheet metal screws (without drill bit-type tip, but can be sharp pointed). Screws shall have at least 1 in. of thread. Fine threaded screws or drywall screws shall not be permitted. Note that many straps will not accommodate screws larger than #8.





**A103.6.2 Nails.** Unless otherwise indicated in the provisions or drawings, where fastener lengths are indicated in Figures and Tables as 1¼ in., 8d common nails with shank diameter 0.131 in. and head diameters no less than 0.3 in. shall be permitted. Unless otherwise indicated in the provisions or drawings, where fasteners lengths are indicated in Figures and Tables as 3 in., 10d common nails with shank diameter of 0.148 in. and head diameters no less than 0.3 in. shall be permitted.

**A103.7 Fastener spacing.** Fastener spacing shall be as follows:

- a) Distance between fasteners and the edge of lumber shall be a minimum of ½ in. unless otherwise indicated.
- b) Distance between fasteners and the end of lumber shall be a minimum of 2½ in.
- c) Distance between fasteners parallel to grain (center-to-center) when straps are not used shall be a minimum of 2½ in. unless a ½-in. stagger (perpendicular to the grain) is applied for adjacent fasteners, then the distance between fasteners parallel to the grain shall be a minimum of 1¼ in.
- d) Distance between fasteners across grain (row spacing) when straps are not used shall be a minimum of 1 in.
- e) Distance between fasteners inserted in metal plate connectors, straps, and anchors as defined in Section A103.4 shall be those provided by holes manufactured into the straps.

## SECTION A104 RETROFITTING GABLE END WALLS

**A104.1 Scope and intent.** Gable ends to be strengthened shall be permitted to be retrofitted using methods prescribed by provisions of this section. These prescriptive methods of retrofitting are intended to increase the resistance of existing gable end wall construction for out-of-plane wind loads resulting from high-wind events. The retrofit method addresses four issues. These include strengthening the framing members of the walls if necessary (retrofit studs), bracing the top and bottom of the gable wall so that lateral loads are transmitted into the roof and ceiling diaphragms (horizontal braces, straps to retrofit studs and compression blocks) and connecting the bottom of the gable end wall to the wall below to help brace the top of that wall (specialty metal brackets).

The following prescriptive methods are intended for applications where the gable end wall framing is provided by a wood gable end wall truss or a conventionally framed rafter system. The retrofits are appropriate for wall studs oriented with their broad face parallel to or perpendicular to the gable wall surface. An overview perspective drawing of the retrofit is shown in Figure A104.1.

**A104.2 Horizontal Braces.** Horizontal braces shall be installed approximately perpendicular to the top and bottom chords of the existing roof trusses or approximately perpendicular to the rafters and ceiling joists at the location of each existing gable end wall stud greater than 3 ft in length. If the spacing of existing gable end studs is greater than 24 in. or no vertical gable end stud is present, a stud and horizontal braces shall be installed such that the maximum spacing between existing and added studs shall be 24 in. Additional gable end wall studs shall not be required at locations where their length would be 3 ft or less. Each required added stud shall be attached to the existing roofing framing members (truss top chord or rafter and truss bottom



chord or ceiling joist) using a minimum of two (2) 3-in. toenail fasteners (#8 wood screws or 10d nails) and a metal connector or mending plate with a minimum of four (4) 1¼-in.-long fasteners (#8 wood screws or 8d nails) at each end. The horizontal braces shall consist of the minimum size member indicated in Table A104.2. The horizontal brace shall be oriented with their long face across the top and bottom chords of the wood trusses (or rafters and ceiling joists) and extend a minimum of three framing spacings from the gable end wall plus 2½ in. beyond the last top chord or bottom chord member (rafter or ceiling joist) as shown in Figure A104.2.1 (and A104.2.6). The horizontal brace shall be located no farther than ½ in. from the inside face of the gable end wall truss. Each horizontal brace shall be fastened to each existing framing member (top chord or rafter or bottom chord or ceiling joist) that it crosses using three (3) 3-in.-long fasteners (#8 wood screws or 10d nails) as indicated in Figures A104.2.2 through A104.2.5 for trusses (and Figures A104.2.7 through A104.2.10 for rafters).

### Exceptions

1. Where obstructions, other permanently attached obstacles or conditions exist that will not permit installation of new horizontal braces at the indicated locations, refer to Section A104.5 for permitted modification of these prescriptive retrofit methods.
2. Where obstructions, other permanently attached obstacles or conditions exist that will not permit extension of the new horizontal braces across the existing framing members a minimum of three (3) framing spaces from the gable end wall, the horizontal braces may be shortened provided that all of the following conditions are met.
  - a. The horizontal brace shall be installed across a minimum of two (2) framing spaces and fastened to each existing framing member with three (3) 3-in.-long fasteners (#8 wood screws or 10d nails).
  - b. The minimum size of the anchor block shall be equivalent to the existing framing members. The anchor block shall be fastened to the side of the horizontal brace in the second framing space from the gable end wall as shown in Figure A104.2.11. Six (6) 3-in.-long fasteners (#8 wood screws or 10d nails) shall be used to fasten the anchor block to the side of the horizontal brace.
  - c. The anchor block shall extend beyond the surface of the horizontal brace that is in contact with the existing framing members a minimum of one-half the depth of the existing framing member. The anchor block shall be installed tightly between the existing framing members such that the gap at either end shall not exceed 1/8 in.

**A104.3 Retrofit Studs.** The retrofit studs shall consist of the minimum size members for the height ranges of the existing vertical gable end wall studs indicated in Table A104.2. Retrofit studs shall be installed adjacent to the existing or added (Section A104.2) vertical gable end wall studs and extend from the top of the lower horizontal brace to the bottom of the upper horizontal brace. A maximum gap of 1/8 in. shall be permitted between the retrofit stud and the bottom horizontal brace. A maximum gap of 1/2 in. shall be permitted between the top edge of the retrofit stud closest to the upper horizontal brace and the horizontal brace surface.



### Exception

Where obstructions, other permanently attached obstacles or conditions exist that will not permit the installation of a new retrofit stud adjacent to an existing gable end wall stud, refer to Section A104.5 for permitted modification of these prescriptive retrofit methods.

**A104.3.1 Retrofit Stud Fastening.** Each retrofit stud shall be fastened to the top and bottom horizontal brace members with a minimum of a 20 gauge, 1¼-in.-wide flat metal strap with pre-punched fastener holes. The flat metal straps shall be the minimum length as indicated in Table A104.2. Each top and bottom strap shall extend sufficient distance onto the vertical face of the retrofit stud and be fastened with the number of 1¼-in.-long fasteners (#8 wood screws or 8d nails) indicated in Table A104.2. Each strap shall be fastened to the top and bottom horizontal brace members with the minimum number of 1¼-in.-long fasteners (#8 wood screws or 8d nails) as indicated in Table A104.2. The retrofit stud members shall also be fastened to the side of the existing vertical gable end wall studs with 3-in.-long fasteners (#8 wood screws or 10d nails) spaced at 6 in. o.c. as shown in Figure A104.2.1.

**A104.3.2 Retrofit Stud Splices.** Retrofit studs greater than 8 ft in height may be field spliced as shown in Figure A104.3.

**A104.4 Compression Blocks.** Compression blocks shall have minimum lengths as indicated in Table A104.2. Compression blocks shall be installed on the horizontal braces directly against either the existing vertical gable end wall stud or the retrofit stud. For clarity, Figures A104.2.2 through A104.2.5 (trusses) and Figures A104.2.7 through A104.2.10 (rafters) show the installation of the compression block against the existing vertical gable end wall stud with the strap from the retrofit stud running beside the compression block. When the compression block is installed against the retrofit stud, the block shall be allowed to be placed on top of the strap. A maximum gap between the compression block and the existing vertical gable end wall stud member or retrofit stud of ¼ in. shall be permitted. Compression blocks shall be fastened to the horizontal braces with the minimum number of 3-in.-long fasteners (#8 wood screws or 10d nails). End and edge distances for fastener installation shall be as listed in Section A103.7 and shown in Figures A104.2.2 through A104.2.5 (trusses) and Figures A104.2.7 through A104.2.10 (rafters).

### A104.5 Obstructions – Permissible modifications to prescriptive gable end retrofits.

Where obstructions, other permanently attached obstacles or conditions exist in attics that preclude the installation of a retrofit stud or horizontal braces in accordance with Sections A104.2 or A104.3, the gable end retrofit shall be deemed to meet the requirements of this section if the requirements of Section A104.5.1 are met. Obstructions to the installation of retrofit studs or horizontal braces include gable end vents, attic accesses, recessed lights, skylight shafts, chimneys, air conditioning ducts, or equipment. Where the installation of a horizontal brace for the top of a center stud is obstructed by truss plates near the roof peak, methods prescribed in A104.5.1 are permitted to be used, or retrofit ridge ties as prescribed in Section A104.5.2 are permitted to be used to support the horizontal brace.

**A104.5.1 Remedial measures where obstacles prevent installation of retrofit studs or horizontal braces.** If a retrofit stud or horizontal brace cannot be installed because of an obstruction, the entire assembly can be omitted from that location provided all of the following conditions are met.

1. No more than two (2) assemblies of retrofit studs and horizontal braces are omitted on a single gable end.
2. There shall be at least two (2) retrofit studs and horizontal brace assemblies on either side of the locations where the retrofit studs and horizontal bracing members are omitted (no two ladder braces bearing on a single retrofit stud).
3. The retrofit studs on each side of the omitted retrofit stud are increased to the next indicated member size in Table A104.2 and fastened as indicated in Section A104.3.1.
4. The horizontal bracing members on each side of the omitted brace shall be sized in accordance with Table A104.2 for the required retrofit studs at these locations.
5. The horizontal bracing members on each side of the omitted brace shall extend a minimum of three (3) framing spaces from the gable end wall unless anchor blocks are installed in accordance with Exception 2 of Section A104.2.
6. Ladder bracing is provided across the location of the omitted retrofit studs as indicated in Figures A104.5.1.1 (trusses) and A104.5.1.2 (rafters).
7. Ladder bracing shall consist of a minimum 2- x 4-in. members oriented horizontally and spaced at 12 in. o.c. vertically. Ladder bracing shall be attached to each adjacent retrofit stud with a metal framing angle with a minimum lateral capacity of 175 lb. Ladder bracing shall be attached to the existing stud at the location of the omitted retrofit stud with a metal hurricane tie with a minimum capacity of 175 lb.
8. Where ladder bracing spans across a gable end vent, no attachment to the gable end vent framing shall be required.
9. Notching of the ladder bracing shall not be permitted.

**A104.5.2 Retrofit ridge ties.** When obstructions along the ridge of the roof obstruct the installation of a horizontal brace for one or more studs near the middle of the gable wall, retrofit ridge ties may be used to provide support for the required horizontal brace. Retrofit ridge tie members shall be installed a maximum of 12 in. below the existing ridge line. The retrofit ridge tie members shall be installed across a minimum of three (3) bays to permit fastening of the horizontal brace. A minimum of a 2- x 4-in. member shall be used for each ridge tie and fastening shall consist of two (2) 3-in.-long wood screws, four (4) 3-in.-long 10d nails, or two (2) 3½-in.-long 16d nails driven through and clinched at each top chord or web member intersected by the ridge tie as illustrated in Figure A104.5.2.

**A104.5.3 Notching of retrofit studs.** Retrofit studs may be notched in one location along the height of the stud member provided that all of the following conditions are met.

1. The retrofit stud to be notched shall be sized such that the remaining depth of the member at the location of the notch (including cut lines) shall not be less than that required by Table A104.2.



2. The notched retrofit stud shall not be spliced within 12 in. of the location of the notch. The splicing member shall not be notched and shall be installed as indicated in Figure A104.3.
3. The length of the flat metal straps indicated in Table A104.2 shall be increased by the increased depth of the notched retrofit stud member to be installed.
4. The height of the notch shall not exceed 12 in. vertically as measured at the depth of the notch.
5. The notched retrofit stud member shall be fastened to the side of the existing gable end wall studs in accordance with Section A104.3.1. Two (2) additional 3-in. fasteners (#8 wood screws or 10d nails) shall be installed on each side of the notch in addition to those required by Section A104.3.1.

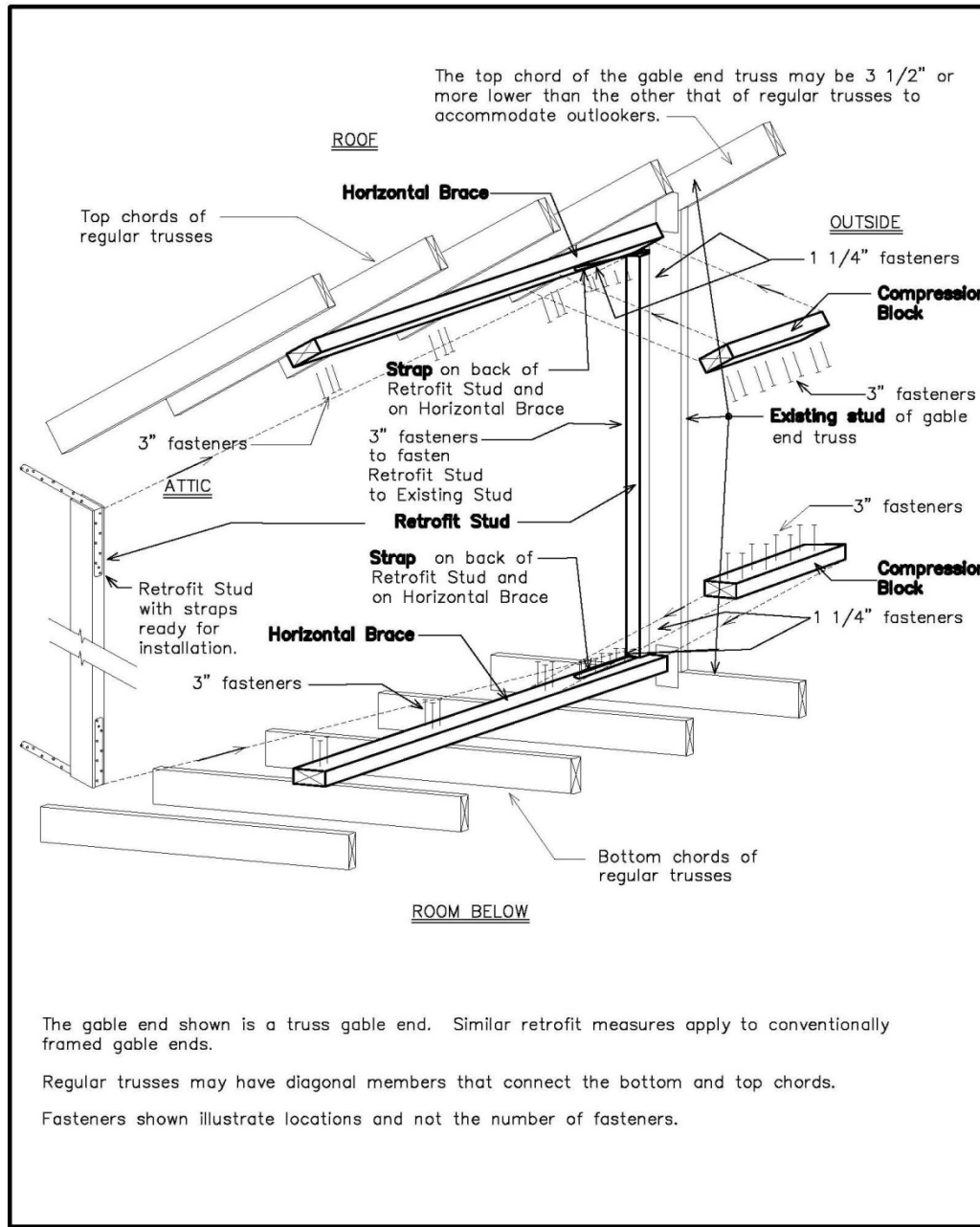
**A104.6 Connection of gable end wall to wall below.** The bottom chords or bottom members of wood framed gable end walls shall be attached to the wall below using one of the methods prescribed in Sections A104.6.1 or A104.6.2. The particular method chosen shall correspond to the framing system and type of wall construction encountered. Due to access considerations, this retrofit needs to be carried out before any of the other gable end retrofit activities referenced in Sections A104.2, A104.3, A104.4 or A104.5.

**A104.6.1 Truss gable end wall.** The bottom chords of the gable end wall shall be attached to the wall below using right angle gusset brackets consisting of 14 gage or thicker material with a minimum load capacity of 350 lb perpendicular to the plane of either face of the connector. The right-angle gusset brackets shall be installed throughout the portion of the gable end where the gable end wall height is greater than 3 ft at the spacing specified in Table A104.6. A minimum of two (2) of the fasteners specified by the manufacturer shall engage the body of the bottom chord. Connection to the wall below shall be by one of the methods listed below:

1. For a wood frame wall below, the two (2) fasteners into the top of the wall below that are closest to the face of the gable end bottom chord shall be 4½ in. long and of the same diameter and style specified by the bracket manufacturer. Other fasteners shall be consistent with the bracket manufacturer's specifications for size, style, and length.
2. For a concrete or masonry wall below without a sill plate, the fasteners into the wall shall be consistent with the bracket manufacturer's specifications for fasteners installed in concrete or masonry.
3. For a concrete or masonry wall below with a 2x sill plate, the fasteners into the wall below shall be of the diameter and style specified by the bracket manufacturer for concrete or masonry connections, but long enough to pass through the wood sill plate and provide the required embedment into the concrete or masonry below. Alternatively, the bracket can be anchored to the sill plate using fasteners consistent with the bracket manufacturer's specifications for wood connections provided, the sill plate is anchored to the wall on each side of the bracket by a ¼-in. diameter masonry screw with a 2½-in. embedment into the concrete or masonry wall. ¼-in. washers shall be placed under the heads of the masonry screws.

**A104.6.2 Conventionally framed gable end wall.** Each stud in a conventionally framed gable end wall, throughout the length of the gable end wall where the wall height is greater than 3 ft, shall be attached to the bottom or sill plate using a stud-to-plate connector. The bottom or sill plate shall then be connected to the wall below using one of the methods listed below:

1. For a wood frame wall below, the sill or bottom plate shall be connected to the top plates below using  $\frac{1}{4}$ -in.-diameter screws  $4\frac{1}{2}$  in. long. The fasteners shall be installed at the spacing indicated in Table A104.6.
2. For a concrete or masonry wall below, the sill or bottom plate shall be connected to the concrete or masonry wall below using  $\frac{1}{4}$ -in.-diameter concrete or masonry screws of sufficient length to provide a  $2\frac{1}{2}$ -in. embedment into the top of the concrete or masonry wall. The fasteners shall be installed at the spacing indicated in Table A104.6.



