A PROGRAM OF IBHS

FORTIFIED COMMERCIAL™

WIND STANDARDS

2019

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1 Introduction

The Insurance Institute for Business & Home Safety's (IBHS) FORTIFIED Commercial™ resilience standard addresses specific natural hazard risks and provides recommendations for reducing damage particular to that risk. The FORTIFIED Commercial™–Wind standard helps building owners improve their commercial structure's ability to resist damage from hurricanes and tropical and convective storms. Incorporating FORTIFIED features when building or re-roofing will transform a commercial building into a more resilient and durable asset.

FORTIFIED Commercial employs an incremental approach toward making new and existing commercial buildings more resistant to damage from severe weather. With three levels of FORTIFIED Commercial designation available—FORTIFIED Roof™, FORTIFIED Silver™, and FORTIFIED Gold™—builders can work with owners to choose a desired level of protection that best suits their budgets and resilience goals. Note: To properly address this weather hazard, some requirements vary depending on the structure's location in a hurricane-prone region versus a high-wind-prone region as defined in section 1.4. These differences are noted throughout this document. Additionally, due to the nature of commercial construction and occupancy, FORTIFIED Roof requirements for FORTIFIED Commercial are more stringent than FORTIFIED Roof requirements for IBHS's residential construction standard, FORTIFIED Home™.

The following sections outline eligibility requirements for the FORTIFIED Commercial program for all designation levels. Designation certificates issued by IBHS verifying that a commercial building's design and construction is in accordance with the FORTIFIED Commercial standards are currently available in the state of Alabama. Buildings in other states are eligible for certification letters verifying compliance with the FORTIFIED Commercial standards.

1.1 Occupancy and Land Use

Use and Occupancy: Classifications are primarily based on Chapter 3, Section 302 of the 2018 International Building Code. Eligible groups include Assembly (A-1, A-2, A-3, and A-4), Business (B), Educational (E), Factory/Industrial (moderate- and low-hazard factory/industrial only: F-1, and F-2), Institutional (I-1, I-2, I-3, and I-4), Mercantile (M), Residential (R-1, R-2, R-3, and R-4), and Storage (moderate- and low-hazard storage: S-1 and S-2). Excluded groups include High-Hazard and appurtenances such as barns and sheds. IBHS and the FORTIFIED Commercial Evaluator have the discretion and reserve the right to determine a building's eligibility for the program based on use and occupancy.

FORTIFIED Commercial standards are to be applied in conjunction with federal, state, and local codes, ordinances, and regulations. In case of a conflict between provisions, use whichever regulation is more stringent.

Land Use: FORTIFIED Commercial is not intended to supersede local and municipal policy concerning land use and locations deemed safe to build commercial structures. Additionally, IBHS believes it is unwise to construct any building in areas that are especially prone to natural hazards. These include low-lying barrier islands and coastal regions, areas near known seismic fault lines or major levees, and steep slopes potentially subject to erosion. A FORTIFIED Commercial–designated structure constructed in one of the aforementioned areas will still maintain a reduced risk of damage but may be more vulnerable than if it were constructed in a less risk-prone area.

1.2 Foundation Qualification Requirements

1.2.1 Ineligible Foundations

Commercial buildings on a foundation constructed of unrestrained stacked masonry or stone (a dry-stack foundation) are NOT eligible for any FORTIFIED Commercial designation.

1.2.2 Elevated Floor Building-to-Foundation Connections

To be eligible for designation, re-designation, or to obtain a compliance letter under the FORTIFIED Commercial program, commercial buildings 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, buildings on piers or pilings must have connections from the tops of the piers/pilings to the building's floor beams and a building 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 section 3.1.4 of this standard, and installed per the connector manufacturer's installation instructions. All structural connections must be engineered and specified by the structural engineer of record.

1.2.3 All Other Foundations

1.2.3.1 New construction

All other new foundation systems must be engineered and specified by the structural engineer of record.

1.2.3.2 Existing conditions

Existing foundation systems must have adequate positive connections from the floor or wall structure to the supporting foundation. When seeking FORTIFIED Gold, the existing foundation

systems must be evaluated by the structural engineer of record. Additional information and on-site testing may be required to verify the structural capacity of the existing conditions.

1.3 IBHS Contact Information

For more detailed information about how to make your commercial building stronger, please visit fortifiedcommercial.org. You also can contact:

- **Christopher Cioffi**, Commercial Lines Engineer
  (813) 286-3400, ccioffi@ibhs.org

1.4 Definitions

Ballasted roofing system: a roofing system where the membrane is not anchored or adhered in any way to the decking material; it is kept in place using river-washed stones or paver blocks.

Ballasted roof-mounted equipment: equipment that is not mechanically attached to structural members; it is held down by concrete blocks or similar material.

Compliance letter: a letter issued by the FORTIFIED Commercial Evaluator verifying a commercial building's design and construction is in accordance with the FORTIFIED Commercial standards (FORTIFIED Roof, FORTIFIED Silver, or FORTIFIED Gold).

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.

Designation: a certificate issued by IBHS verifying a commercial building's design and construction is in accordance with the FORTIFIED Commercial standards (FORTIFIED Roof, FORTIFIED Silver, or FORTIFIED Gold); the building must be located in the state of Alabama to qualify.

Design pressure rating: the allowable wind pressure rating assigned to a roof, 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 which 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 a specific requirement has been met.

Drip edge: metal flashing installed at eaves and along gable rake edges on steep-sloped roofs.

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.

FORTIFIED Commercial application: an online form filled out and submitted by the building owner or design team. Information collected on this form determines whether the project is eligible to pursue a FORTIFIED designation (if located in Alabama) or seek a compliance letter (outside Alabama). An application can be filled out by visiting the IBHS FORTIFIED Commercial website.

FORTIFIED Commercial–Wind Low-Sloped Re-Roofing Form: a document that captures the specific existing construction details as well as re-roofing details (qualifications outlined in section 3.1.1.2.1). This document also captures the items necessary for an applicant to achieve FORTIFIED Silver and FORTIFIED Gold. It is to be filled out by the general contractor/roofer, structural engineer, or project architect. It confirms the re-roofing requirements and outlines the required documentation of the existing construction including photo documentation.

FORTIFIED Commercial–Wind New Construction and New Additions Form: a document that captures the specific construction details for new construction and additions to buildings (qualifications outlined in section 3.1.1.2.3). It is to be filled out by the project architect, a licensed structural engineer, and the general contractor and/or roofer. It confirms the requirements for the selected FORTIFIED level have been included in the building documents and the contractor and/or roofer is aware of these requirements.

FORTIFIED Commercial–Wind Steep-Sloped Re-Roofing Form: a document that captures the specific existing construction details as well as re-roofing details (qualifications outlined in section 3.1.1.2.2). This document also captures the items necessary for an applicant to achieve FORTIFIED Silver and FORTIFIED Gold. It is to be filled out by the general contractor/ roofer, structural engineer, or project architect. It confirms the re-roofing requirements and outlines the required documentation of the existing construction including photo documentation.

FORTIFIED Commercial Evaluator: a member of a third-party company certified by IBHS to complete the necessary reviews and evaluations to verify compliance of commercial buildings as FORTIFIED.

FORTIFIED Commercial Evaluator consulting agreement: a document that provides the terms and conditions between the FORTIFIED Commercial Evaluator and the client/building owner.

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.

High-wind-prone regions: areas NOT located in a hurricane-prone region.

Hurricane-prone regions: areas vulnerable to hurricanes as defined in ASCE.

- For ASCE 7-05, hurricane-prone regions are locations along the Gulf of Mexico and Atlantic coasts where the design wind speed is greater than 90 mph, plus Hawaii, Puerto Rico, the Virgin Islands, Guam, and American Samoa.

- For ASCE 7-10 and ASCE 7-16, hurricane-prone regions are locations along the Gulf of Mexico and Atlantic coasts where the wind speed for Risk Category II buildings is greater than 115 mph, plus Hawaii, Puerto Rico, the Virgin Islands, Guam, and American Samoa.

Re-covering: the application of a new roof cover over an existing system. This not permitted for FORTIFIED Commercial.

Re-roofing: the replacement of a roof cover when an existing roof cover system is completely removed and stripped down to the roof deck.

Impact resistant/rated: products or materials specified in this standard that meet the ASTM E1996 large missile test rating.

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 building if the primary roof covering is damaged or lost due to high winds.

2 Program Overview

The following sections outline the general features of each level of the FORTIFIED Commercial–Wind standard. (For more detailed requirements for each level, see Section 3 of this document.) In addition, this overview section provides guidance and suggested best practices for whole-building flood protection and resilience in hail-prone areas.

2.1 FORTIFIED Roof

Enhanced Roof Performance

- Roof-related components and connections shall meet ASCE 7 wind load requirements with a factor of safety as defined in Section 3.1.1.3 Roof Design Load Requirements.
    - For ASCE 7-05 based design, the appropriate Risk Category and Importance Factor shall be used, with a minimum Risk Category II.
    - For ASCE 7-10 and ASCE 7-16 based design, the appropriate Risk Category design wind speed shall be used, with a minimum Risk Category II.
- Roof-related components include:
    - Roof cover anchorage and condition
    - Roof cover edge flashing and attachment
    - Roof deck attachment and anchorage of cantilever overhangs
    - Gutter strength/attachment
    - Anchorage of roof-mounted structures and equipment (including photovoltaic arrays and satellite dishes/communication devices)
    - Skylight pressure rating and impact resistance

2.2 FORTIFIED Silver

FORTIFIED Roof Requirements Plus Building Envelope Protection and Reduction of Business Operations Downtime

- All glazed openings in hurricane-prone regions shall be protected to minimize water and wind/wind pressure intrusion.
- Wall systems shall be designed with code-specified wind pressure resistance, and in hurricane-prone regions shall be impact resistant similar to that for protected glazed openings.
- Exterior entry doors shall be rated for the code-specified wind pressure resistance, and in hurricane-prone regions shall be either impact rated or protected by a qualified impact-rated system.
- Large exterior commercial doors shall be rated for the code-specified wind pressure resistance, and in hurricane-prone regions shall have a qualified impact rating.
- Parapets and false fronts shall be adequately braced and anchored.
- Electrical and mechanical equipment and connections shall be protected from flood/water damage in hurricane-prone regions.
- Enhanced continuity of electrical utilities for critical systems shall be provided to maintain/quickly restore business operations in hurricane-prone regions.

2.3 FORTIFIED Gold

FORTIFIED Silver Requirements Plus Enhanced Structural Performance and Maintaining Business Operations

- A continuous load path shall be verified from roof to ground to resist both uplift and lateral loads.
- Canopies shall be adequately anchored/supported.
- Backup power shall be provided.

2.4 Other Considerations

2.4.1 Flood

While protecting electrical and mechanical systems from flood is a requirement of FORTIFIED Silver, whole-building protection against the flood hazard is not required under FORTIFIED Commercial. However, IBHS strongly recommends the following mitigation steps be taken for FEMA-designated flood zones including V, A, B, D, and X-shaded:

- Elevate the building's first finished floor above the 500-year flood level (if known) or 3 ft above the base flood elevation (BFE) for the property. If the building is not sufficiently elevated as described above, it is recommended that dry flood protection such as flood gates, walls, or doors, inflatable barriers, sand bags, or similar devices be used to prevent water intrusion to the heights described above. Flood depth, duration, velocity, and condition of water should be considered (including floating debris).

- Buildings should have a check valve or similar backflow device installed at the point of entry into the building on the sanitary line to prevent sewage from potentially flowing back into the building during a flood.

2.4.2 Hail

The hail hazard is NOT required to be mitigated under FORTIFIED Commercial. However, if located in a hail-prone area as shown in Figure 1, IBHS **recommends** the following design parameters to reduce exposure.