The gable end shown is a truss gable end. Similar retrofit measures apply to conventionally framed gable ends.

Regular trusses may have diagonal members that connect the bottom and top chords.

Fasteners shown illustrate locations and not the number of fasteners.

Figure A104.1. Overall sketch showing the concept for strengthening and bracing a gable end wall.

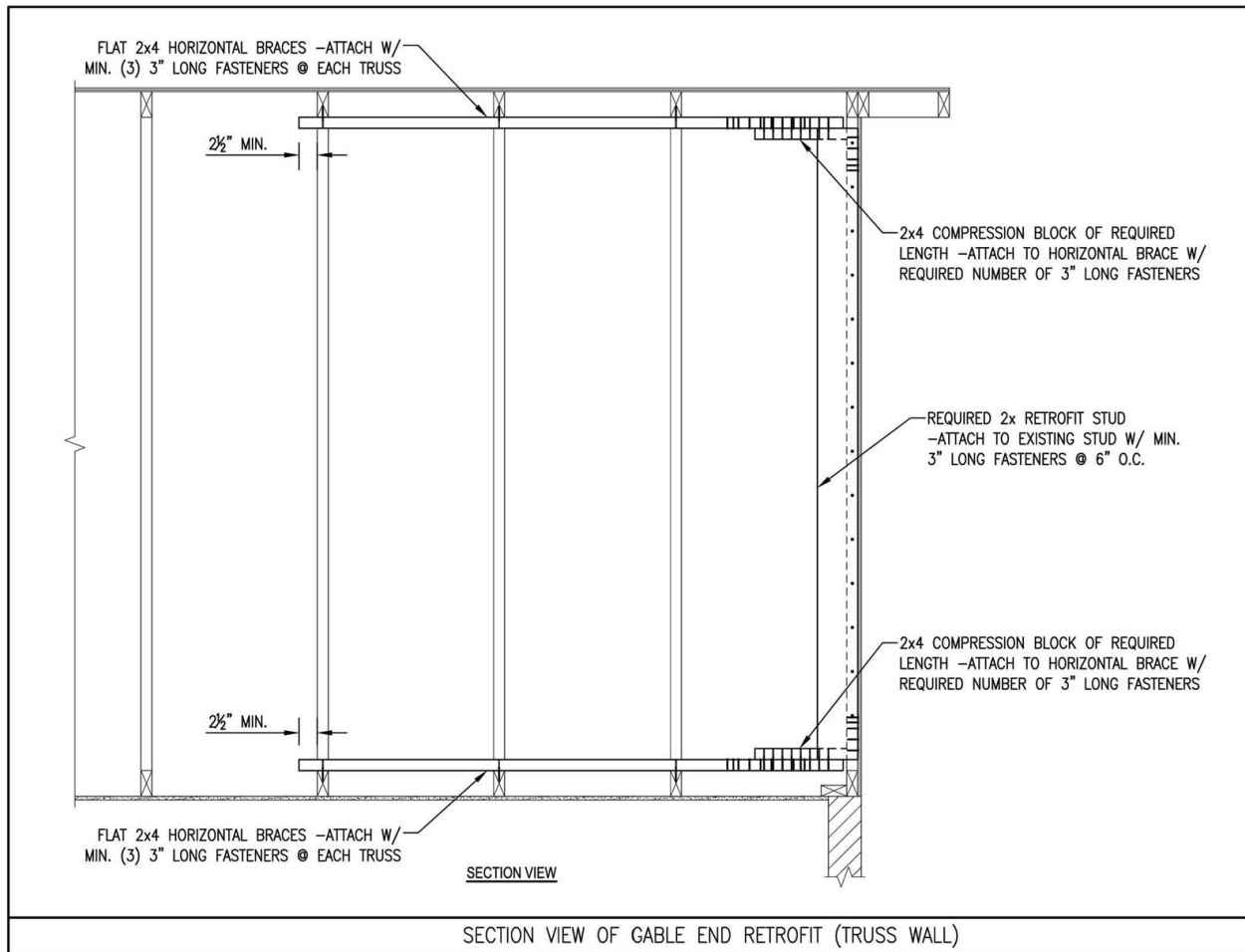


Figure A104.2.1. Gable end retrofit components and connections.



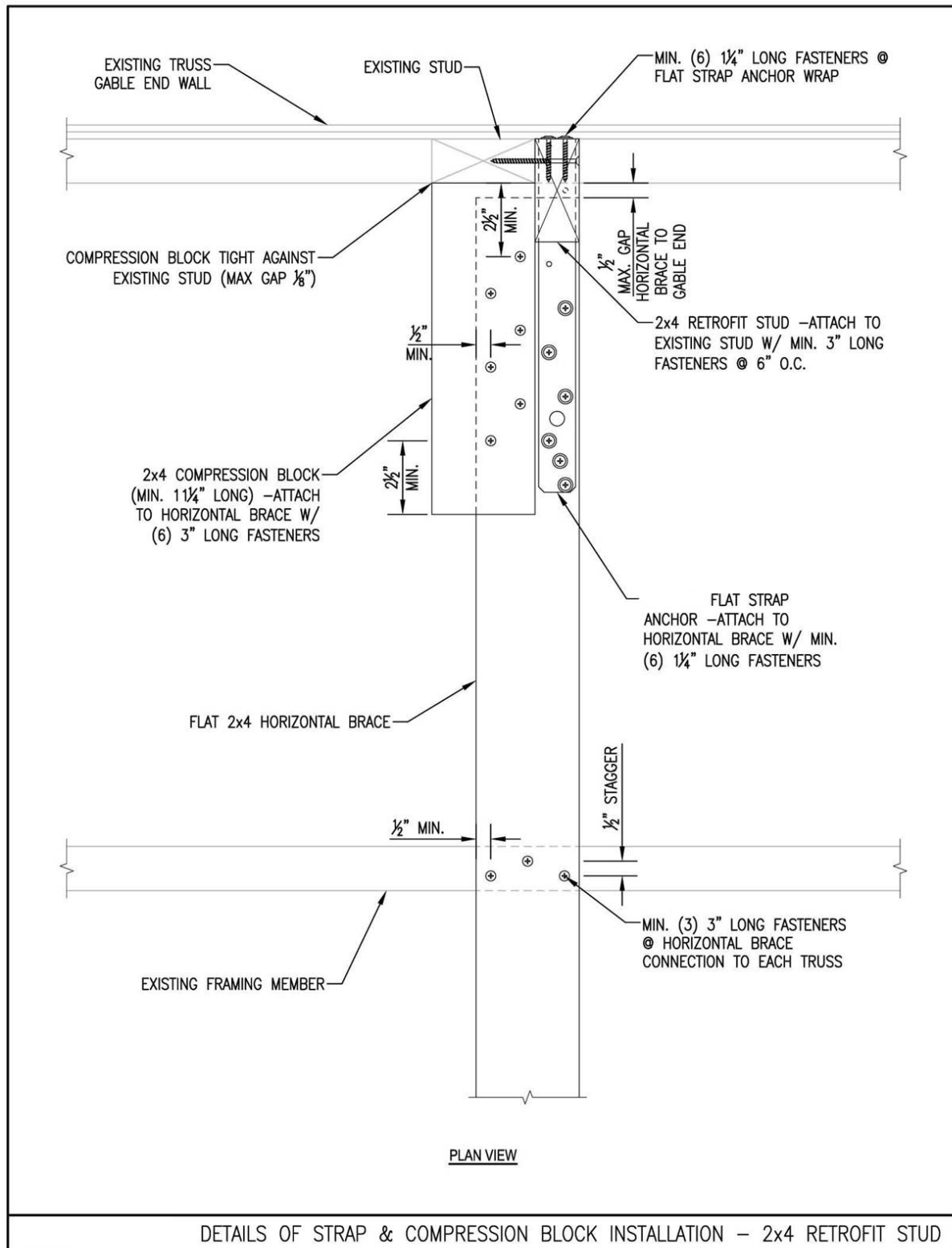


Figure A104.2.2. Details Of Strap & Compression Block Installation – 2x4 Retrofit Stud.

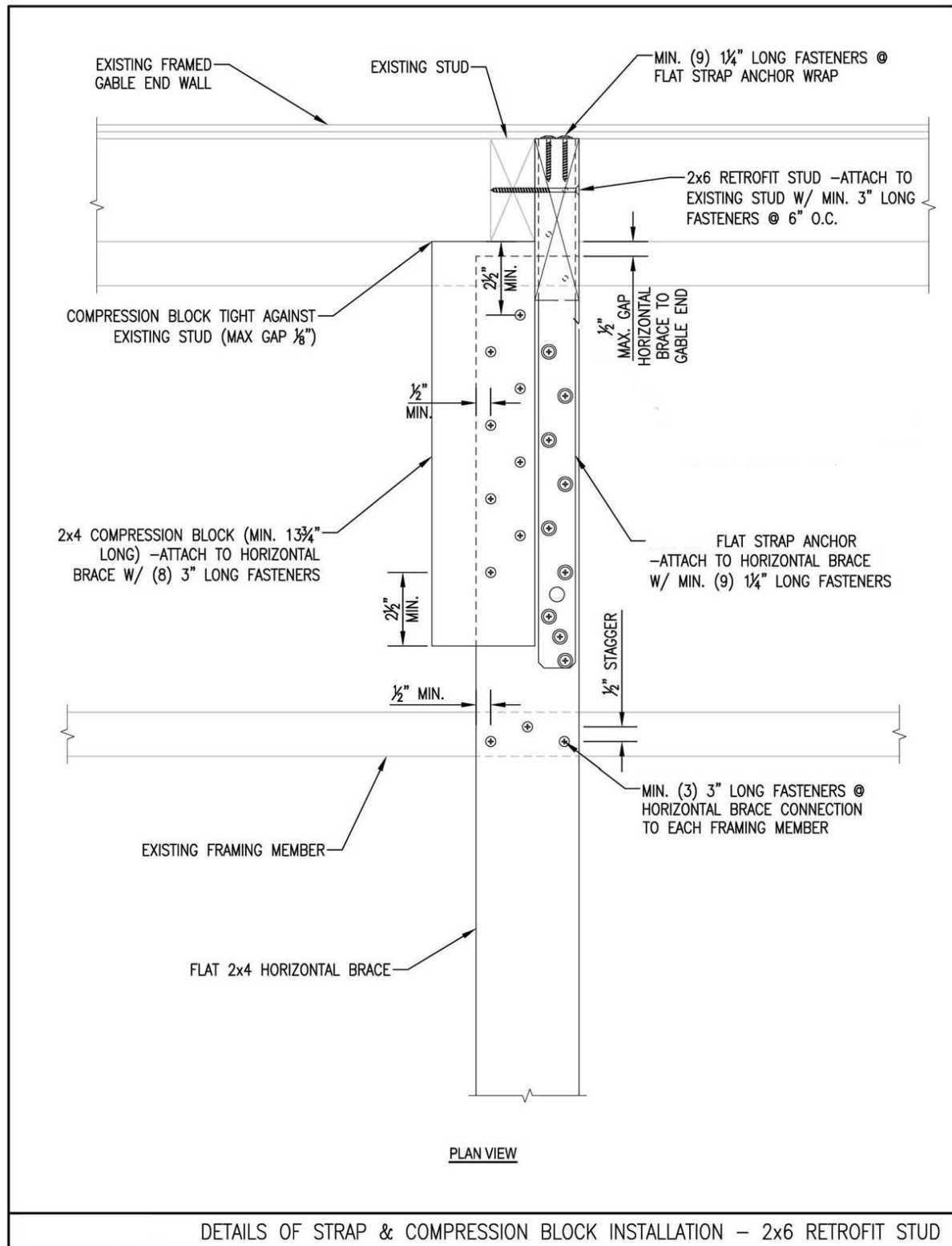


Figure A104.2.3. Details of strap and compression block installation – 2x6 retrofit stud.

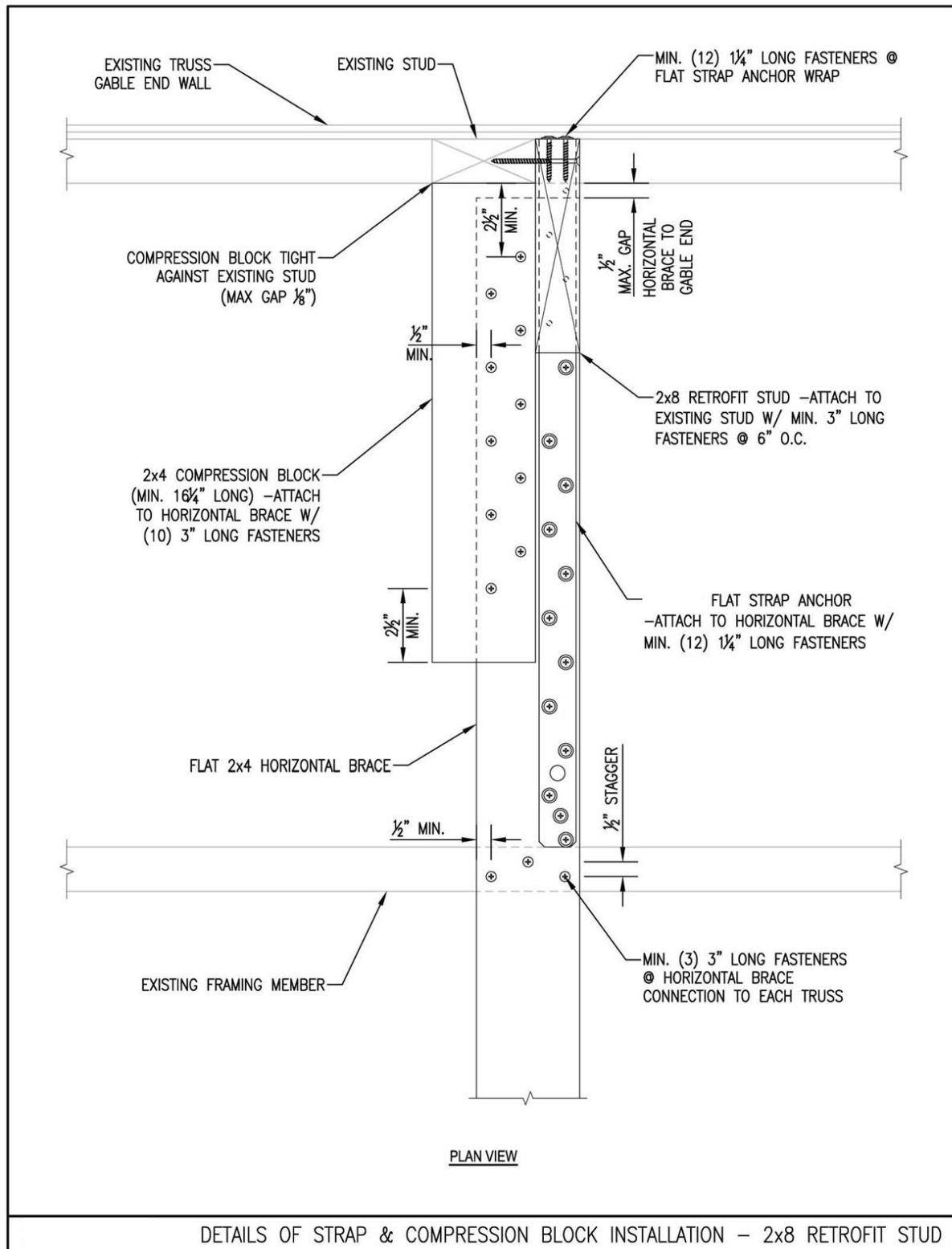


Figure A104.2.4 Details of strap and compression block installation - 2x8 retrofit stud.

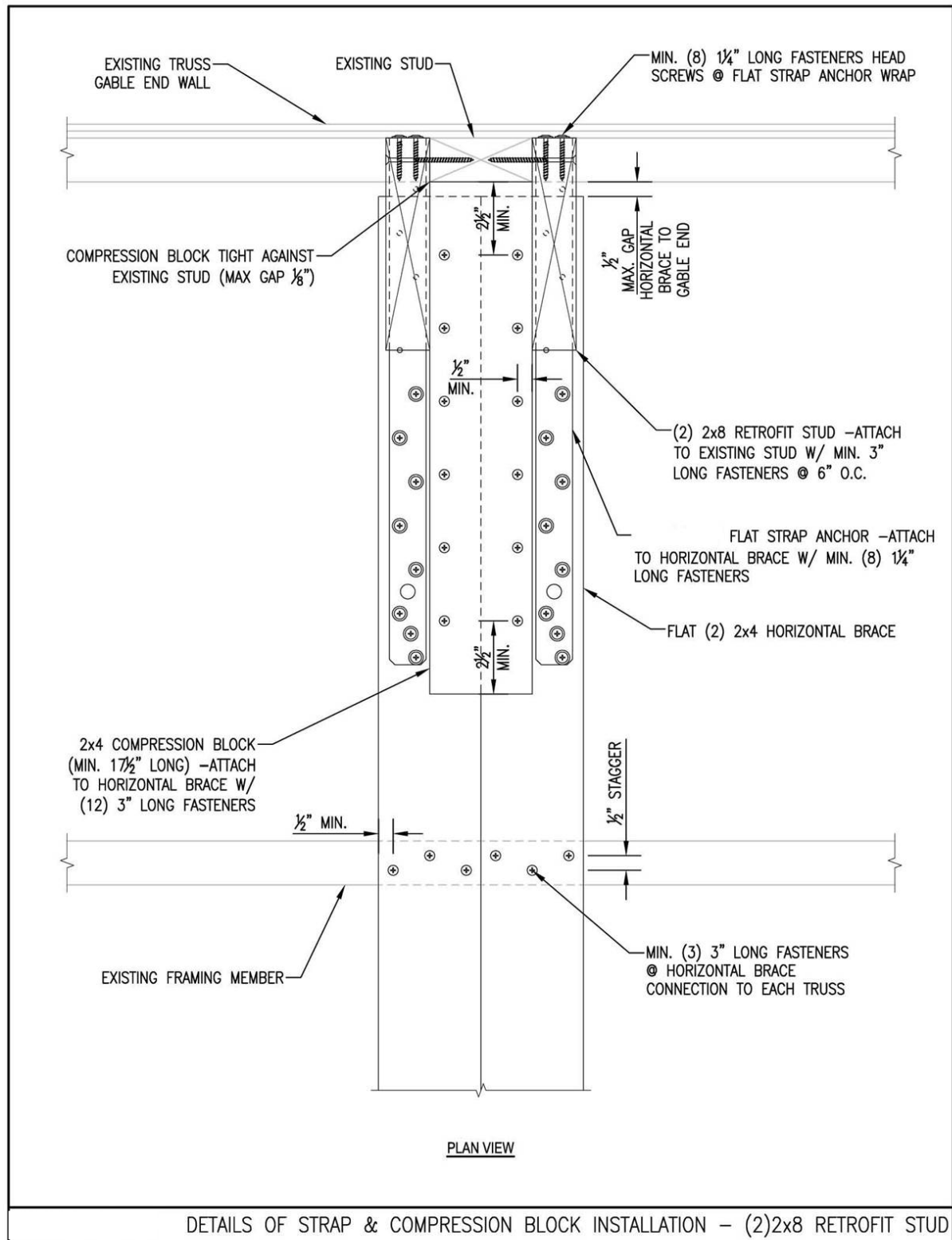


Figure A104.2.5. Detail of strap and compression block installation – (2)2x8 retrofit stud.