Hail-Prone Counties

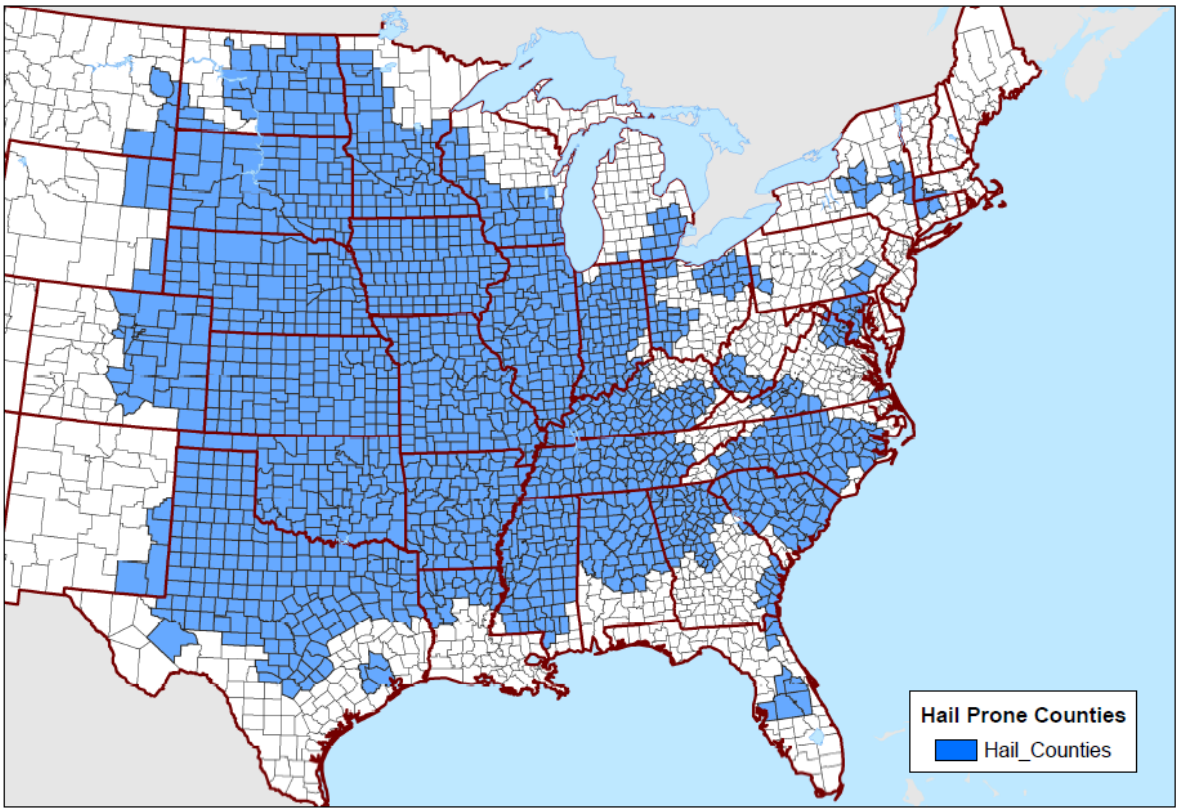

Figure 1. The hail-prone counties shown here are based on hail reports compiled by the Storm Prediction Center. Counties in blue are subject to a high frequency of damaging hailstorms with a maximum hailstone size of 1 in. or larger. Source: IBHS

2.4.2.1 Hail-Impact-Resistant Roof Cover (Recommended)

IBHS recommends installing a hail-impact-resistant roof cover that meets the standards listed under the Hail-Related Performance Criteria for Roofing located in section 5.1 of Appendix A.

Best Practices: *IBHS recommends protecting the mechanical fasteners and plates that secure insulation boards on low-sloped roof covers by placing them below an adhered coverboard and roof cover.*

2.4.2.2 Roof-Mounted Equipment Hail Guard (Recommended)

IBHS recommends installing hail guards on air conditioner condenser fins, air intakes such as fans, and any other vulnerable component that, if struck by hail, can impair the operation of the unit.

2.4.2.3 Photovoltaic (PV) System Hail Damage Resistance (Recommended)

IBHS recommends installing PV modules that are hail damage resistant and listed under the Hail-Related Performance Criteria located in section 5.1 of Appendix A.

3 FORTIFIED Commercial Requirements

3.1 FORTIFIED Roof

3.1.1 Roof System Overview

Eligible roof cover systems include class A fire-rated covers that are part of new construction or replacement roof covers when an existing roof cover system is completely removed and stripped down to the roof deck (re-roofing). Re-covering applications are not permitted.

See section 5.2 of Appendix A for listed approved systems. Additionally, roof systems shall meet the wind uplift load requirements specified in section 3.1.1.3.

Existing roof cover systems that meet the minimum FORTIFIED Commercial requirements and have been installed within 10 years may qualify. An evaluation by a FORTIFIED Commercial Evaluator is required including a physical inspection and review of all design and installation documentation. The FORTIFIED Commercial Evaluator may require in-situ tests such as a moisture survey, uplift, or similar test, if sufficient documentation of records is not available.

3.1.1.1 Re-evaluation

FORTIFIED Commercial designations (FORTIFIED Roof, FORTIFIED Silver, and FORTIFIED Gold; available only in Alabama) are valid for a period of 5 years from the certificate issue date. The re-designation inspection focuses on the design and construction items of each respective level.

Third-party-issued compliance letters for FORTIFIED Commercial(FORTIFIED Roof, FORTIFIED Silver, and FORTIFIED Gold; outside of Alabama) are valid for a period of 5 years from the issue date. The re-compliance inspection focuses on the design and construction items of each respective level.

To ensure a roof system continues to retain its durability and the building continues to remain eligible for a designation or compliance letter using the IBHS FORTIFIED Commercia program, a re-evaluation shall occur every 5 years as part of the required re-designation or re-compliance audit. The evaluation will be similar to an initial inspection that includes a physical inspection of the roof cover, roof edge securement, and any roof-related items that may affect the performance of the cover, as well as a review of roof cover design, installation, and maintenance records, repairs, improvements, etc. The FORTIFIED Commercial Evaluator may require an in-situ test such as a moisture survey, uplift or similar test, if sufficient documentation of records is not available.

Since low-sloped (≤10°) roof systems can conceal performance issues due to undetected moisture, leaks, and material degradation, and these issues worsen with age, these roof cover systems may require an in-situ test to maintain their FORTIFIED status or compliance.

Additionally, the items outlined in FORTIFIED Silver and FORTIFIED Gold will be re-evaluated if the building is seeking a re-designation at those levels. This will include re-evaluation of items outlined in section 3.2 and/or 3.3.

3.1.1.2 Additions and re-roofing

Existing buildings with wood frame roofs must be constructed in accordance with the 2000 IBC or later for eligibility. In addition, the following sections describe requirements for re-roofing and constructing additions to an existing building.

3.1.1.2.1 Re-roofing low-sloped (≤10°) roof cover systems

If re-roofing, all roof decks shall be evaluated for any rust, rotting, or any other condition that may reduce the integrity of the deck. If the deck includes lightweight insulating concrete, gypsum, cementitious wood-fiber or similar materials, the deck also must be evaluated for moisture, cracks, or brittleness, and insulation fastener pull tests shall be conducted.

Structural roof deck must be re-evaluated to verify that its capacity meets the field, perimeter, and corner component and cladding wind pressure requirements of ASCE 7 as outlined in section 3.1.1.3.1.

Structural roof deck attachments must be re-evaluated to verify that their capacity meets the field, perimeter, and corner component and cladding wind pressure requirements of ASCE 7 for the building location with the adjustments in design/allowable pressures outlined in section 3.1.1.3.

An option is to through-fasten, so that fasteners penetrate through the bottom of the structural deck. For example, gypsum and cementitious wood-fiber decks may include through-fastened toggle bolts. Lightweight insulating concrete on steel form may include through-fastened insulation fasteners that penetrate the steel form below the lightweight insulating concrete.

All necessary repairs to the roof deck shall be completed prior to installation of a new roof cover system.

3.1.1.2.2 Re-roofing steep-sloped (>10°) roofs

Inspect the wood 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 ¼ in. of the surface is deteriorated or damaged, the members shall be evaluated by the structural engineer of record to ensure they have sufficient residual capacity to handle all design loads and shall be repaired or replaced per the structural engineer of record.

Where roof deck is removed, the removed portions shall not be reused. New roof deck shall be used and fastened per 3.1.3.2.1.

Structural roof deck must be re-evaluated to verify that its capacity meets the field, perimeter, and corner component and cladding wind pressure requirements of ASCE 7 as outlined in section 3.1.1.3.1.

Structural roof deck attachments (existing and added fasteners) must be evaluated to verify that their capacity meets the field, perimeter, and corner component and cladding wind pressure requirements of ASCE 7 for the building location with the adjustments in design/allowable pressures outlined in section 3.1.1.3.

3.1.1.2.3 Additions to existing buildings

Commercial properties constructing additions to an existing building are eligible for a FORTIFIED Commercial designation or compliance letter under the following conditions:

1. Extension to the Existing Roof
    a. Connected Roof Structure: a condition where the addition's roof structure has any structural interaction with the existing structure (gravity, lateral, etc.).
        i. Existing structural deck and framing members capacity must meet the requirements of section 3.1.1.3.1 and be verified by the structural engineer of record. Structural deck attachments shall meet the design requirements of section 3.1.1.3. Structural interactions between the addition and existing structure shall be engineered (i.e., diaphragm action).
    b. Expansion Joint: a condition where the addition's roof structure is separated by an expansion joint and there is no structural interaction between the existing roof and the new roof.
        i. Existing structural deck and framing members capacity must meet the requirements of section 3.1.1.3.1 and be verified by the structural

engineer of record. Structural deck attachments shall meet the design requirements of section 3.1.1.3.

2. Addition Roof at a Different Elevation: a condition where the addition's roof is at a different elevation than the existing roof. The existing roof and the new roof have no structural interaction.
    i. Existing structural deck and framing members capacity must meet the requirements of section 3.1.1.3.1 and be verified by the structural engineer of record. Structural deck attachments shall meet the design requirements of section 3.1.1.3.

If seeking a FORTIFIED Silver or FORTIFIED Gold designation or compliance letter, the addition and the existing building must both follow the standards outlined in section 3.0. All existing conditions' compliance with the standards shall be verified and may require additional on-site testing (invasive/noninvasive) to verify capacity as requested by the FORTIFIED Commercial Evaluator.

3.1.1.3 Design load requirements

3.1.1.3.1 Design parameters

For ASCE 7-05 based design, the appropriate Risk Category and Importance Factor shall be used, with a minimum Risk Category II.

For ASCE 7-10 and ASCE 7-16 based design, the appropriate Risk Category design wind speed shall be used, with a minimum Risk Category II.

Exposure Category must be a minimum "C" or "D" as defined by ASCE 7.

3.1.1.3.2 Factor of safety

The minimum required factor of safety is 2.0 for ASCE 7-05 and ASCE 7-10, and 1.67 for ASCE 7-16 based on allowable stress design (ASD) loads, unless a higher factor of safety is required for a particular assembly, system, element, fastener, or connection. The ultimate strength of the building assembly, element, fastener, or connection shall meet or exceed the load on that assembly, element, fastener, or connection using one of the following calculated wind loads:

1. ASCE 7-05 ASD Method: Calculated ASD wind load x 2 (minimum required factor of safety)

2. ASCE 7-05 Load and Resistance Factor Design (LRFD) Method: Calculated LRFD wind load/1.6 x 2 (minimum required factor of safety)

3. ASCE 7-10 ASD Method: Calculated ASD wind load x 2 (minimum required factor of safety)

4. ASCE 7-10 LRFD Method: Calculated LRFD wind load x 0.6 x 2 (minimum required factor of safety)

5. ASCE 7-16 ASD Method: Calculated ASD wind load x 1.67 (minimum required factor of safety)

6. ASCE 7-16 LRFD Method: Calculated LRFD wind load

3.1.2 Design Requirements for Low-Sloped Roof Systems (≤10°)

Low-sloped roof applications with continuous-type membrane roof assemblies such as built-up roof, modified bitumen, single-ply, hybrids, and metal panel roofs, must be designed for the appropriate wind pressures of ASCE 7 for the field, perimeter, and corners with the adjustments outlined under the Design Load Requirements in section 3.1.1.3.

3.1.2.1 Low-sloped continuous roof covers

Low-sloped continuous roof covers with an approved product approval found in section 5.3 of Appendix A are permitted, provided the adjustments are made in design/allowable pressures outlined under Design Load Requirements in section 3.1.1.3.

3.1.2.1.1 Single-ply membrane (SPM)

A) Peel-Stop: Single-ply roof covers shall include a perimeter peel-stop with a termination bar or similar, located 1–2 ft from the roof edge. Mechanically attached systems with fasteners 1–2 ft from the roof edge do not require an additional peel-stop.

B) Mechanically Attached - SPM On Steel Decks: Mechanically attached membranes shall have their sheets and fasteners installed perpendicular to the steel deck ribs.