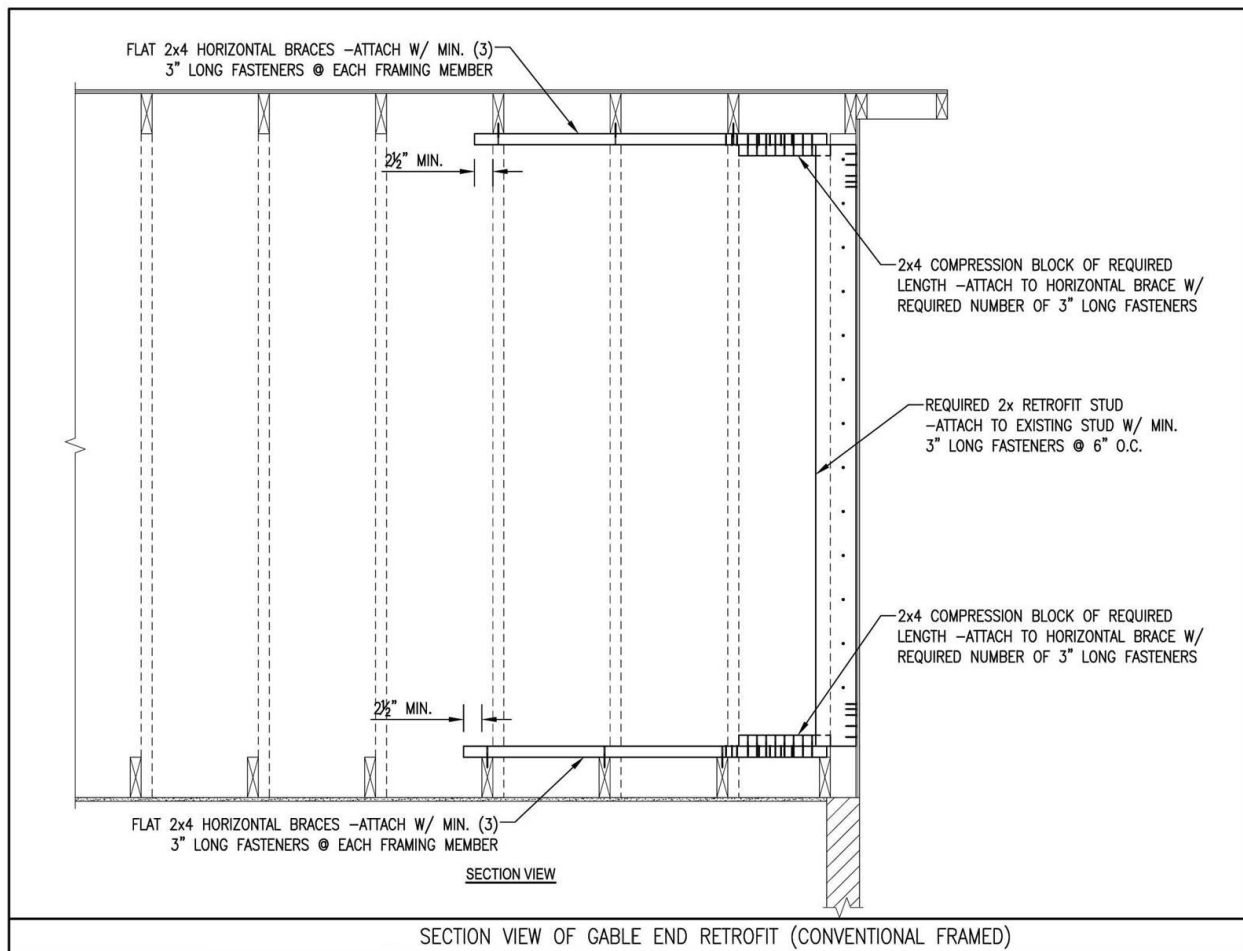


Figure A104.2.6. Section view of gable end retrofit (conventional framed).

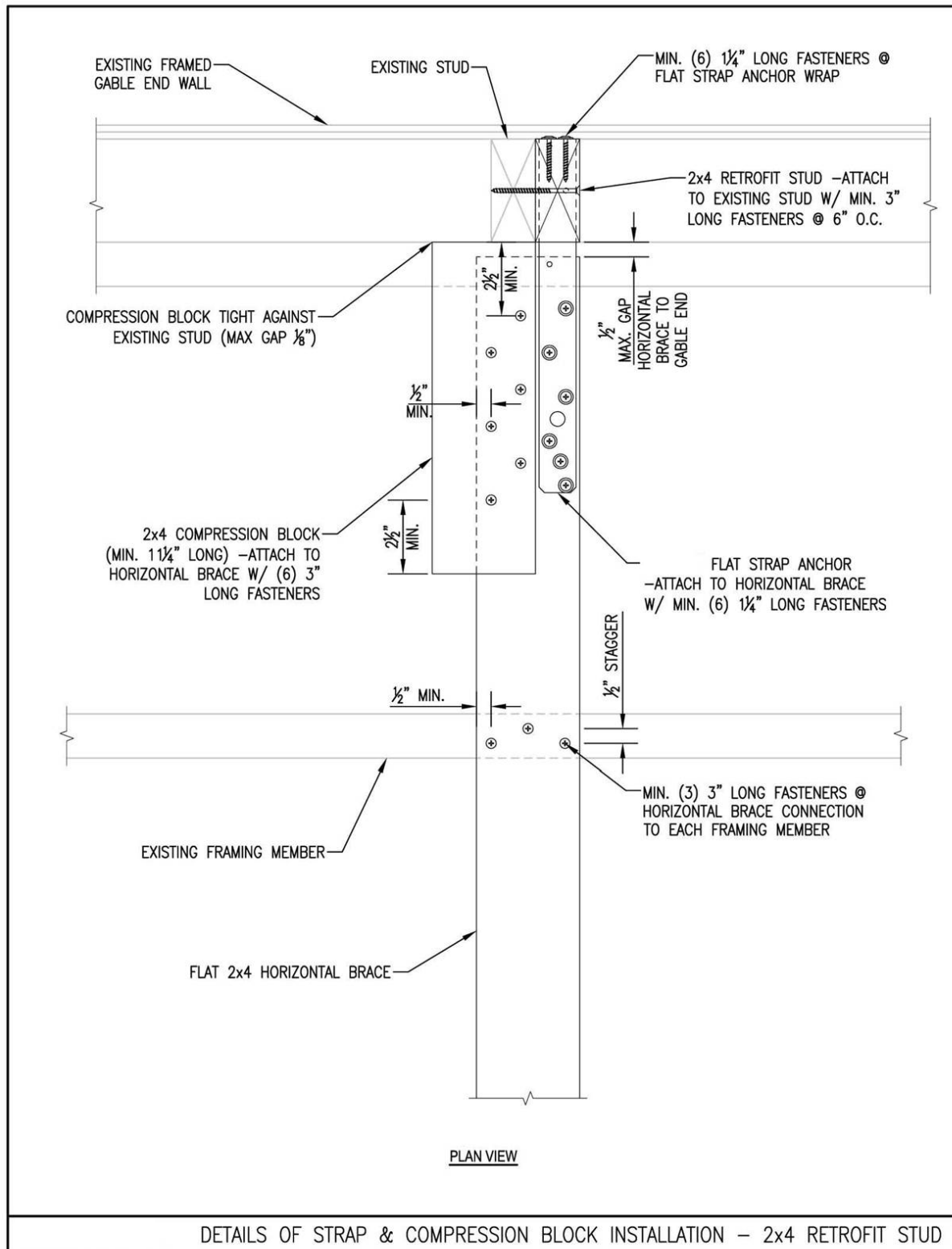


Figure A104.2.7. Details of strap and compression block installation – 2x4 retrofit stud.



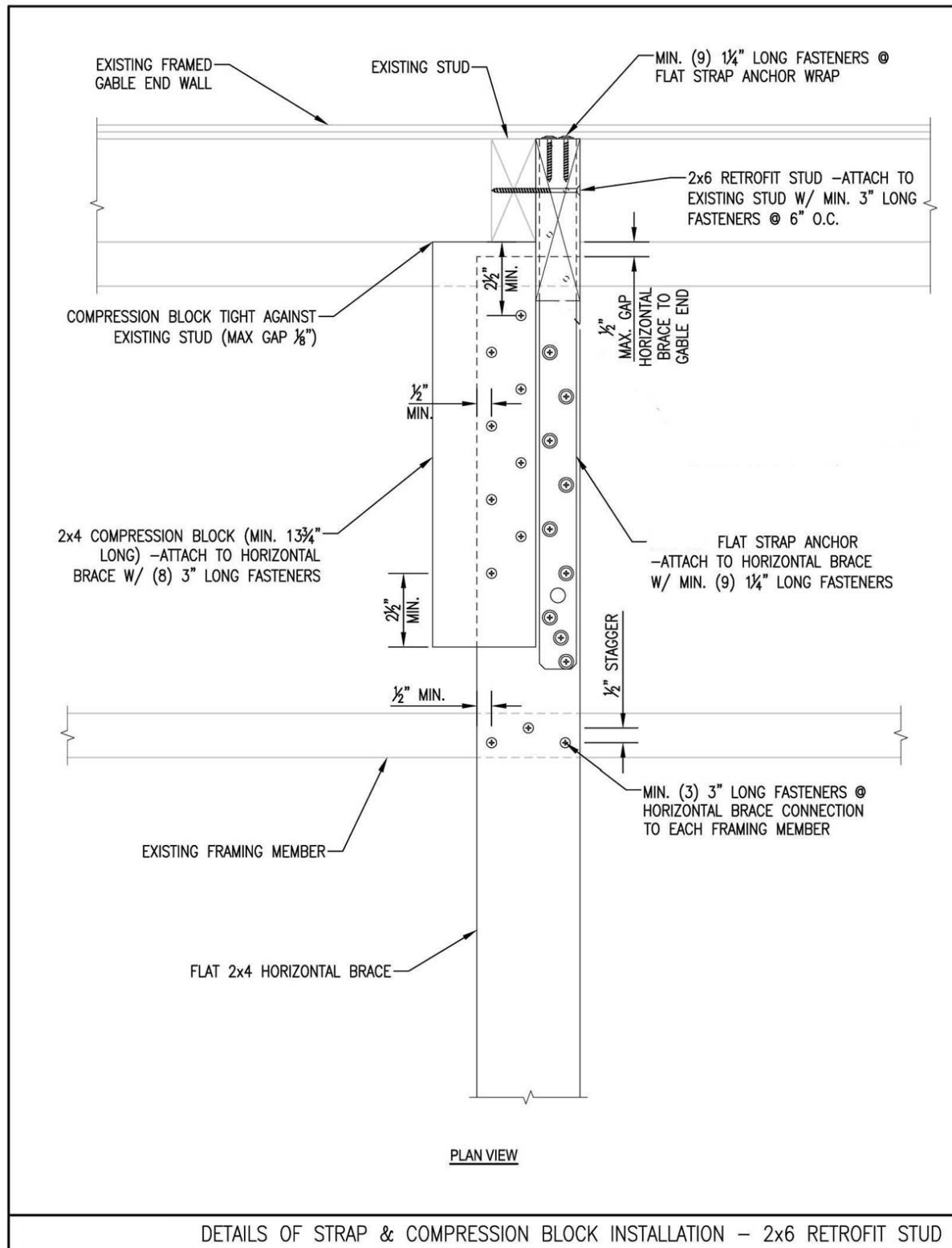


Figure A104.2.8. Details of strap and compression block installation – 2x6 retrofit stud.

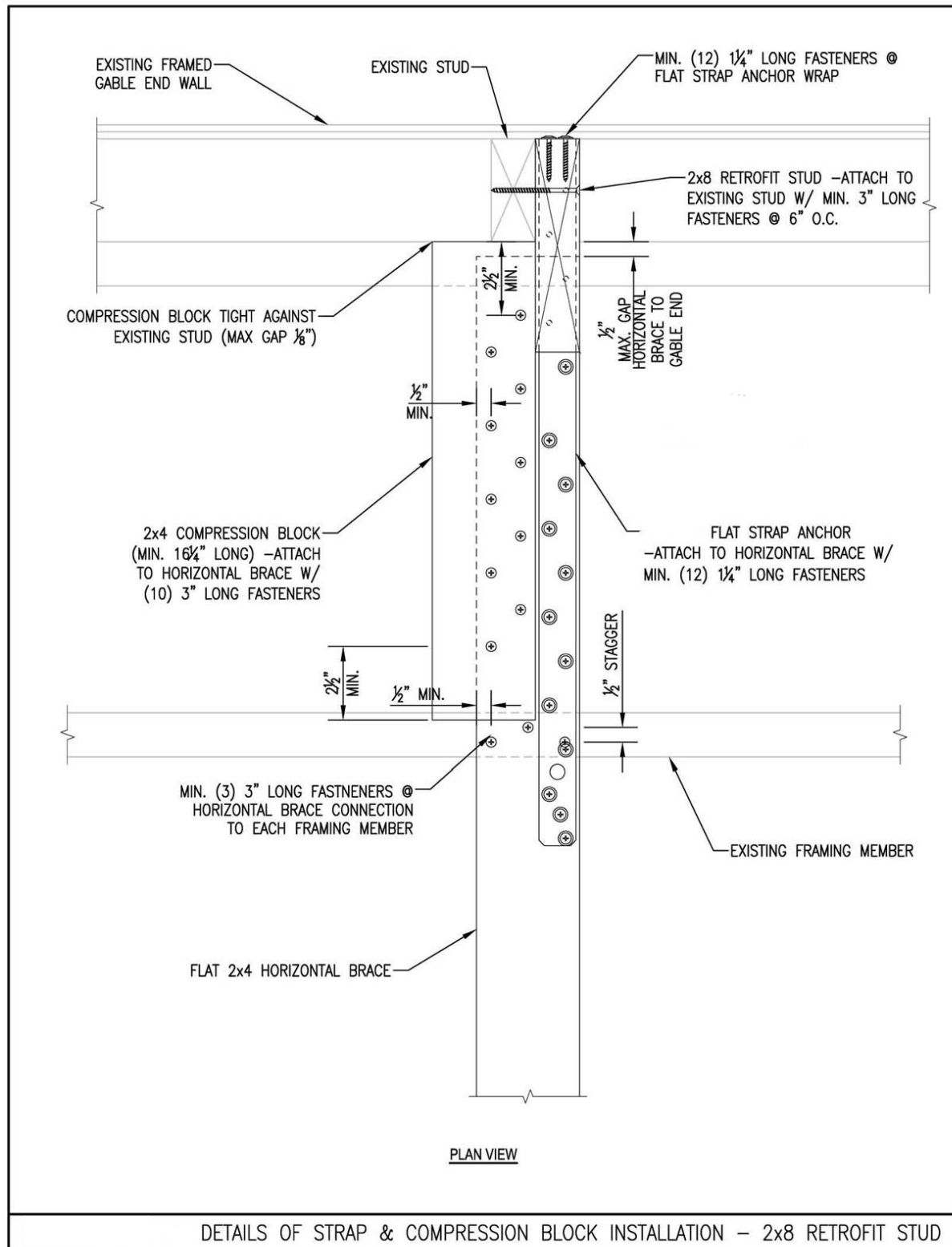


Figure A104.2.9. Details of strap and compression block installation - 2x8 retrofit stud.

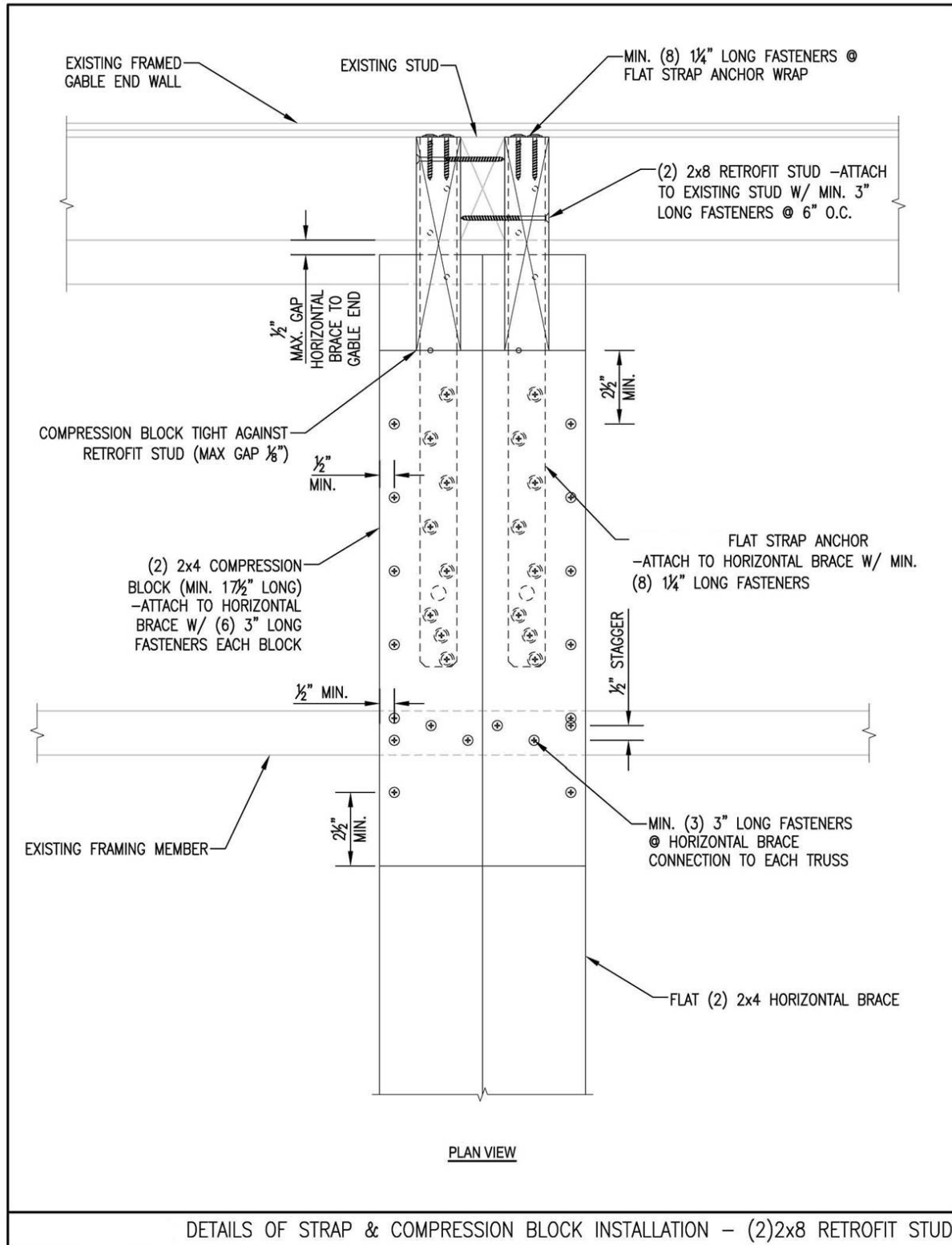


Figure A104.2.10. Details of strap and compression block installation - (2)2x8 retrofit stud.