C) Ballasted, Roof Pavers, and Pedestal Systems:

In **hurricane-prone regions,** stone ballast, roof pavers for ballast applications, plaza decks or terrace pavers shall NOT be permitted. This includes loosely laid, interlocked, mechanically connected, and all pedestal systems.

In **high-wind-prone regions**, stone ballast, roof pavers for ballast applications, plaza decks or terrace pavers shall meet the minimum uplift requirements as defined in section 3.1.1.3 and shall be installed in accordance with FM Data Sheet 1-29 and ANSI/SPRI

RP-4. Structural calculations, uplift tests and/or additional documentation may be requested by the FORTIFIED Commercial Evaluator.

3.1.2.1.2 Structural and architectural metal roof panel systems

Structural metal panel roof systems on open framing members and nonstructural architectural metal roof panels on solid wood sheathing with any of the product approvals found in section 5.4 of Appendix A are permitted, provided adjustments are made in design/allowable pressures as outlined in section 3.1.1.3.

3.1.2.1.3 Vegetative roof systems

Vegetative roof systems shall NOT be permitted in **hurricane-prone regions**. This includes intensive, simple intensive (semi-intensive), and extensive green roof systems.

In **high-wind-prone regions**, only extensive and simple intensive (semi-intensive) vegetative roof systems with an active FM RoofNav number or Miami-Dade NOA are permitted. Extensive vegetative roofs have growth less than 6 in. in depth and simple intensive (semi-intensive) vegetative roofs have growth from 6 to 8 in. in depth. Structural calculations, uplift tests and/or additional documentation may be requested by the FORTIFIED Commercial Evaluator.

3.1.2.1.4 Built-up roofing systems

Built-up roofing systems with pea-size, loosely laid gravel are NOT permitted in **hurricane-prone regions**. Built-up roofing systems with pea-size gravel that is fully embedded in asphalt are permitted.

3.1.2.2 Structural roof deck

Structural roof deck shall be capable of resisting the loads and load combinations specified in ASCE 7 as outlined in section 3.1.1.3.1.

Structural roof deck attachments shall be designed for field, perimeter, and corner component and cladding wind pressures requirements of ASCE 7 for the building location with the adjustments in design/allowable pressures outlined in section 3.1.1.3.

3.1.2.3 Roof edge flashing, coping, and counter-flashing

Roof edge flashing, coping, and counter-flashing shall be designed and tested in accordance with ANSI/SPRI/FM 4435/ES-1 for ASCE 7 design wind pressures as outlined in section 3.1.1.3.

3.1.2.3.1 Wood nailers

Wood nailers shall comply with the design guidance in section 2.2.2 of the FM Data Sheet 1-49.

Provide wood nailers when recommended by the manufacturer or when required for fastening of flashing or the edge of the roof assembly. When roofs meet at parapets or vertical walls, it is acceptable to secure the roof assembly, when required, to the deck without a wood nailer.

Use minimum 1½-in. by 5½-in. (40-mm by 140-mm) wood nailers of pressure-treated or untreated Douglas Fir, Southern Yellow Pine, or wood having similar decay-resistant properties. The maximum unsupported overhang is 2 in. (50 mm), in which case minimum 1½-in. by 7¼-in. (38-mm by 185-mm) nailers are needed, secured with two rows of staggered fasteners.

3.1.2.3.2 Wood nailer securement

Securement of wood nailers shall comply with the design guidance in section 2.2.2 of the FM Data Sheet 1-49. Use corrosion-resistant fasteners compatible with the wood nailer. When the wood nailer is treated wood, use stainless steel, hot-dipped galvanized steel complying with ASTM A153 (or equivalent) or fasteners with propriety coatings recommended by the manufacturer for use in the specific type of treated wood. Bolts should be of sufficient length for all threads in the nuts to be fully engaged.

3.1.2.4 Gutter systems

Gutter systems consisting of gutters, gutter straps, gutter brackets, joints, fasteners, and roof flanges shall be designed in accordance with ANSI/SPRI GD-1 (2010) or ANSI/SPRI GT-1 (2016) with the adjustments in design/allowable pressures outlined in section 3.1.1.3.

Notes:

A. ANSI-SPRI GD-1 document includes a minimum factor of safety of 1.67 (see section 2.0 of ANSI-SPRI GD-1). A minimum 2.0 factor of safety as outlined in section 3.1.1.3 shall be applied.
B. ANSI-SPRI GT-1 document does not include a minimum factor of safety. A minimum 2.0 factor of safety as outlined in section 3.1.1.3 shall be applied to the maximum test loads obtained.

3.1.3 Design Requirements for Steep-Sloped Roofs (>10°)

3.1.3.1 Structural roof deck

3.1.3.1.1 Plywood and OSB

Roof sheathing must be capable of resisting the loads and load combinations specified in ASCE 7 as outlined in section 3.1.1.3.1. 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 $^{7}/_{16}$ in.

Best Practices: *Use plywood for roof sheathing instead of OSB. Plywood has 30 percent greater impact resistance than oriented strand board (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 must be capable of resisting the loads and load combinations specified in ASCE 7 as outlined in section 3.1.1.3.1. The minimum thickness is $^{15}/_{32}$-in. plywood. However, manufacturer installation guidelines, evaluation reports, and site-specific design requirements may require a roof deck material greater than $^{15}/_{32}$-in. plywood.

Engineering calculations verifying the structural capacity of the deck may be required by the FORTIFIED Commercial Evaluator.

3.1.3.1.2 Sawn lumber or wood boards

Sawn lumber or wood board roof deck must be capable of resisting the loads and load combinations specified in ASCE 7 as outlined in section 3.1.1.3.1.

3.1.3.1.3 Steel decks

Steel deck must be capable of resisting the loads and load combinations specified in ASCE 7 as outlined in section 3.1.1.3.1.

3.1.3.2 Structural roof deck attachments

3.1.3.2.1 Structural wood panel roof sheathing (plywood or OSB)

Table 1 describes the fastening requirements for OSB and plywood sheathing on steep-sloped (>10°) wood framing members. Engineering calculations are required for roofs with a peak height over 30 ft. Roof zones and dimension "a" shall be in accordance with ASCE 7.

Table 1. Sheathing Fastening

<table>
<tr><th rowspan="2">Roof Peak Height[A]</th><th rowspan="2">Max Roof Member Spacing</th><th rowspan="2">Roof Square Footage</th><th rowspan="2">Sheathing Thickness</th><th rowspan="2">Fastener Type</th><th colspan="3">Fastener Spacing Along Structural Members</th></tr>
<tr><th>Field</th><th>Perimeter</th><th>Corner</th></tr>
<tr><td rowspan="3">H ≤ 30 ft</td><td rowspan="3">24 in. o.c.</td><td rowspan="2">Less than or equal to 5,000 sq ft</td><td>7/16–5/8 in.</td><td>8d ring-shank nails</td><td colspan="3">4 in.</td></tr>
<tr><td>> ⅝ in.</td><td>10d ring-shank nails</td><td>6 in.</td><td>4 in.</td><td>4 in.</td></tr>
<tr><td>Greater than 5,000 sq ft</td><td rowspan="2">Shall be capable of resisting the loads and load combinations specified in ASCE 7 as outlined in section 3.1.1.3.1[C]</td><td rowspan="2">Fasteners selected by engineer[B]</td><td colspan="3" rowspan="2">Shall be designed for component and cladding wind pressures requirements of ASCE 7 for the building location with the adjustments in design/allowable pressures outlined in section 3.1.1.3[C]</td></tr>
<tr><td>H > 30 ft</td><td>Member spacing designed by engineer</td><td>-</td></tr>
</table>

A. Roof Peak Height refers to the dimension of the tallest part of the roof from grade.
B. All fasteners shall be ring-shank nails or screws unless otherwise noted and approved by IBHS. The following restrictions shall be used in determining fastener size and spacing:
    a. Size and spacing shall be based on loads calculated for the largest tributary area assigned to any of the panel fasteners.
    b. No increase in allowable withdrawal values for load duration effects is allowed.
C. Calculations for uplift and lateral loads (diaphragm action) for sheathing and fasteners required.

Ring-shank nails shall either meet or exceed the length and diameter dimensions provided below or meet the Roof Sheathing Ring Shank (RSRS-01) nail specifications in ASTM F1667 (nails identified as "F1667 NLRSRS"). Note that RSRS-02 through RSRS-05 nail sizes included in ASTM F1667 have larger diameters and lengths than RSRS-01 fasteners and consequently will have greater withdrawal capacities. The increased withdrawal capacity may be limited by head pull-through for thinner sheathing, such as 7/16 in. versus 19/32 in.

Clipped-head ring-shank nails are not acceptable for attachment of structural wood roof sheathing panels. The specific minimum required dimensions and characteristics for the ring-shank nails (Figure 2) to be used for roof sheathing attachment are:

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

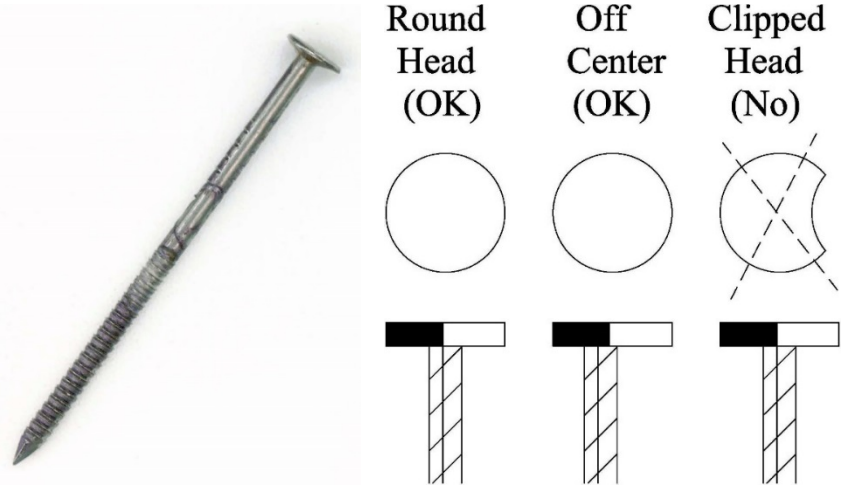

Figure 2. Use 8d ring-shank nails when attaching roof sheathing. Research indicates that panels attached with ring-shank nails have about twice the uplift capacity compared to panels attached with the same size smooth-shank nails.

3.1.3.2.2 Sawn lumber or wood board roof deck

Attachments shall be designed in accordance with the uplift requirements outlined in section 3.1.1.3.

3.1.3.2.3 Steel decks

Attachments shall be designed in accordance with the uplift requirements outlined in section 3.1.1.3.

3.1.3.3 Sealed roof deck

Steep-sloped roof cover installations require a sealed roof deck system that keeps water out of the attic and the interior of the building in the event the roof covering is damaged during a hurricane.

3.1.3.3.1 Options for shingle or metal roof covers

Sealed Roof Deck Option 1: Tape the 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 (American Architectural Manufacturers Association) 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 an ASTM D226 Type II (#30) or ASTM D4869 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 Type IV. Look for ASTM D4869 felt that is labeled Type IV. ASTM D4869 Type I, Type II, or Type III 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 ⅛ 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 3.1.3.4 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 3. Installing a sealed roof deck system; taping the seams of roof sheathing.

Sealed Roof Deck Option 2: 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. 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 ⅛ 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 3.1.3.4 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.

Sealed Roof Deck Option 3: Install two (2) layers of ASTM D226 Type II (#30) or ASTM D4869 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 Type IV. Look for ASTM D4869 felt that is labeled Type IV. ASTM D4869 Type I, Type II or Type III will NOT be accepted.

The starter course of felt is to be installed as described below and shown in Figure 4. 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 IV (#30) underlayment over the 19-in.-wide course of ASTM D226 Type II (#30) or ASTM D4869 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 underlayment layer 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. Use annular-ring or deformed-shank nails with 1-in.-diameter thin metal disks (“tincaps”).

Installation Notes:

- Best practice for drip edge installation: 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 roofs, seal the drip edge, underlayment, and starter strip at the eave by using a self-adhering starter strip or applying an 8-in.-wide layer of compatible flashing cement, maximum thickness ⅛ 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.