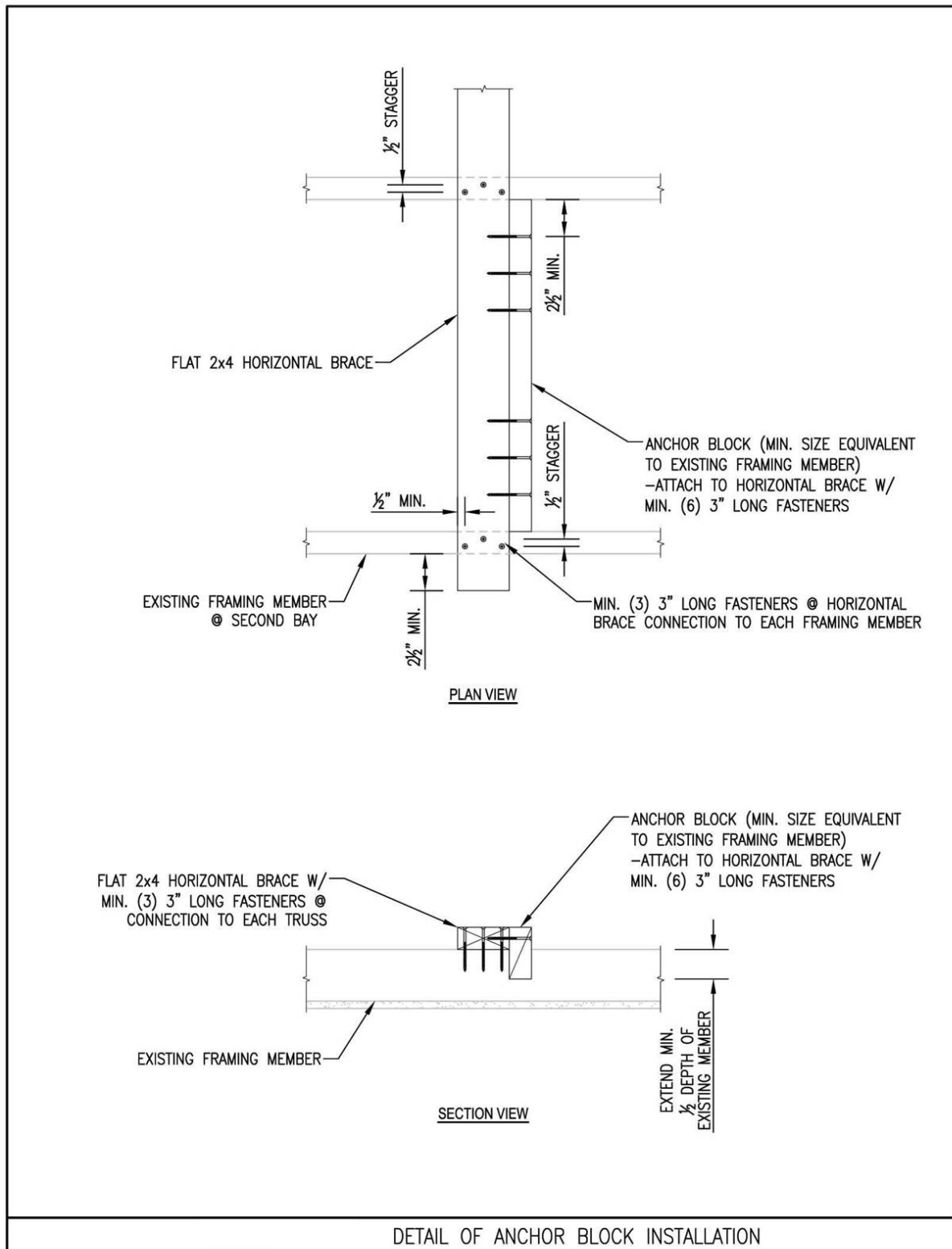


Figure A104.2.11. Detail of anchor block installation.

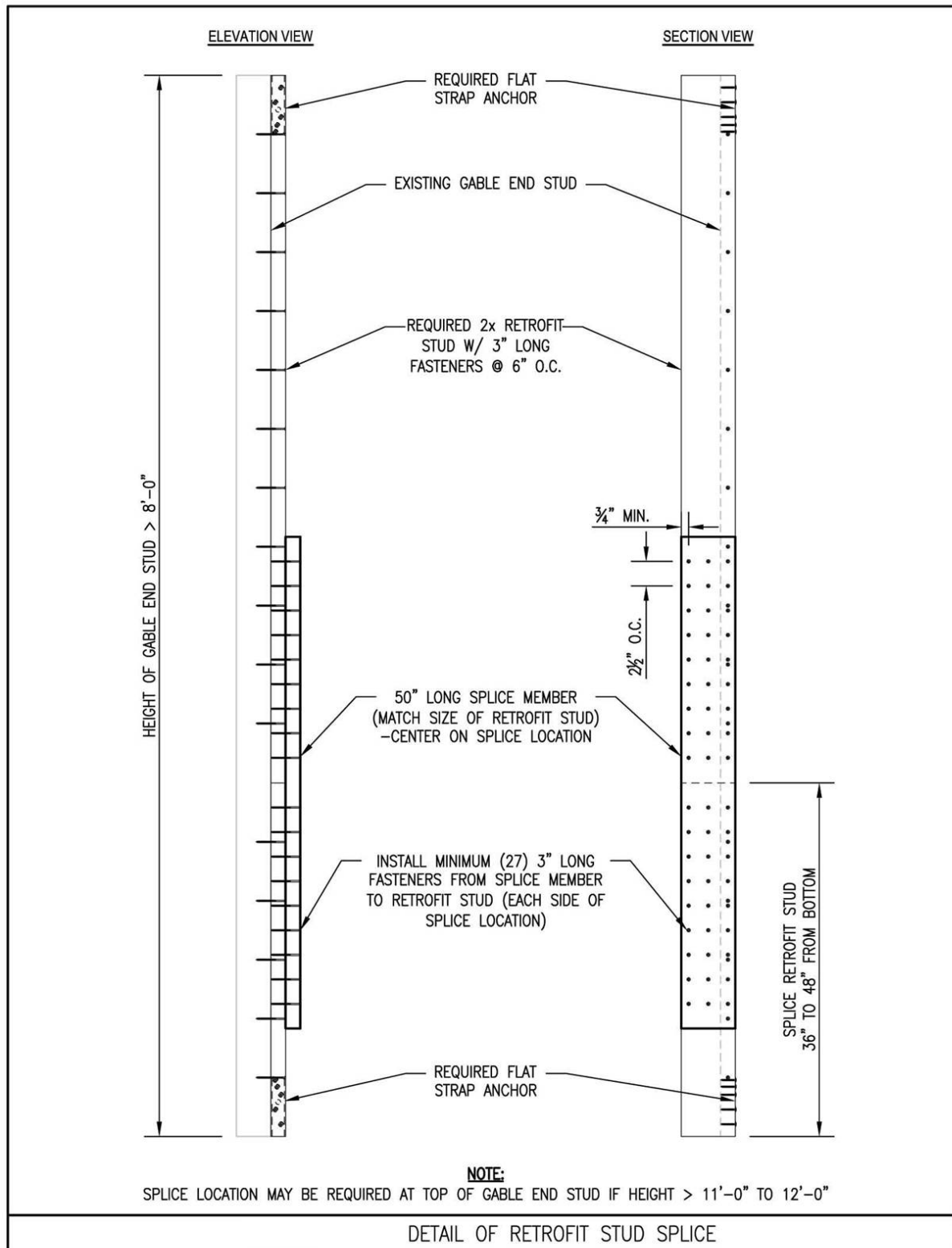


Figure A104.3. Detail of retrofit stud splice.

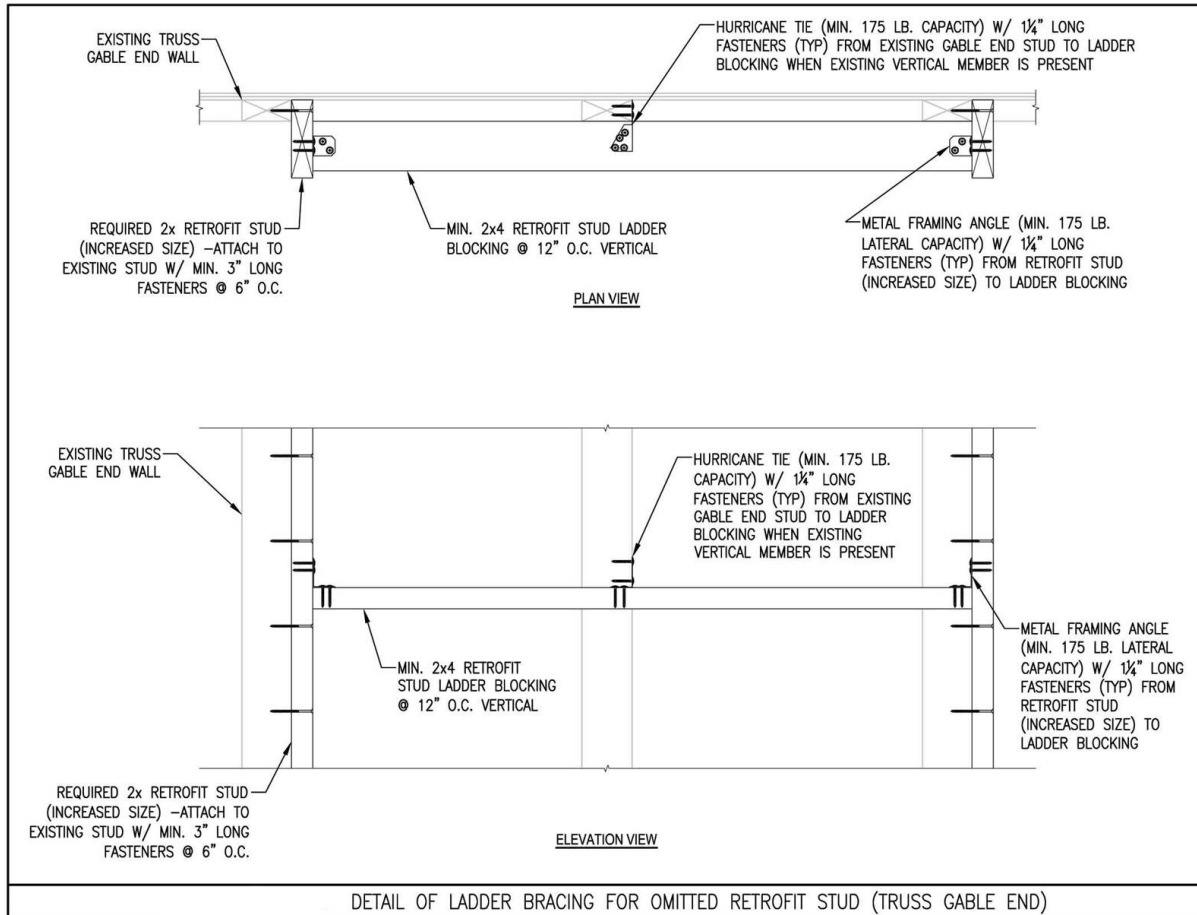


Figure A104.5.1.1. Detail of ladder bracing for omitted retrofit stud (truss gable end).



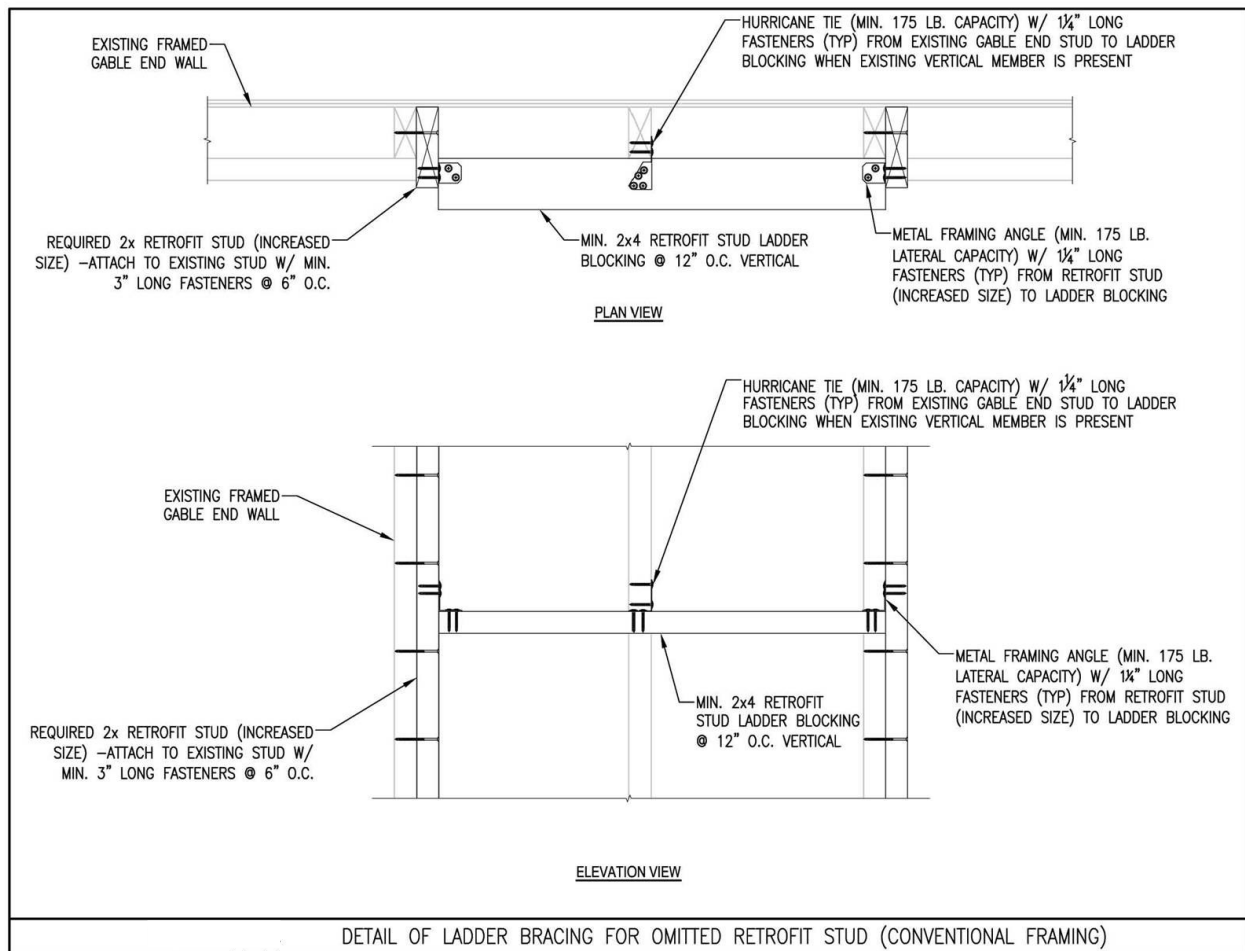


Figure A104.5.1.2. Detail of ladder bracing for omitted retrofit stud (conventional framing).