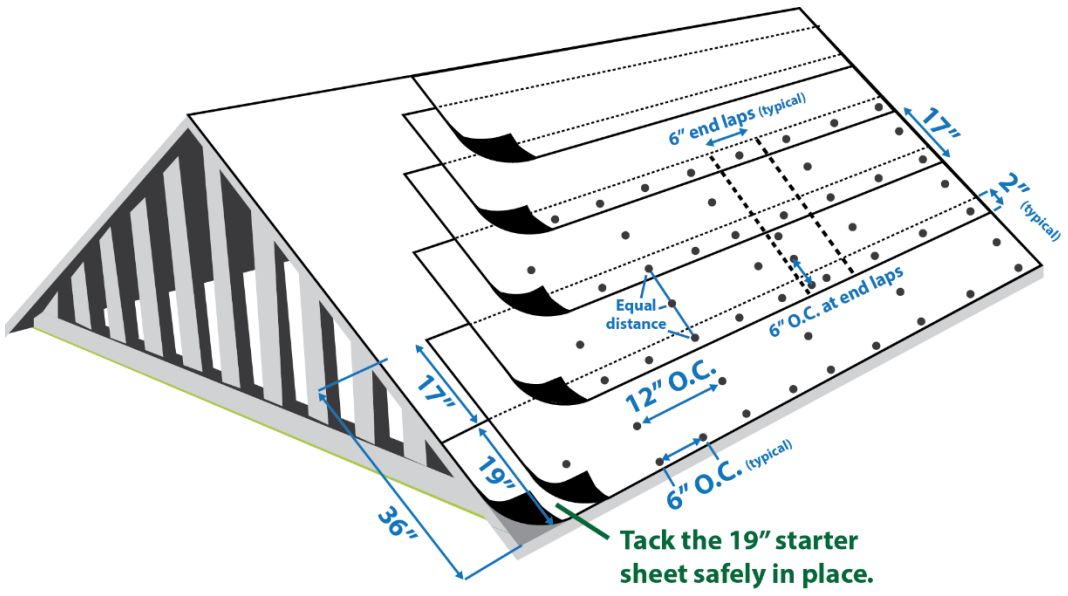

Figure 4. Installation of 19 in. starter course general notes

3.1.3.3.2 Options for concrete and clay tile roof covers

The following options qualify as sealed roof decks under clay and concrete roof tiles. In option 1, the self-adhering tape provides a required barrier against water intrusion in case the roofing felt begins to lift.

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 #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 3.1.3.4 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: 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 3.1.3.4 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.

3.1.3.4 Drip edge (edge flashing)

Provide a minimum 26-gauge galvanized 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 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 section 3.1.3.3 for the sealed roof deck option and roof cover selected.

3.1.3.5 Flashing (all non-edge flashing application)

Steep-sloped 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 non-edge flashing installation shall meet the requirements found in the 2018 IBC and the product manufacturer's installation instructions.

3.1.3.6 Approved steep-sloped roof covering

Roof coverings and their attachment shall be rated for the design wind speeds and parameters outlined in section 3.1.1.3 and installed in accordance with the manufacturer's recommendations for high-wind regions.

3.1.3.6.1 Asphalt shingles

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

Table 2. Design Wind Speed and Shingle Testing Standards (h<60 ft)

Wind Speed (V_{asd})	Wind Speed (V_{ult})	Shingle Wind Testing Standard/Classification
100 MPH	129 MPH	ASTM D3161 (Class F) or ASTM D7158 (Class G or H)[1]
110 MPH	142 MPH	
120 MPH	155 MPH	
130 MPH	168 MPH	ASTM D3161 (Class F) or ASTM D7158 (Class H)[1]
140 MPH	180 MPH	
150 MPH	194 MPH	

[1] 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 2018 IBC.

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 3.1.3.3 and 3.1.3.4. 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 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.

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 ⅛ 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 ⅛ 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 ¼ 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 ¼ 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 ⅛ in. Cut side of closed valleys shall be set in a minimum 2-in.-wide, ⅛-in.-thick strip of flashing cement. Woven valleys to be according to the manufacturer's specifications.

3.1.3.6.2 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 in section 3.1.3.3.2.

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.

3.1.3.6.3 Architectural metal panels

Structural metal panel roof systems on open framing members and nonstructural architectural metal roof panels on solid wood sheathing with any of the product approvals found in section 5.4 of Appendix A are permitted, provided adjustments are made in design/allowable pressures as outlined in section 3.1.1.3.

Architectural metal panels shall be installed over continuous decking and one of the acceptable sealed roof deck underlayment options from section 3.1.3.3.1.

3.1.3.6.4 Other steep-sloped roof coverings

For all other roof coverings, the designer must provide documentation showing the roof covering was designed to meet the ASCE 7 building-specific parameters outlined in section 3.1.1.3.1. The attachments were designed for the component and cladding wind pressures corresponding to areas to section 3.1.1.3.

3.1.3.7 Attic ventilation system resistance to wind-driven water intrusion

The following requirements address additional vulnerabilities to wind-driven water intrusion.

3.1.3.7.1 Ridge and off-ridge vents

Ridge vents, off-ridge vents, and turbines 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.

3.1.3.7.2 Gable end vents

IBHS recommends against including gable end vents in new commercial buildings built in hurricane-prone regions. (Research indicates that gable end vents are more susceptible to water intrusion than vents at other locations.) 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.

3.1.4 Corrosion Protection—Materials

Fasteners and connectors shall have corrosion protection based on the building's proximity to salt water. Table 3 provides approved guidance.

Best Practices: *While it may not be required, IBHS recommends the use of stainless steel as corrosion protection in all locations.*