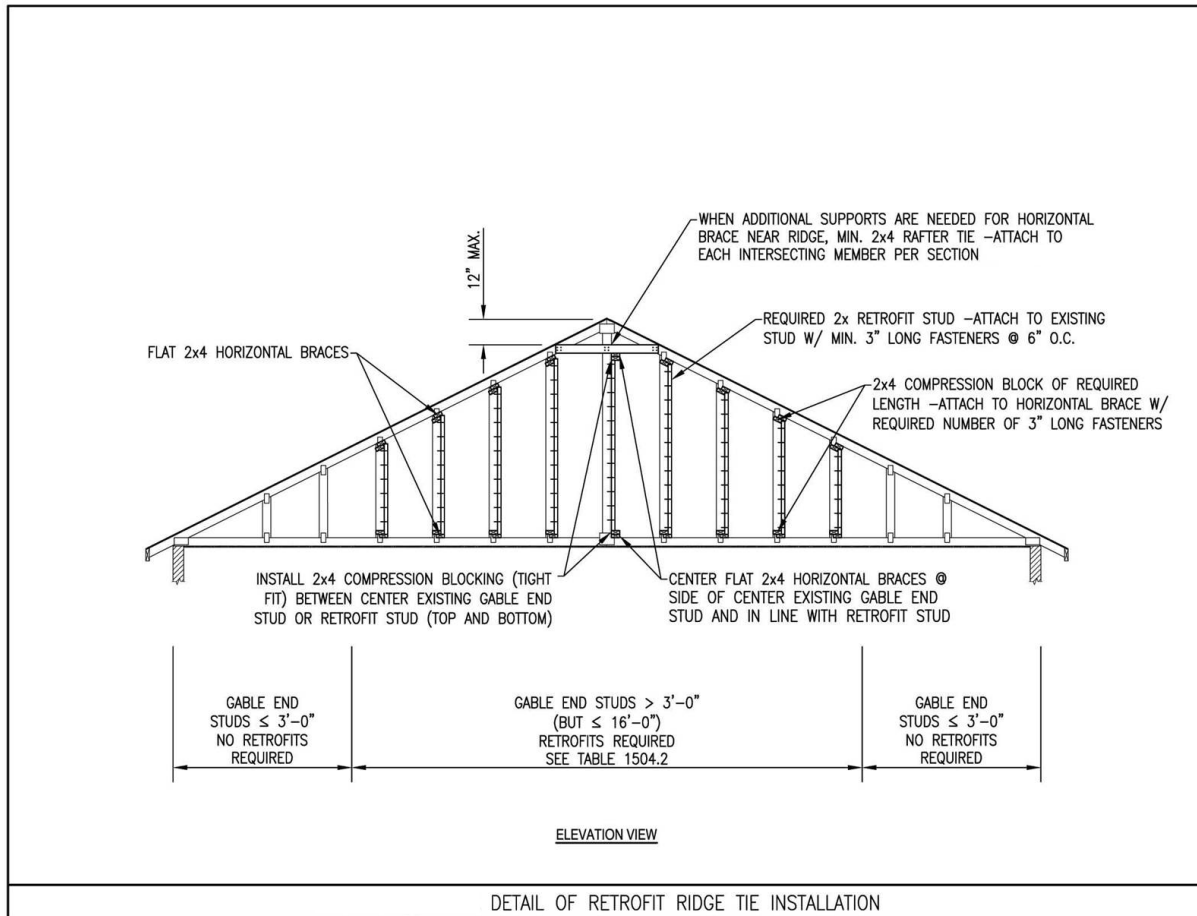


Figure A104.5.2. Detail of retrofit ridge tie installation.



Table A104.2 Gable End Retrofit		Basic Wind Speed (mph) Vasd/Vult		Maximum Height of Gable End Stud <sup>a</sup>			
C		110/142		8 ft, 0 in.	11 ft, 3 in.	14 ft, 9 in.	16 ft, 0 in.
C		120/155		7 ft, 6 in.	10 ft, 6 in.	13 ft, 6 in.	16 ft, 0 in.
C		130/168		7 ft, 0 in.	10 ft, 0 in.	12 ft, 3 in.	16 ft, 0 in.
C		150/193		6 ft, 6 in.	8 ft, 9 in.	11 ft, 0 in.	16 ft, 0 in.
B		110/142		8 ft, 0 in.	12 ft, 3 in.	16 ft, 0 in.	16 ft, 0 in.
B		130/155		8 ft, 0 in.	11 ft, 3 in.	14 ft, 9 in.	16 ft, 0 in.
B		140/168		7 ft, 6 in.	10 ft, 6 in.	13 ft, 6 in.	16 ft, 0 in.
B		150/193		7 ft, 0 in.	10 ft, 0 in.	12 ft, 3 in.	16 ft, 0 in.
				Method #1	Method #2	Method #3	Method #4
				See Figures A104.2.2, A104.2.7	See Figures A104.2.3, A104.2.8	See Figures A104.2.4, A104.2.9	See Figures A104.2.5, A104.2.10
Step	Retrofit Elements						
1	Minimum size of Horizontal			2x4	2x4	2x4	2 each 2x4
2	Minimum number of 3-in.- long fasteners to connect Horizontal Brace to existing stud			3	3	3	3
3	Retrofit Stud to Minimum			2x4	2x6	2x8	2 each 2x8
4	Flat Strap Length Minimum length			21 in.	30 in.	38 in.	2 straps 30"
5	Minimum number of 1¼-in.- long fasteners to connect Flat Strap to Retrofit Stud			6	9	12	8 on each strap
6	Maximum on center spacing of 3-in.-long fasteners to connect Retrofit Stud to Existing Stud			6"	6"	6"	6"
7	Minimum number of 1¼-in.- long fasteners to connect Strap to Retrofit Stud			6	9	12	8 on each strap
8	Compression Block Minimum			11¼ in.	13¾ in.	16¼ in.	17½ in.
9	Minimum number of 3-in.- long fasteners to connect Compression Block to Horizontal Brace			6	8	10	12

a. Existing gable end studs less than or equal to 3 ft, 0 in. in height shall not require retrofitting.

\* Exposure Category D requires engineering design and is not included in this retrofit guidance



**Table A104.6 Spacing of Right Angle Gusset Brackets Connecting Gable End Wall to Wall Below**

Exposure Category *	Wind Speed, mph	Maximum Spacing of Right Angle Gusset Brackets
	Vasd/Vult	
C	110/142	38 in.
C	120/155	32 in.
C	130/168	28 in.
C	140/180	24 in.
C	150/193	20 in.
B	110/142	48 in.
B	120/155	40 in.
B	130/168	36 in.
B	140/180	30 in.
B	150/193	26 in.

**Note:** See Section A104.2 for definition of right-angle gusset brackets.

\*Exposure Category D requires engineering design and is not included in this retrofit guidance

## 5.2 Appendix B

### Exposure Categories

#### Definition of exposure category from the International Residential Code (IRC)

**Exposure category.** For each wind direction considered, an exposure category that adequately reflects the characteristics of ground surface irregularities shall be determined for the site at which the building or structure is to be constructed. For a site located in the transition zone between categories, the category resulting in the largest wind forces shall apply. Account shall be taken of variations in ground surface roughness that arise from natural topography and vegetation as well as from constructed features. For a site where multiple detached one- and two-family *dwelling*s, *townhouses* or other structures are to be constructed as part of a subdivision or master-planned community, or are otherwise designated as a developed area by the authority having jurisdiction, the exposure category for an individual structure shall be based on the site conditions that will exist at the time when all adjacent structures on the site have been constructed, provided that their construction is expected to begin within 1 year of the start of construction for the structure for which the exposure category is determined. For any given wind direction, the exposure in which a specific building or other structure is sited shall be assessed as being one of the following categories:

**Exposure B.** Urban and suburban areas, wooded areas or other terrain with numerous closely spaced obstructions having the size of single-family *dwelling*s or larger. Exposure B shall be assumed unless the site meets the definition of another type exposure.

**Exposure C.** Open terrain with scattered obstructions, including surface undulations or other irregularities, having heights generally less than 30 ft (9144 mm) extending more than 1,500 ft (457 m) from the building site in any quadrant. This exposure shall apply to any building located within Exposure B type terrain where the building is directly adjacent to open areas of Exposure C type terrain in any quadrant for a distance of more than 600 ft (183 m). This category includes flat, open country and grasslands.

**Exposure D.** Flat, unobstructed areas exposed to wind flowing over open water, smooth mud flats, salt flats and unbroken ice for a distance of not less than 5,000 ft (1524 m). This exposure shall apply only to those buildings and other structures exposed to the wind coming from over the unobstructed area. Exposure D extends downwind from the edge of the unobstructed area a distance of 600 ft (183 m) or 20 times the height of the building or structure, whichever is greater.



## 5.3 Appendix C: Design Wind Pressures For Components: Windows, Entry Doors, Patio Doors, Garage Doors, and Opening Protection Products

**Table C-1 Design Wind Pressures (PSF) for Components within 4 ft of a Corner; 30 ft Mean Roof Height, Exposure B <sup>1, 2</sup>**

Effective wind area (ft <sup>2</sup> )	Basic Wind Speed (MPH) Vasd/Vult					
	100/130	110/142	120/155	130/168	140/180	150/193
<b>10</b>	18.0, -24.1	21.8, -29.1	25.9, -34.7	30.4, -40.7	35.3, -47.2	40.5, -54.2
<b>20</b>	17.2, -22.5	20.8, -27.2	24.7, -32.4	29.0, -38.0	33.7, -44.0	38.7, -50.5
<b>50</b>	16.1, -20.3	19.5, -24.6	23.2, -29.3	27.2, -34.3	31.6, -39.8	36.2, -45.7
<b>100</b>	15.3, -18.7	18.5, -22.6	22.0, -26.9	25.9, -31.6	30.0, -36.7	34.4, -42.1

**Table C-2 Design Wind Pressures (PSF) for Components more than 4 ft from a Corner; 30 ft Mean Roof Height, Exposure B <sup>1, 2</sup>**

Effective wind area (ft <sup>2</sup> )	Basic Wind Speed (MPH) Vasd/Vult					
	100/130	110/142	120/155	130/168	140/180	150/193
<b>10</b>	18.0, -19.5	21.8, -23.6	25.9, -28.1	30.4, -33.0	35.3, -38.2	40.5, -43.9
<b>20</b>	17.2, -18.7	20.8, -22.6	24.7, -26.9	29.0, -31.6	33.7, -36.7	38.7, -42.1
<b>50</b>	16.1, -17.6	19.5, -21.3	23.2, -25.4	27.2, -29.8	31.6, -34.6	36.2, -39.7
<b>100</b>	15.3, -16.8	18.5, -20.4	22.0, -24.2	25.9, -28.4	30.0, -33.0	34.4, -37.8

**Table C-3 Design Wind Pressures (PSF) for Garage Doors; 30 ft Mean Roof Height, Exposure B <sup>1, 2</sup>**

Effective wind area (ft <sup>2</sup> )	Basic Wind Speed (MPH) Vasd/Vult					
	100/130	110/142	120/155	130/168	140/180	150/193
<b>50 (Single car)</b>	16, -18	20, -22	23, -26	27, -30	31, -35	36, -40
<b>100 (Two Car)</b>	15, -17	19, -21	22, -25	26, -29	30, -33	35, -38

Notes for Tables C-1, C-2, and C-3:

<sup>1</sup> Positive pressures indicate pressure acting toward the building surface; negative pressures indicate pressure acting away from the building surface.

<sup>2</sup> Table values shall be adjusted for height and exposure by multiplying by the adjustment coefficient in Table C-4.





**Table C-4: Height and Exposure Adjustment Coefficients for Use with Tables C-1, C-2, and C-3**

Mean Roof Height (ft)	Exposure B	Exposure C	Exposure D
15	1.00	1.21	1.47
20	1.00	1.29	1.55
25	1.00	1.35	1.61
30	1.00	1.40	1.66
35	1.05	1.45	1.70
40	1.09	1.49	1.74
45	1.12	1.53	1.78
50	1.16	1.56	1.81
55	1.19	1.59	1.84
60	1.22	1.62	1.87



## 5.4 Appendix D: FORTIFIED Corrosion Protection Requirements

FORTIFIED Fastener and Connector Corrosion Protection Requirements				
Fasteners/Connector	Structures within 300 ft of saltwater	Structures more than 300 ft but less than 1,000 ft from saltwater <sup>1</sup>	Structures more than 1,000 ft but less than 3,000 ft from saltwater	Structures more than 3,000 ft from saltwater
Roofing nails for shingles	Stainless steel	Stainless steel	Hot-dip galvanized <sup>4</sup>	Corrosion resistant <sup>5</sup>
Concrete and clay roof tile fasteners	Stainless steel	Stainless steel	Hot-dip galvanized <sup>4</sup>	Corrosion resistant <sup>5</sup>
Metal roof clips and fasteners (exposed)	Stainless steel	Stainless steel	Stainless steel	Corrosion resistant <sup>5</sup>
Fasteners used for attachment of underlayment to roof deck	Hot-dip galvanized <sup>4</sup>	Hot-dip galvanized <sup>4</sup>	Hot-dip galvanized <sup>4</sup>	Corrosion resistant <sup>5</sup>
Aluminum soffits	Not allowed	Not allowed	Allowed	Allowed
Soffit and roof vent fasteners	Stainless steel	Stainless steel	Stainless steel	Corrosion resistant <sup>5</sup>
Metal framing connectors, fasteners, anchors, and hangers in exposed areas <sup>2</sup>	Stainless steel	Stainless steel	Stainless steel	Stainless steel or G185 galvanized
Metal framing connectors, fasteners, anchors, and hangers in vented enclosed areas <sup>3</sup>	Stainless steel	Stainless steel or G185 galvanized coating	Stainless steel or G185 galvanized coating	Corrosion resistant <sup>5</sup>
<sup>1</sup> Buildings on open, elevated foundations within 1,000 ft of saltwater shall follow the requirements of structures within 300 ft of saltwater. <sup>2</sup> Examples of exposed areas include areas that are under roof overhangs, decks and covered walkways or in any location that is openly or partially exposed to saltwater air. <sup>3</sup> Examples of vented enclosed areas include attics with vents. <sup>4</sup> Hot-dip galvanized shall meet the requirements of ASTM A153, Class D for nails and screws. <sup>5</sup> Corrosion-resistant nails and screws shall meet the requirements of ASTM A 641, Class 1, or an equal corrosion resistance by coating, galvanization, stainless steel, or other suitable corrosion-resistant material. Corrosion-resistant sheet metal connectors, anchors, and hangars shall meet the requirements of ASTM A653, G90.				



## Sealed Roof Deck

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Fred Malik, Vice President,  
FORTIFIED Programs

**Applicable Standards:**

FORTIFIED Home™—Hurricane  
FORTIFIED Home™—High Wind  
FORTIFIED Home™—High Wind & Hail  
FORTIFIED for Safer Living™

**Applicable Designation Level:**

# Installation of 2 Layers of #30 Felt as a Qualified Sealed Roof Deck System for Asphalt Shingle or Metal Roofing

## Abstract

The installation of 2 layers of #30 roofing felt has been tested, evaluated and approved by IBHS as a qualified sealed roof deck system for asphalt shingle or metal roofing.

## Requirements

- Two (2) layers of ASTM D226 Type II (#30) or ASTM D4869 Type III or Type IV (#30) underlayment shall be installed in a shingle fashion, lapped 19 in. on horizontal seams (36-in. roll), and 6 in. on vertical seams.
  - **NOTE:** Be sure to check product labeling carefully. Not all products labeled ASTM D4869 are Type III or Type IV. Look for ASTM D4869 felt that is labeled Type III or Type IV. ASTM D4869 Type I or Type II will **NOT** be accepted.
- Installation of first course of felt to be installed as described below and shown in Figure 1.
  - Cut 17 in. off one side of the roll and install the remaining 19-in.-wide strip of underlayment\* along the eave. Safely tack in place. Carefully install a 36-in.-wide roll of underlayment\* over the 19-in.-wide course of underlayment along the eave. Follow the same procedure for each, overlapping the sheets 19 in. (leaving a 17-in. exposure). Fasten with one row in the field of the sheet at 12 in. o.c. and one row at the overlaps fastened 6 in. o.c.
- Fasten underlayment at approximately 6 in. o.c. along the laps and at approximately 12 in. o.c. in the field of the sheet between the side laps.
  - For design wind speeds less than 140 mph (ASCE 7-05): secure underlayment using annular ring or deformed shank nails with 1-in.-diameter caps (button cap nails).

\*Must use ASTM D226 Type II (#30) or ASTM D4869 Type III or Type IV (#30) underlayment.

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FORTIFIED for Safer Living™

### Applicable Designation Level:



- For design wind speeds 140 mph or greater (ASCE 7-05): secure underlayment using annular ring or deformed shank nails with thin metal disks (“tincaps”).

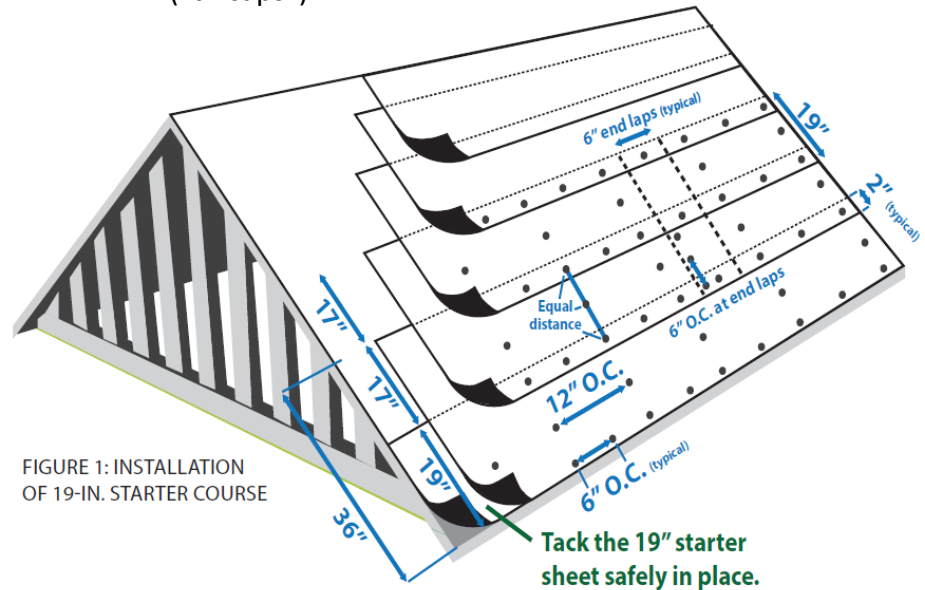


FIGURE 1: INSTALLATION OF 19-IN. STARTER COURSE

## Compliance Verification Requirements

This method of sealing the roof deck is to be documented and verified by a certified FORTIFIED evaluator. Acceptable documentation includes but is not limited to: pictures of laps and fasteners at 4 different locations of the roof; a completed Roof Compliance Form (RCF-1); certification by the installer; bills of lading; invoices; and product packaging.

## Completing Evaluation Form (For FORTIFIED Evaluators Only)

On the evaluation form, in the “Sealed Roof Deck” section, for question SRD System Type, select “Other” (see Figure 2 below). It will be necessary to provide documentation as described above.



Figure 2. Evaluation Form; Section—Sealed Roof Deck; Question—SRD System Type?



# Sealed Roof Deck

## Material Options for Taping Roof Deck Seams

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FORTIFIED Home™—High Wind & Hail  
FORTIFIED for Safer Living™

**Applicable Designation Level:**

### Abstract

The material options for taping the seams of the roof deck have been expanded to include AAMA 711-13, Level 3 (for exposure up to 80°C/176°F).

### Requirements

There are two material options for taping the seams on the roof deck.

#### Option 1

Apply an ASTM 1970 compliant self-adhering polymer-modified bitumen flashing tape, at least 4-in. wide, directly to the roof deck to seal the horizontal and vertical joints in the roof deck.

#### Option 2

Apply an AAMA 711-13, Level 3 (for exposure up to 80°C/176°F) compliant self-adhering flexible flashing tape, at least 3¼-in. wide, directly to the roof deck to seal the horizontal and vertical joints in the roof deck.

Any flashing tape used to achieve a sealed roof deck must be fully adhered without voids (e.g., wrinkles) in order to be accepted. In some instances, the ability of self-adhered flashing tapes to adhere to Oriented Strand Board (OSB) sheathing may be compromised by the level of surface texture or the wax used to improve the water resistance of the OSB panel. In applications where flashing tape adhesion to OSB is marginal, apply a manufacturer-specified compatible primer to the OSB panels where the tape will be applied to ensure the proper attachment of the self-adhering tape to the sheathing. Do not nail or staple the tape to the roof sheathing. Refer to the manufacturer's recommendations for installation and primer requirements (if applicable). Next, apply a code-compliant #30 ASTM D226 Type II or ASTM D4869 Type IV underlayment over the self-adhering tape. This underlayment must be attached using annular ring or

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FORTIFIED Home™—High Wind & Hail  
FORTIFIED for Safer Living™

### Applicable Designation Level:



**Note:** Although 4 photographs is the minimum number of pictures required, the goal is to achieve a 360° view of the house and FORTIFIED upgrades. Most photographs will be taken from the ground and site conditions may dictate that more than the minimum be provided.

deformed shank roofing fasteners with minimum 1-in.-diameter caps (button cap nails) at 6 in. o.c. spacing along all laps and at 12 in. o.c. in the field or a more stringent fastener schedule if required by the manufacturer for high-wind and prolonged exposure installations. Horizontal laps must be a minimum of 2 in. and end laps must be a minimum of 6 in.

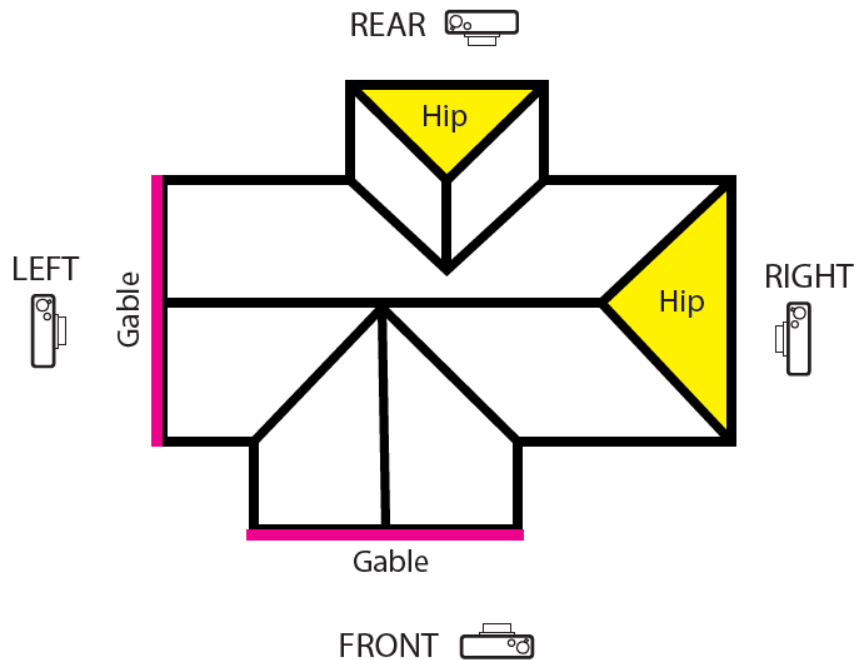


Figure 0-1. Minimum photograph requirement and locations (Front, Rear, Left and Right).

## Compliance Verification Requirements

This method of sealing the roof deck is to be documented and verified by a certified FORTIFIED Evaluator. Acceptable documentation includes, but is not necessarily limited to:

### Pictures of Tape Installed

Count: Minimum = 4

- Must show 4 different sections of the roof (Front, Rear, Left and Right). See Fig. 0-1.
- Must clearly show tape fully adhered to the deck without wrinkles or voids. See Fig. 0-2.
- Must show at least one full sheet of roof decking (with all 4 seams taped) per photo.
- Must be in focus.



# Sealed Roof Deck

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FORTIFIED Home™—High Wind  
FORTIFIED Home™—High Wind & Hail  
FORTIFIED for Safer Living™

### Applicable Designation Level:



- Must have the following clearly visible: date, address or FORTIFIED ID, location (e.g., Front, Rear, Left and Right). See Fig. 0-3.

## Pictures of Felt Installed

Count: Minimum = 4

- Must show 4 different sections of the roof (Front, Rear, Left and Right).
- Must clearly show laps and fasteners.
- Must have the following clearly visible: date, address or FORTIFIED ID, location (e.g., Front, Rear, Left and Right).

## Other Documentation Required

- Completed Roof Compliance Form (RCF-1) identifying tape manufacturer, specification requirement (ASTM 1970 or AAMA 711-13, Level 3) and type of compatible primer, if used.

OR

- Invoices and product packaging identifying tape product name, manufacturer, specification requirement (ASTM 1970 or AAMA 711-13, Level 3) and type of compatible primer, if used.



Figure 0-2. Applying qualified tape to roof deck seams using flat blade to eliminate voids and wrinkles.

# Sealed Roof Deck

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FORTIFIED for Safer Living™

### Applicable Designation Level:

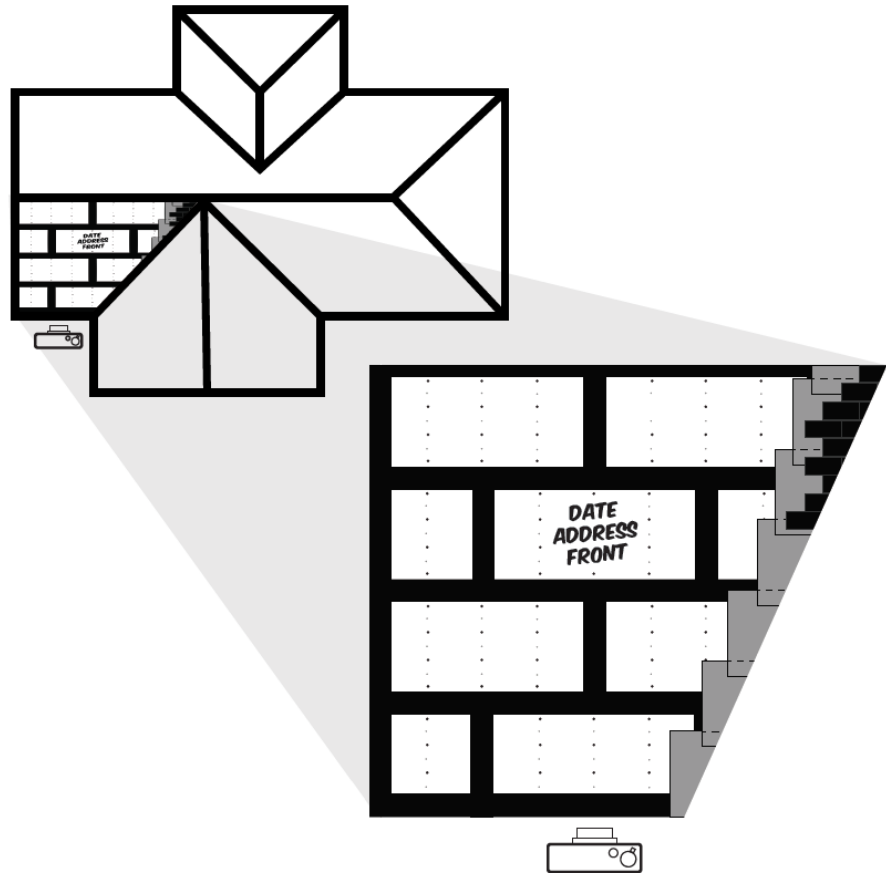


Figure 0-3. Labeling of roof deck to identify project and photo location.

## Completing Evaluation Form

When completing the Sealed Roof Deck section of a FORTIFIED Home Evaluation form, select SRD System Type as shown in Fig. 0-4. Add photos and other documentation by clicking on the camera icon.

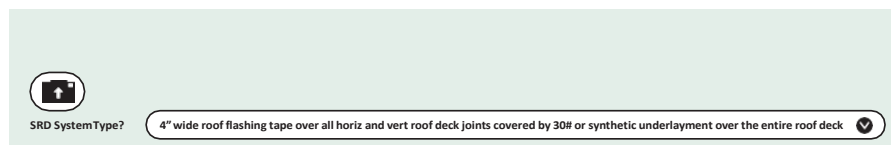


Figure 0-4. Selection for SRD system type.

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FORTIFIED Home™—High Wind  
FORTIFIED Home™—High Wind & Hail  
FORTIFIED for Safer Living®

### Applicable Designation Level:



## Using 2-Part Closed-Cell Foam Adhesive

### Abstract

Strengthening the attachment of roof sheathing and installation of a sealed roof deck system can be achieved simultaneously by applying an ASTM or TAS tested two-part, spray polyurethane foam adhesive to the underside of the roof deck as shown in Figure 1.

This system can satisfy two FORTIFIED Roof™ requirements:

1. Sealing the roof deck.
2. Supplemental deck attachment, when the roof deck is fastened with staples, 6d common nails or 8d common nails at 12 in. on center in the field.



Figure 1. Closed-cell polyurethane foam adhesive applied to the underside of the roof sheathing at the joints between the sheathing panels and along all intersections between roof sheathing and all roof framing members.



# Sealed Roof Deck Supplemental Deck Attachment

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FORTIFIED Home™—High Wind & Hail  
FORTIFIED for Safer Living®

**Applicable Designation Level:**

## Requirements

A 2-part closed-cell foam polyurethane adhesive can be used on new or existing homes. This system is most commonly used on existing homes where the roof cover is deemed to be in good condition and NOT in need of replacement. When the roof cover is not being replaced, other systems that are installed from the topside cannot be used. Spray foam allows for improvements to be made from within the attic. This system can be used to satisfy two FORTIFIED Roof requirements:

1. Sealing the roof deck.
2. Supplemental deck attachment, when the roof deck is fastened with staples, 6d common nails or 8d common nails at 12 in. on center in the field.

The minimum requirements for spray adhesives are:

- Product must be tested and evaluated in accordance with either ASTM E330, Standard Test Method for Structural Performance of Exterior Windows, Doors, Skylights and Curtain Walls by Uniform Static Air Pressure Difference (applied to roof sheathing), or TAS 202-94, Criteria for Testing Impact and Non- Impact Resistant Building Envelope Components Using Uniform Static Air Pressure. The minimum allowable Design Uplift Pressure must be greater than or equal to those listed below.
  - FORTIFIED Home—Hurricane: at least 110 psf (proof test of at least 165 psf)
  - FORTIFIED Home—High Wind: at least 80 psf (proof test of at least 120 psf)
  - FORTIFIED Home—High Wind & Hail: at least 80 psf (proof test of at least 120 psf)
- Two-component spray polyurethane foam system with a minimum core density of 1.5–3.0 pcf in accordance with ASTM D1622, Standard Test Method for Apparent Density of Rigid Cellular Plastics.
- Spray polyurethane foam adhesive system must be installed by a properly trained and qualified applicator in accordance with the manufacturer's maintenance and installation guidelines.



## Sealed Roof Deck Supplemental Deck Attachment

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FORTIFIED Home™—High Wind  
FORTIFIED Home™—High Wind & Hail  
FORTIFIED for Safer Living®

**Applicable Designation Level:**

**Note:** In order for this method to be accepted for sealing the roof deck and for adding supplemental roof deck attachment, access to the entire underside of the roof deck within the attic must be available. If the slope of the roof is low, such that eaves are inaccessible, or any portion of the underside of the deck is obstructed by equipment or ductwork, or is otherwise inaccessible, it will be necessary to use an alternative qualified method to seal the portion of the deck that is unreachable by the spray foam installer.

To provide enhanced roof sheathing attachment and to seal the roof deck, apply a 1.5- to 3-in. fillet of 2-part spray-applied polyurethane foam adhesive to:

- All joints between sheathing
- All intersections between roof sheathing and roof framing members
- All valleys

Use the minimum density and installation requirements prescribed by the manufacturer to meet a minimum Design Uplift Pressure on the sheathing of 80 psf or 110 psf; as appropriate to the applicable standard.

All installations must be in accordance with the manufacturer's instructions.

### Compliance Verification Requirements

It is not possible to determine the chemistry of a spray foam product by visual inspection. Therefore, it is necessary to collect documentation from the installing contractor identifying the manufacturer and product used for the improved roof sheathing attachment/sealed roof deck.

Documentation must be provided to the Certified FORTIFIED Home Evaluator and be included with the FORTIFIED Home evaluation checklist. Documentation must state the installation meets the manufacturer's requirements for an allowable Design Uplift Pressures detailed below.

- FORTIFIED Home—Hurricane: at least 110 psf (proof test of at least 165 psf)
- FORTIFIED Home—High Wind: at least 80 psf (proof test of at least 120 psf)
- FORTIFIED Home—High Wind & Hail: at least 80 psf (proof test of at least 120 psf)





# Sealed Roof Deck Supplemental Deck Attachment

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FORTIFIED Home™—High Wind & Hail  
FORTIFIED for Safer Living®

### Applicable Designation Level:



**Note:** Although 4 photographs is the minimum number of pictures required, the goal is to achieve a complete view of the underside of the roof deck. Photographs must be taken from inside the attic and show product installed in accordance with the requirements listed above. Site conditions may dictate that more than the minimum be provided.

## Minimum Documentation Required

- Letter from installing contractor, on company letterhead, that the material was applied by a trained installer and the installation meets the manufacturer's requirements for an allowable Design Uplift Pressure specified for the appropriate standard.
- Documentation from Miami-Dade, FBC, TDI product approvals or ICC Evaluation Reports, if applicable (invoices and/or product labels identifying product name and manufacturer may be substituted in the absence of product test documents).
- A minimum of 4 photos of the material applied to the entire underside of the roof deck. Pictures must be taken at 4 different locations of the attic to show complete coverage.

## Completing Evaluation Form

(For FORTIFIED Evaluator)

### Entering Supplemental Deck Attachment

Section: Roof Deck

First, identify type of attic accessibility.

Attic accessibility

Next, indicate qualified supplemental documentation is installed. Select closed-cell foam adhesive and upload documentation.

Is qualified supplemental deck attachment installed? ☒ Yes

What type of supplemental deck attachment is installed?

### Entering the SRD System Type

Section: Sealed Roof Deck

Select a closed-cell foam applied along all roof framing members and over all horizontal roof deck seams. Upload documentation.

SRD System Type?





## Eligible Dwellings

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**First Release:**

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**Prepared by:**Remington Brown,  
Senior Engineering Director**Applicable Standards:**FORTIFIED Home™—Hurricane  
FORTIFIED Home™—High Wind  
FORTIFIED Home™—High Wind & Hail  
FORTIFIED for Safer Living®**Applicable Designation Level:**

# FORTIFIED Home™ Dwelling Type Eligibility Requirements

## Abstract

The purpose of this document is to provide specific information about the type of residential building that is eligible for designation consideration in the FORTIFIED Home program.

## Introduction

The goal of IBHS FORTIFIED Home program is to strengthen homes against specific natural hazards using system-based resilience upgrades and a comprehensive verification process. “Home” or “dwelling” encompasses a broad category of residential buildings. This technical bulletin defines the specific types of residential buildings that are eligible for consideration in the FORTIFIED Home program.

## Eligibility

### Qualifying Homes—Dwelling Type

1. Single-family detached homes
2. Two-family dwelling units (duplex)
3. (HUD) manufactured homes
4. Townhouses

## Definitions and Conditions

1. **Single-family detached home**—a freestanding residential building occupied by one family. Limited to three stories above grade. This also includes detached single-family factory-built modular homes that are designed, built and sited to meet all local building codes.
2. **Two-family dwelling units (duplex)**—a freestanding residential building occupied by two families. Limited to three stories above grade. Note: The entire two-family building, which includes both dwelling units under consideration, must be evaluated under the appropriate FORTIFIED Home requirements. Individually evaluated



# Eligible Dwellings

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Senior Engineering Director

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FORTIFIED Home™—High Wind  
FORTIFIED Home™—High Wind & Hail  
FORTIFIED for Safer Living®

### Applicable Designation Level:



units are NOT eligible for designation outside of the entire building being designated.

3. **(HUD) manufactured homes**—a single-family residential home manufactured to HUD's Manufactured Home Construction and Safety Standards. Must be sited on a permanent foundation. HUD manufactured homes built before July 1994 are NOT eligible.
4. **Townhouse**—a single-family dwelling unit constructed in a group of three or more attached units in which *each unit extends from foundation to roof and has a yard or public way on not less than two sides*. Limited to three stories above grade. Mixed use (commercial and residential) buildings are NOT eligible. Note: The entire townhouse building, which includes all townhouse units under consideration, must be evaluated under the appropriate FORTIFIED Home requirements. Individually evaluated townhouse units are NOT eligible for designation outside of the entire building being designated. Example: A four-unit, two-story townhouse with all units attached is eligible for FORTIFIED only if the entire building, including each and every townhouse unit, is evaluated.

## Completing Evaluation Forms

(For the FORTIFIED Evaluator)

### Address Entry in Evaluation Application

When completing the FORTIFIED Home Evaluation Application for two-family dwelling units (duplex) or townhouses, list all dwelling unit addresses for the entire building under consideration on the Property Address lines. The example below lists four address numbers for a four-unit townhouse.



# Eligible Dwellings

## Bulletin No. 2016-01

### First Release:

March 4, 2016

### Prepared by:

Remington Brown,  
Senior Engineering Director

### Applicable Standards:

FORTIFIED Home™—Hurricane  
FORTIFIED Home™—High Wind  
FORTIFIED Home™—High Wind & Hail  
FORTIFIED for Safer Living®

### Applicable Designation Level:



### FORTIFIED Home Evaluation Application

Choosing to have a FORTIFIED Home™ evaluation conducted is important to understanding where your home is vulnerable to severe weather. A FORTIFIED Home is more resistant to damage from high winds and wind-driven rain common in thunderstorms, tropical storms, hurricanes and hailstorms. With three levels of FORTIFIED designation available: Bronze, Silver and Gold, you can choose a level of protection best suited to your budget and resilience goals. Take the first step and complete the FORTIFIED application below. Fields marked with an (\*) are required.

Figure 1. Application indicating four addresses for a four-unit townhouse.

## Dwelling Type Entry in Evaluator Checklist

Figure 2 shows dwelling type options available on the Evaluator Checklist. This drop-down menu can be found in the General/Site Information section.

Figure 2. FORTIFIED Home Evaluator Checklist indicating dwelling type options.



## Eligible Dwellings

### Bulletin No. 2016-01

**First Release:**

March 4, 2016

**Prepared by:**Remington Brown,  
Senior Engineering Director**Applicable Standards:**FORTIFIED Home™—Hurricane  
FORTIFIED Home™—High Wind  
FORTIFIED Home™—High Wind & Hail  
FORTIFIED for Safer Living®**Applicable Designation Level:**

### Designation Certificates

Designation certificates will be issued based on verification of the appropriate FORTIFIED requirements and will list a single address for single-family detached homes. Two-family homes (duplex) and townhouse designation certificates will be issued with all addresses for the building listed on the certificate. Figure 3 is an example of a designation certificate for a four-unit townhouse.



Figure 3. Example certificate for a qualified, four-unit townhouse.



# Shingle Installation at Roof Edge

## Bulletin No. 2016-05

### First Release:

November 3, 2016

### Prepared by:

Fred Malik, Vice President,  
FORTIFIED Programs

Mark Zehnal, Senior Roofing Specialist,  
FORTIFIED Program Manager – Great  
Plains

### Applicable Standards:

FORTIFIED Home™–High Wind

FORTIFIED Home™–High Wind & Hail

FORTIFIED Home™–Hurricane

### Applicable Designation Level:



## Asphalt Shingle Installation at Roof Edges, Intersections and Valleys

### Abstract

This updated document is intended to provide additional guidance and options for asphalt shingle installations at roof edges, intersections and valleys. The verification and documentation requirement referenced in the original technical bulletin (Technical Bulletin 2016-05, released November 3, 2016) was effective December 5, 2016.

### Introduction

Research conducted at the IBHS Research Center on a number of three-year-old roofs with various edge attachment details clearly demonstrated the need to ensure that shingles are properly installed and well adhered along the perimeter of a roof. While this directive has been included in standards and guidance since the beginning of the program, and also addressed in manufacturers' high-wind guidance for asphalt shingle installation, it has not been specifically spotlighted in compliance forms or in evaluator training.

As a result, IBHS is issuing this updated technical bulletin to provide additional guidance with options that describe alternate methods to help ensure that asphalt shingles are well sealed and connected at roof edges, intersections and valleys. Please make sure you become familiar with the installation requirements outlined below and work with roofers to ensure proper installation instructions are followed. **Additionally, appropriate documentation described at the end of this bulletin continues to be required for all asphalt shingle roof installations.**



# Shingle Installation at Roof Edge

## Bulletin No. 2016-05

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Fred Malik, Vice President,  
FORTIFIED Programs

Mark Zehnal, Senior Roofing Specialist,  
FORTIFIED Program Manager – Great  
Plains

**Applicable Standards:**

FORTIFIED Home™–High Wind

FORTIFIED Home™–High Wind & Hail

FORTIFIED Home™–Hurricane

**Applicable Designation Level:**

## Sealed Roof Deck Installation Options

### Taped Sheathing Seams

**Tape Installation**

Tape must be rolled to help ensure it is installed flat and adheres to the deck. If the tape doesn't stick well, the seams must be primed or a different product that does stick well must be used. Recent IBHS experience suggests that there may be fewer adhesion problems for installations on OSB decks with the high temperature-rated acrylic tape allowed by the program.

**Underlayment Installation**

Apply a code-compliant ASTM D226, Type II underlayment over the self-adhering tape (felt or synthetic is allowed). This underlayment shall be attached using annular ring or deformed shank roofing fasteners with minimum 1-in.-diameter caps at 6 in. o.c. spacing along all laps and two rows 12 in. o.c. in the field or a more stringent fastener schedule if required by the manufacturer for high-wind installations. Horizontal laps shall be a minimum of 2 in. and end laps shall be a minimum of 6 in. Nails with plastic or metal caps are allowed in areas where the design wind speed is less than 140 mph. Metal caps are required for areas where the design wind speed is greater than or equal to 140 mph.

### ASTM D1970 Self-Adhered Membranes

**ASTM D1970 Membrane Installation**

Cover the entire roof with a full layer of self-adhering polymer-modified bitumen membrane meeting ASTM D1970 requirements.

**Recommended Bond Break Installation**

It is recommended that #15 felt be installed over the membrane to provide a bond break between the self-adhering membrane and the shingles in order to prevent the shingles from fusing with the self-adhering membrane. The bond break shall be held back 8 in. from the eave and rake edges to allow application of flashing cement along the edges to ensure proper sealing of shingles along the roof edges.





# Shingle Installation at Roof Edge

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FORTIFIED Programs

Mark Zehnal, Senior Roofing Specialist,  
FORTIFIED Program Manager – Great  
Plains

### Applicable Standards:

FORTIFIED Home™–High Wind

FORTIFIED Home™–High Wind & Hail

FORTIFIED Home™–Hurricane

### Applicable Designation Level:



## Roof Edges, Intersections and Valleys

### Drip Edge Installation Requirements

1. Provide code-compliant, minimum gauge metal drip edge at eaves and gables.
2. Overlap to be a minimum of 3 in. at joints.
3. Eave drip edges shall extend ½ in. below sheathing and extend back on the roof a minimum of 2 in.
4. The drip edge shall be mechanically fastened to the roof deck. Fasteners shall be fabricated from similar or compatible material. For FORTIFIED–Hurricane compliance, spacing shall be a maximum of 4 in. o.c. For FORTIFIED–High Wind and FORTIFIED–High Wind & Hail compliance, spacing shall be a maximum of 12 in. o.c. Mechanical fasteners shall be applied in an alternating (staggered) pattern along the length of the drip edge with adjacent fasteners placed near opposite edges of the leg/flange of drip edge on the roof.
5. Drip edge at eaves shall be installed over the underlayment (this is compatible with high-wind installations where flashing cement is used to seal the edges).

### Installation of Starter Strips at Eaves (Drip Edge Installed Over Underlayment)

Manufacturer-approved starter strips at eaves shall be set in a minimum 8-in.-wide strip of compatible flashing cement.

Maximum thickness of flashing cement shall be ⅛ in. Fasten starter strips parallel to the eaves along a line above the eave line according to the manufacturer's specifications. Position fasteners to ensure they will not be exposed under the cutouts in the first course. Starter strips and shingles must not extend more than ¼ in. beyond the drip edge.

### Approved Option

Shingle manufacturer–approved ASTM D1970 fully adhered (peel-and-stick) starter strip with asphaltic adhesive strip at eave—installed so that starter strip adheres to and covers the drip edge top surface.



# Shingle Installation at Roof Edge

## Bulletin No. 2016-05

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Mark Zehnal, Senior Roofing Specialist,  
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Plains

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FORTIFIED Home™–High Wind

FORTIFIED Home™–High Wind & Hail

FORTIFIED Home™–Hurricane

### Applicable Designation Level:



## Installation of Shingles at Rakes (Drip Edge Installed Over Underlayment)

Install shingles at rakes set in a minimum 8-in.-wide strip of compatible flashing cement. Maximum thickness of flashing cement shall be  $\frac{1}{8}$  in. Fasten shingles at the rakes according to the manufacturer's specifications.

## Optional Installation of Starter Strips at Rakes (Drip Edge Installed Over Underlayment)

Manufacturer-approved starter strips at rakes shall be set in a minimum 8-in.-wide strip of compatible flashing cement. Maximum thickness of flashing cement shall be  $\frac{1}{8}$  in. Fasten starter strips parallel to the rakes according to the manufacturer's specifications. Position fasteners to ensure they will not be exposed. Starter strips and shingles must not extend more than  $\frac{1}{4}$  in. beyond the drip edge.

## Approved Option

Shingle manufacturer–approved ASTM D1970 fully adhered (peel-and-stick) starter strip with asphaltic adhesive strip at rake—installed so that starter strip adheres to and covers the drip edge top surface.

## Attachment of Shingles at Intersections and Valley

Shingles installed at all intersections and both sides of open valleys shall be set in a minimum 8-in.-wide strip of flashing cement. Maximum thickness of flashing cement shall be  $\frac{1}{8}$  in. Cut side of closed valleys shall be set in a minimum 2-in.-wide,  $\frac{1}{8}$ -in.-thick strip of flashing cement. Woven valleys to be according to the manufacturer's specifications.



# Shingle Installation at Roof Edge

## Bulletin No. 2016-05

**First Release:**

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**Prepared by:**

Fred Malik, Vice President,  
FORTIFIED Programs

Mark Zehnal, Senior Roofing Specialist,  
FORTIFIED Program Manager – Great  
Plains

**Applicable Standards:**

FORTIFIED Home™–High Wind

FORTIFIED Home™–High Wind & Hail

FORTIFIED Home™–Hurricane

**Applicable Designation Level:**

## Verification and Documentation

The contractor shall complete the revised compliance form and provide in-progress photos with identifiable traits or landmarks of the property showing the following:

1. Installation of tape or self-adhered membrane.
2. Fastening of underlayment.
3. Fastening of drip edge metal over underlayment.
4. Application of flashing cement or approved alternate means of attachment along roof edges, intersections and valleys.
5. Installation of approved starter strips at eaves.

The Evaluator shall verify that shingles along the edges of the roof do not overhang more than ¼ in. beyond the drip edge metal.



# Gable End Overhang: Existing Homes Only

## Bulletin No. 2017-02

**First Release:**

April 12, 2017

**Prepared by:**

Remington Brown,  
Senior Engineering Director

**Applicable Standards:**

FORTIFIED Home™—Hurricane

**Applicable Designation Level:**



# Retrofit for Ladder Framed Gable Overhang 12–18 in. Depth

## Applicable Conditions

- 1. Existing homes only
- 2. Silver and Gold designation levels

## Abstract

Older homes are often constructed with overhangs greater than 12 in. in depth. This bulletin provides prescriptive instructions, for the site condition limitations outlined below, on how to retrofit ladder framing on gable end overhangs to achieve a maximum depth of 18 in. from the face of the wall. Gable ends with ladder framed plywood/OSB overhangs greater than 18 in. seeking a Silver or Gold designation will require a site-specific engineered solution.

**Site Condition Limitation**

**Exposure B**

**Mean Roof Height = 30 ft maximum**

<b>Wind Provision</b>	<b>ASCE 7-10</b>
<b>Wind Speed (mph)</b>	<b>160 (ultimate)</b>

## Requirements

FORTIFIED Home™ requirements have not changed. This prescriptive retrofit utilizes 2x framing members and 7/16-in. structural sheathing (plywood or OSB) at soffits to form a structural box which will enable an existing gable overhang to extend 18 in. to the outermost surface of the overhang without site-specific engineering.

## Documentation Requirements

All components installed must be documented with photos and verified by a certified FORTIFIED Evaluator. Required photos include all installed framing and sheathing. Include photos of fasteners that clearly indicate sizes and spacing of the fasteners installed as well as at least one overview showing the continuous ledgers in place.

# Gable End Overhang: Existing Homes Only

## Bulletin No. 2017-02

### First Release:

April 12, 2017

### Prepared by:

Remington Brown,  
Senior Engineering Director

### Applicable Standards:

FORTIFIED Home™—Hurricane

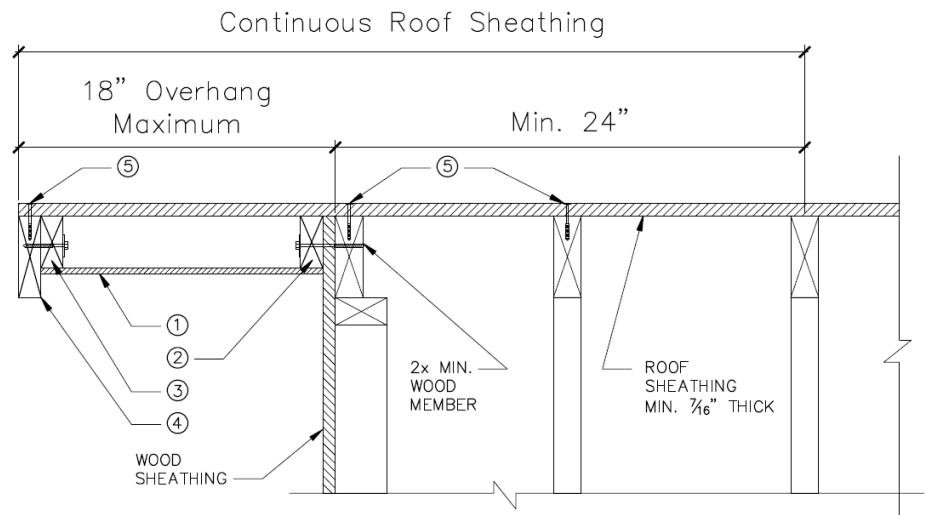
### Applicable Designation Level:



## For Evaluators Only: Evaluation Form Input

Overhang retrofit documentation photos, material invoices, etc., should be uploaded into the SOFFIT section of the evaluation in FOCUS.

## Retrofit Specifications



1.  $\frac{7}{16}$ -in. structural sheathing (plywood or OSB) fastened to 2- x 4-in. ledgers with 8d nails at 3 in. o.c. at each end. Provide 2- x 4-in. blocking at all soffit panel joints.
2. 2- x 4-in. continuous ledger fastened to wall framing through exterior sheathing with #10 x 4-in.-long deck screw and a 1.5-in.-diameter washer at 6 in. o.c. and 3 in. from each end of the ledger.
3. 2- x 4-in. continuous ledger fastened to 2- x 6-in. fascia with #10 x 3-in.-long deck screw and a 1.5-in.-diameter washer at 8 in. o.c. and 3 in. from each end of the ledger.
4. 2x minimum fascia board.
5. Nail the roof deck to the fascia and first and second rafters with 8d ring shank nails at 4 in. o.c. (minimum  $1\frac{3}{8}$ -in. penetration).



## Roof System

### Bulletin No. 2017-03

**First Release:**

November 15, 2017

**Prepared by:**

Remington Brown  
Senior Engineering Director

**Applicable Standards:**

FORTIFIED Home™–Hurricane  
FORTIFIED for Safer Living™

**Applicable Designation Level:**

# Low-Slope Roof Guidelines in Mobile and Baldwin Counties, Alabama

## Abstract

This bulletin is intended to provide design guidance for residential roof systems installed over wood roof decks with a roof slope less than 2/12 (10 degrees). Low-slope roof systems must meet the required design pressures for the site and the locations on the building. Roofing manufacturers' tested uplift design pressures must have a factor of safety of 2:1; roof system design pressures listed in an ICC Evaluation Service Report, Florida Product Approval, or Miami-Dade Notice of Acceptance (NOA) have the 2:1 factor of safety already applied. These reports can be used to validate compliance with the project site-specific design pressure requirements. The report documents can be difficult to navigate; the roofing manufacturer technical services department is the best resource to help identify the correct system for the project.

## Typical Residential Low-Slope Systems

Built-up roof (BUR) systems are composed of multiple layers of reinforcing membranes held together with hot bitumen, solvent-based adhesives, torch welding and self-adhered plies that create a finished membrane. The number of plies in a cross section is the number of membrane layers on a roof. The term "two-ply" denotes a two-layer membrane construction. When installed directly over the wood deck, the base sheet (also known as an anchor sheet) can either be mechanically fastened or attached with an adhesive foam or be a self-adhered product.

Modified bitumen roof systems are a form of BUR system that uses multiple layers of reinforcing membranes with a granulated or uncoated finish cap sheet that includes added modifiers to give plastic or rubber-like properties. Modified bitumen roof systems usually consist of two- or three-ply systems.





# Roof System

## Bulletin No. 2017-03

### First Release:

November 15, 2017

### Prepared by:

Remington Brown  
Senior Engineering Director

### Applicable Standards:

FORTIFIED Home™–Hurricane  
FORTIFIED for Safer Living™

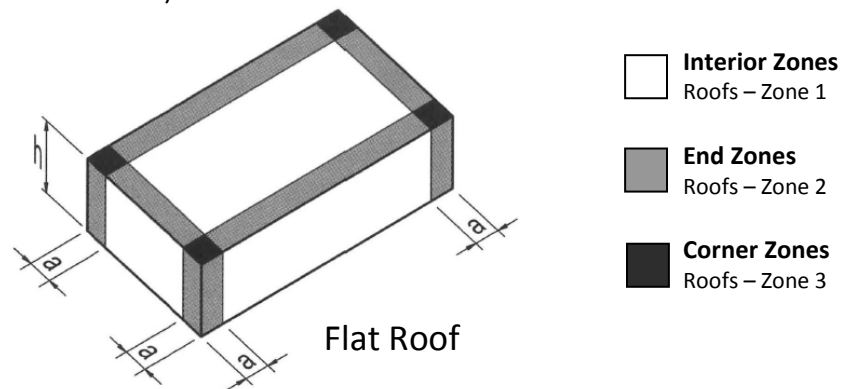
### Applicable Designation Level:



Single-ply roofing membranes are flexible sheets of compounded synthetic materials that are generally mechanically attached or fully adhered to rigid insulation or a cover board. There are two categories of single-ply membranes: thermoplastic membranes such as TPO (thermoplastic olefin), PVC (polyvinyl chloride), and KEE (ketone ethylene ester), and thermoset membranes such as EPDM (ethylene propylene diene monomer).

## Example for Mobile and Baldwin Counties

Low-slope roofs must be installed to meet design pressures for the site location *and* for the location on the roof. **Figure 1** (below) shows three roof “zones.” **Use 4 ft for dimension “a.”** The Corner Zone (Zone 3) is the roof zone that has the highest pressure (see **Table 1**) and is a 4-ft x 4-ft area in each of the four corners of the roof. The End Zone (Zone 2) is a 4-ft wide strip around the perimeter of the roof and the Interior Zone is the rest of the roof (anything not in Zones 2 or 3).



**Figure 1. Flat Roof Zones**

In Mobile and Baldwin counties, use **Table 1** to determine the roof uplift pressure you need for an approved roof system. Note that the ASCE 7-10 wind speed in Mobile and Baldwin counties does not exceed 160 mph in any location.

**Table 1. Roof Uplift Pressures: 160 mph, 30 ft Max Roof Height**

160 mph (ASCE 7-10)	Zone 1 (interior)	Zone 2 (end)	Zone 3 (corner)
Exposure B (residential neighborhood)	-28 psf	-47 psf	-70 psf
Exposure C (open area)	-39 psf	-66 psf	-98 psf
Exposure D (on water)	-47 psf	-78 psf	-116 psf



# Roof System

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Senior Engineering Director

### Applicable Standards:

FORTIFIED Home™–Hurricane  
FORTIFIED for Safer Living™

### Applicable Designation Level:



## Basic Procedure for Selecting a Roof Assembly

1. From **Table 1**, determine uplift pressure required for Zone 1 (field), Zone 2 (perimeter), and Zone 3 (corners).
2. Select a roofing system manufacturer and a method of application (self-adhered, mechanically fastened, hot mopped, single-ply, etc.).
3. There are many variables associated with flat roof systems; make sure you select a system that's appropriate for the roof deck. Most residential flat roof assemblies are applied over a wood deck without insulation; make sure the system you choose is compatible.
4. Select a roof assembly from the manufacturer that has an approval for a design pressure greater than or equal to the uplift pressures determined in step 1.
  - **NOTE:** It would be best to select a system rated for the corner (Zone 3) uplift pressures and use it for the entire roof. **For a home located in a residential neighborhood (Exposure B) in Mobile or Baldwin county, look for a roof assembly system that has an approval indicating a design uplift pressure of 70 psf. The ICC Evaluation Service Report, Florida Product Approval, and Miami-Dade Notice of Acceptance (NOA) already have the required 2:1 factor of safety incorporated in the listed design pressures.**

## Installation

1. Re-fasten the wood deck as required by FORTIFIED or the roofing approval if it's more restrictive.
2. Apply base/anchor sheet, intermediate plies, cap sheet, and roof coating as required by the system approval. **Do not substitute materials; use the components and fasteners as listed in the system approval.**
3. Follow roof manufacturers' installation guidelines for edge details, parapet details, skylight curb details, pitch transitions, wall connections where roofs meet upper stories, and penetrations for vent stacks or hardware mounts.



# Roof System

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FORTIFIED for Safer Living™

### Applicable Designation Level:



## Documentation Requirements

The **Roofing Compliance Form** must indicate the manufacturer and system type of the roof assembly.

The product approval indicating the design pressure rating for the installed system must be provided to the Evaluator.

**Photos indicating the attachment of the base/anchor sheet in compliance with the roofing system approval must be provided.**



## Bulletin No. 2017-04

### First Release:

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### Prepared by:

Fred Malik, Vice President,  
FORTIFIED Programs

### Applicable Standards:

FORTIFIED Home™—Hurricane  
FORTIFIED Home™—High Wind  
FORTIFIED Home™—High Wind & Hail  
FORTIFIED for Safer Living™

### Applicable Designation Level:



## Eligibility Requirements and Retrofit Requirements for Elevated-Floor (Not Slab-on-Grade) Houses

### Applicable Conditions

1. Dry stack foundations: all house types
2. All elevated-floor home-to-foundation connections

### Abstract

This technical bulletin is intended to clarify FORTIFIED Home™ requirements that relate to a home's foundation and the need for the home to have a positive connection to the foundation in order to be eligible for a FORTIFIED Home designation. The criteria included are requirements for any and all FORTIFIED Home designations and are not limited to FORTIFIED Home Gold designations which address the continuous load path.

### Requirements

#### Dry Stack Foundations

A dry stack foundation is defined as a foundation constructed of unrestrained stacked masonry or stone.

**Eligibility:** Homes that are supported by a dry stack foundation are ineligible for any level of FORTIFIED Home designation unless the home is retrofitted so that it is supported by and attached to a permanent foundation capable of resisting the design level wind uplift and lateral forces on the building.

#### All Foundations

To be eligible for designation or re-designation under the FORTIFIED Home program, homes with elevated floors (not slab-on-grade construction) must have adequate positive connections from the floor or wall structure to the supporting foundation, e.g. homes on piers or pilings must have a connection from the



# Eligibility Requirements—Foundations

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### Prepared by:

Fred Malik, Vice President,  
FORTIFIED Programs

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FORTIFIED Home™—High Wind  
FORTIFIED Home™—High Wind & Hail  
FORTIFIED for Safer Living™

### Applicable Designation Level:



piers/pilings to the perimeter beams of the house. All connectors must be free from damage, corrosion-resistant (if applicable) in accordance with Appendix D of the FORTIFIED Home—Hurricane standards, and installed per the connector manufacturer's installation instructions.

### HUD-Code Manufactured Home Foundations

Foundation must meet the design wind load requirements with no more than ¼-in. lateral deflection. Requirements specified in the U.S. Department of Housing and Urban Development (HUD) Permanent Foundation Guide for Manufactured Housing (HUD-4930.3G) dated September 1996 or later provide useful assistance in identifying suitable foundation options. Based on results of past inspections of home installations that were reported as permanent, the following requirements of the HUD Guide and FORTIFIED Home requirements are emphasized and are part of the Field Evaluation inspection.

1. Screw-in soil anchors are not considered a permanent anchorage and cannot be used as any part of the required permanent foundation unless their heads are restrained from lateral movement by embedment in a reinforced concrete footing or concrete slab.
2. All concrete masonry unit (CMU) bearing walls, piers and columns, as well as any units used as part of systems to resist uplift, overturning and lateral loads must be composed of reinforced concrete masonry with mortared bed and head joints. Cells with reinforcing must be fully grouted. Dry-stacking of CMU is not allowed.
3. All bearing walls, piers and columns must be installed on and connected to acceptable footings or a concrete slab. Footings and slabs must be protected from the effects of frost heave by extending below the frost line or by using a frost protected shallow foundation design.
4. Walls and piers used as part of the uplift, overturning or lateral load-resisting system must include adequately sized connections and elements capable of resisting tension or compression loads as appropriate. Straps or cables are acceptable, provided they are connected to the home or its chassis and transfer the design loads to the slab or footings supporting the walls, piers or columns. Use



# Eligibility Requirements—Foundations

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### Prepared by:

Fred Malik, Vice President,  
FORTIFIED Programs

### Applicable Standards:

FORTIFIED Home™—Hurricane  
FORTIFIED Home™—High Wind  
FORTIFIED Home™—High Wind & Hail  
FORTIFIED for Safer Living™

### Applicable Designation Level:



of frictional resistance between the home or its chassis and the tops of the walls, piers or columns or between the bottom of the walls, piers or columns and the footings to resist lateral loads is not allowed.

**Eligibility:** Manufactured homes must be installed on a foundation designed and installed in accordance with the criteria outlined above. A certification attesting to compliance with the design requirements of the HUD Permanent Foundations Guide for Manufactured Housing (HUD-4930.3G) dated September 1996 or later, and the requirements outlined above must be provided by a licensed professional engineer or registered architect. A copy of the certification and foundation design must be provided before or during the Field Evaluation at the time of the house setting for reference by the inspector and submission to IBHS.

## Documentation Requirements

A minimum of four (4) photographs of a home's foundation is required. The photographs must be taken from four different locations around the perimeter of the home.

Photographs of connectors are required. If any damaged or corroded connectors are present, photographs of the damaged connector(s) need to be provided in the "General/Site Information" section of the evaluation form regardless of designation level being sought. Photographs can be added to the **Finished Elevation Photos** portion of the form.

## For Evaluators Only: Evaluation Form Input

Photographs of the foundation and connectors from perimeter beam to foundation need to be uploaded in the "General/Site Information" section of the evaluation form regardless of designation level being sought. Photographs can be added to the **Finished Elevation Photos** portion of the form.





# Corrosion-Resistant Fasteners

## Technical Bulletin FH 2018-01

### First Release:

March 20, 2018

### Prepared by:

Fred Malik, Vice President,  
FORTIFIED Building Programs

### Applicable Standards:

FORTIFIED Home™–Hurricane

### Applicable Designation Level:



## New Documentation Requirements

### Abstract

Metals exposed to salt and moisture in the air in coastal areas are highly susceptible to accelerated corrosion. The intent of this bulletin is to highlight the requirement for metal structural connections and materials fasteners used to retrofit or construct FORTIFIED buildings less than 3,000 ft. from saltwater to be suitably protected from corrosion. The corrosion resistance outlined in the FORTIFIED standards is not new; however, there are new documentation requirements.

### Introduction

The minimum fastener and connector corrosion-protection retrofit requirements for FORTIFIED Home are outlined in Appendix D (page 85) of the FORTIFIED Home–Hurricane standards at [DisasterSafety.org/wp-content/uploads/FORTIFIED-Home-Hurricane-Standards-2012.pdf](https://www.disastersafety.org/wp-content/uploads/FORTIFIED-Home-Hurricane-Standards-2012.pdf).

### Appendix D: Corrosion Protection Retrofit Requirements

Fasteners/ Connector	Structures within 300 ft. of saltwater	Structures more than 300 ft. but less than 1000 ft. from saltwater <sup>1</sup>	Structures more than 1000 ft. but less than 3000 ft. from saltwater	Structures more than 3000 ft. from saltwater
Roofing nails for shingles	Stainless steel	Stainless steel	Hot dip galvanized <sup>4</sup>	Corrosion resistant <sup>5</sup>
Concrete and clay roof tile fasteners	Stainless steel	Stainless steel	Hot dip galvanized <sup>4</sup>	Corrosion resistant <sup>5</sup>
Metal roof clips and fasteners (exposed)	Stainless steel	Stainless steel	Stainless steel	Corrosion resistant <sup>5</sup>
Fasteners used for attachment of underlayment to roof deck	Hot dip galvanized <sup>4</sup>	Hot dip galvanized <sup>4</sup>	Hot dip galvanized <sup>4</sup>	Corrosion resistant <sup>5</sup>
Aluminum soffits	Not allowed	Not allowed	Not allowed	Allowed
Soffit and roof vent fasteners	Stainless steel	Stainless steel	Stainless steel	Corrosion resistant <sup>5</sup>
Metal framing connectors, fasteners, anchors, and hangers in exposed areas <sup>2</sup>	Stainless steel	Stainless steel	Stainless steel	Stainless steel or G185 galvanized
Metal framing connectors, fasteners, anchors, and hangers in vented enclosed areas <sup>3</sup>	Stainless steel	Stainless steel or G185 galvanized coating	Stainless steel or G185 galvanized coating	Corrosion resistant <sup>5</sup>



# Corrosion-Resistant Fasteners

## Technical Bulletin FH 2018-01

### First Release:

March 20, 2018

### Prepared by:

Fred Malik, Vice President,  
FORTIFIED Building Programs

### Applicable Standards:

FORTIFIED Home™—Hurricane

### Applicable Designation Level:



<sup>1</sup>Buildings on open, elevated foundations within 1,000 ft of saltwater shall follow the requirements of structures within 300 ft of saltwater.

<sup>2</sup>Examples of exposed areas include areas that are under roof overhangs, decks and covered walkways, or in any location that is openly or partially exposed to saltwater air.

<sup>3</sup>Examples of vented enclosed areas include attics with vents.

<sup>4</sup>Hot-dip galvanized shall meet the requirements of ASTM A153, Class D for nails and screws.

<sup>5</sup>Corrosion-resistant nails and screws shall meet the requirements of ASTM A641, Class 1 or an equal corrosion resistance by coating, galvanization, stainless steel, or other suitable corrosion-resistant material. Corrosion-resistant sheet metal connectors, anchors and hangers shall meet the requirements of ASTM A653, G90.

## FORTIFIED Home Evaluators Only: New Applications & Evaluation Form Input

When a new residential application is made, a notification will appear if the address is within a coastal zip code. You will be asked to select one of four approximate distances from a shoreline.

**3. Property Address**

\*Address Line1 :

Address Line2 :

\*City :

\*State :

\*ZIP / Postal Code :

\*Country :

**Mailing Address** ☐ If Mailing Address is

\*Address Line1 :

Address Line2 :

**NOTE:** This home is in a coastal region. If the home is within 3000 linear feet of a salt water shore, special corrosion resistant requirements apply for all designation levels. See [Appendix D](#) of the FORTIFIED Standards - Hurricane.

Distance From Salt Water Shore:

300' or less

More than 300' but less than 1000'

More Than 1000' but less than 3000'

More than 3000'

For reference, there is a direct weblink to Appendix D within the note.



# Corrosion-Resistant Fasteners

## Technical Bulletin FH 2018-01

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FORTIFIED Building Programs

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## FORTIFIED Home Evaluators Only: Documentation Requirements

If the distance from a saltwater shoreline is MORE than 3,000 ft, no additional documentation is required. If the distance is LESS than 3,000 ft, documentation of the corrosion-resistant connections and fasteners used on the home is now required. This information will be entered on the first page of the evaluation.

Photographs of labels, copies of invoices, and/or field delivery tickets indicating corrosion-resistance level for the connections and fasteners used are required. Photographs of the connections and fasteners should also be provided in this location.



# Corrosion-Resistant Fasteners

## Examples

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GULF SHORES, AL			
Actions		Notes	
Item Code	Description	Qty/Footage	Price
	EZ-FIT 17134 HDG 1-1/2"X.148 PP 2M JOIST HANGER NAIL 34DG	2 BOX	5
	EZ-FIT 650385 3X120 HDG RING 33D 2.5M/CTN	2 BOX	8
	EZ-FIT 650383 2-3/8"x.113 RS HDG 2.5M	2 BOX	6
	STAINLESS STEEL JOIST HANGER 17154 PNEU 1-1/2X148 1M	2 BOX	11
	MFM WIND AND WATER SHIELD SMOOTH 2SQ/F	4 EA	11
	FRM RT7A-SS STAINLESS STEEL HURRICANE C	100 EA	
	SPF 2X6-18 #2 & BTR. SPRUCE-PINE-FIR	10 pc	1





### Technical Bulletin FH 2018-02

**First Release:**

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**Prepared by:**

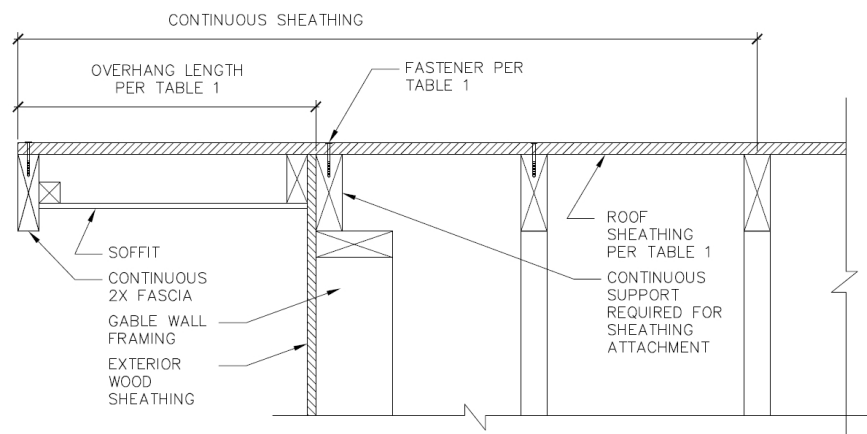
Remington Brown,  
Senior Engineering Director

**Applicable Standards:**

FORTIFIED Home™–Hurricane

**Applicable Designation Level:**

## Gable End Overhangs and Roof Sheathing Fastening: Re-Roofing to Meet FORTIFIED Roof™ – New Roof Designation



### Applicable Conditions

1. Re-roofing projects only.
2. FORTIFIED Roof – New Roof designation only. FORTIFIED Silver™ or FORTIFIED Gold™ designations for existing homes with gable overhangs greater than 12 in. require retrofit in accordance with [TB2017-02](#), revised March 21, 2018.

### Abstract

Attachment requirements for roof sheathing along the gable end truss or rafter to achieve a FORTIFIED Roof – New Roof designation have been enhanced to allow roofers, in most cases, to complete necessary retrofits without having to engage a general contractor. Exceptions, which still require structural modifications by a general contractor, include vented gable rakes and gable ends with overhangs greater than those shown in Table 1 on page 2 of this document.



# Gable End Roof Sheathing Fastening Requirements

## Technical Bulletin FH 2018-02

### First Release:

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### Prepared by:

Remington Brown,  
Senior Engineering Director

### Applicable Standards:

FORTIFIED Home™–Hurricane

### Applicable Designation Level:



## FORTIFIED Roof – New Roof Requirements

Roof sheathing shall be continuously fastened to the top of the gable wall with the minimum fastener size and spacing specified in Table 1 below. These solutions are limited to the maximum overhang length listed in Table 1 and to gable ends with roof sheathing continuously supported by and attached to the gable wall framing.

For gable rake overhangs exceeding the maximum overhang length in Table 1 or for unsupported gable rakes, a professional engineer must develop a building-specific solution.

**Table 1. Roof Sheathing Minimum Fastening Requirements at the Gable Truss or Rafter**

Roof Sheathing Thickness	Maximum Overhang Length	Attachment
7/16–1/2 in. OSB or plywood	18 in.	8d ring-shank nails at 4 in. o.c.
19/32–3/4 in. OSB or plywood	18 in.	10d ring-shank nails at 4 in. o.c.
1x6 or narrower planks	24 in.	(2) 10d common nails per plank
1x8 to 1x10 planks	24 in.	(3) 10d common nails per plank

## Compliance Verification Requirements

The re-nailing of the deck at all applicable gable end overhangs is to be documented and verified by a certified FORTIFIED evaluator. Acceptable documentation includes but may not be limited to the following:

- Pictures of roof deck nailed in accordance with Table 1.
- Size, type and spacing of the fastener attaching the roof sheathing to the gable end must be listed in the RE-NAILING section of the Roofing Compliance Form.





# Gable End Roof Sheathing Fastening Requirements

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## Completing Evaluation Form (For FORTIFIED Evaluators Only)

### In the FOCUS software:

**Photos** showing roof sheathing attachment at the gable wall that clearly illustrate the fastener spacing conforms to Table 1 requirements must be uploaded by the Evaluator as additional photos in the Roof Deck section of FOCUS under “Roof deck fastener count.”

Roof deck fastener count in 48" location 1



From inside the attic, if adequate access exists, verify roof sheathing is supported at the top of the gable wall. If roof sheathing support at the gable end wall cannot be verified from within the attic, evaluator should select “Partial” under Attic Accessibility, in the Roof Deck portion of the evaluation form. Then describe limited access (e.g., Gable end sheathing support cannot be verified due to limited attic access).

Attic accessibility

Partial



If access is Partial or None, describe what restricts access? (Type n/a, if not applicable)

Gable end sheathing support can not be verified due to limited attic access