Table 3. FORTIFIED Commercial Corrosion Protection Requirements

Fasteners/ Connector	Structures within 300 ft of saltwater	Structures more than 300 ft but less than 1,000 ft from saltwater[1]	Structures more than 1,000 ft but less than 3,000 ft from saltwater	Structures more than 3,000 ft from saltwater
All Applications				
Mechanical units (HVAC) fasteners and connections	Stainless steel	Stainless steel	Hot-dip galvanized[4]	Corrosion resistant[5]
Mechanical unit (HVAC) curbs	Stainless steel	Stainless steel	Hot-dip galvanized[4]	Corrosion resistant[5]
Photovoltaic unit fasteners and connections	Stainless steel	Stainless steel	Hot-dip galvanized[4]	Corrosion resistant[5]
Other roof-mounted equipment fasteners and connections	Stainless steel	Stainless steel	Hot-dip galvanized[4]	Corrosion resistant[5]
Exposed structural connections	Stainless steel	Stainless steel	Hot-dip galvanized[4]	Corrosion resistant[5]
Low-Sloped Applications				
Wood nailer fasteners	See section 3.1.2.3.2 for more information			
Steep-Sloped Applications				
Roofing nails for shingles	Stainless steel	Stainless steel	Hot-dip galvanized[4]	Corrosion resistant[5]
Concrete and clay roof tile fasteners	Stainless steel	Stainless steel	Hot-dip galvanized[4]	Corrosion resistant[5]
Metal roof clips and fasteners (exposed)	Stainless steel	Stainless steel	Stainless steel	Corrosion resistant[5]
Fasteners used for attachment of underlayment to roof deck	Hot-dip galvanized[4]	Hot-dip galvanized[4]	Hot-dip galvanized[4]	Corrosion resistant[5]
Aluminum soffits	Not allowed	Not allowed	Allowed	Allowed
Soffit and roof vent fasteners	Stainless steel	Stainless steel	Stainless steel	Corrosion resistant[5]
Metal framing connectors, fasteners, anchors, and hangers in exposed areas[2]	Stainless steel	Stainless steel	Stainless steel	Stainless steel or G185 galvanized

Metal framing connectors, fasteners, anchors, and hangers in vented enclosed areas[3]	Stainless steel	Stainless steel or G185 galvanized coating	Stainless steel or G185 galvanized coating	Corrosion resistant[5]

[1] Buildings on open, elevated foundations within 1,000 ft of saltwater shall follow the requirements of structures within 300 ft of saltwater
[2] 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
[3] Examples of vented enclosed areas include attics with vents
[4] Hot-dip galvanized shall meet the requirements of ASTM A153, Class D for nails and screws
[5] 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 hangars shall meet the requirements of ASTM A653, G90

3.1.5 Skylights

Skylights and their attachments shall be designed and detailed for the ASCE 7 wind speed and provide an uplift resistance with a minimum factor of safety as described in section 3.1.1.3. Installation shall meet the air and water infiltration requirements of ASTM E330 and ASTM E331. The curb installation shall be confirmed by a licensed professional engineer that it will meet the required uplift minimum factor as described in section 3.1.1.3.

- When the ASCE 7-05 design wind speed is ≥100 mph (ASCE 7-10 and ASCE 7-16 when appropriate Risk Category design wind speed is ≥120 mph), large missile impact-resistant skylights are required. They shall meet, at a minimum, ASTM E1886 cyclic pressure test requirements and be ASTM E1996 large missile impact rated.

- When the ASCE 7-05 wind speed is ≥130 mph (ASCE 7-10 and ASCE 7-16 when appropriate Risk Category design wind speed is ≥165 mph), skylights shall also meet AAMA 520-09.

- Options for approved skylight systems include:

    - FM Approved per ANSI FM 4431, with large missile impact rating

    - Miami-Dade County Approved, with large missile impact rating

3.1.6 Roof-Mounted Equipment

3.1.6.1 Roof-mounted structures and equipment

Roof-mounted structures and equipment and their attachments shall be designed in accordance with ASCE 7-10 Section 29.5.1 “Rooftop Structures and Equipment for Buildings with h ≤ 60 ft” or ASCE 7-16 Section 29.4 “Rooftop Structures and Equipment for Buildings.” They shall be

designed with a minimum factor of safety 2.0 for ASCE 7 ASD loads (1.67 for ASCE 7-16 based ASD design loads) as described in section 3.1.1.3.

3.1.6.2 Photovoltaic (PV) systems

PV systems and their attachments shall be designed using wind loads in accordance with ASCE 7-16, SEAOC PV2, or a model-scale wind tunnel study that meets the requirements of ASCE 49-12. A minimum factor of safety as described in section 3.1.1.3 is required. The roof deck shall be designed to support the increased PV array loads with appropriate load combinations, including live loads, wind, rain, and snow (including drifts). For additional approved systems, see section 5.5 of Appendix A.

See ASCE 7-16, C29.3.1 for more information regarding the risk category and additional design guidance for roof-mounted PV.

3.1.6.2.1 Additional PV building risks recommendations

While this document focuses on wind loads and hail risks for PV systems, IBHS strongly recommends that all additional building risks be addressed including: the increased combustibility from above the deck, which may lead to re-classification of the exterior fire rating of the roof cover system; snow, hail, seismic, electrical, and fire hazards; and firefighting hazards. Periodic inspection, maintenance, and repair should include the prevention of roof cover puncturing, debris accumulation, and proper water-shedding of the roof cover to allow drainage, which will prevent overloading of the roof. The use of a cover board is recommended in new roof cover systems to increase puncture resistance.

Best Practices: *When installing PV panels on a low-sloped roof, ensure the row spacing between the panels is wide enough for maintenance crews to service damaged panels. If the panels are installed too close together, perimeter panels may need to be removed to access interior ones.*

3.1.6.3 Roof-mounted antennas, satellite dishes and communication equipment

All roof-mounted antennas, satellite dishes, and other communication equipment and their connections must be designed for the design load requirements defined in section 3.1.1.3.

For both hurricane- and high-wind-prone regions, ballasted roof-mounted antennas, satellite dishes, and communication equipment are <u>not</u> permitted.

3.1.7 Lightning Protection Systems (LPS)

Roof-mounted lightning protection systems shall be designed and installed for wind resistance in accordance with FEMA - Rooftop Attached Lightning Protections Systems in High-Wind

Regions. The information outlined in this section 3.1.7 highlights the key components of the FEMA document. Refer to the link above for more information and additional guidance.

3.1.7.1 Parapet attachment

For parapets greater than 12 in. tall, all air terminal base plates and conductor connectors must be mechanically attached with 12-in. screws that have a minimum 1.25-in. embedment into the inside face of that parapet nailer and properly sealed for watertight protection.

In lieu of conductor connectors that have prongs, it is **required** that mechanically attached looped connectors are used.

3.1.7.2 Adhered single-ply membranes, built-up, and modified bitumen

For adhered single-ply membranes, air terminal base plates must be attached with pourable sealer (type recommended by the manufacturer).

For built-up and modified bitumen roofs, air terminal base plates must be attached with asphalt roof cement.

Option 1: Instead of conductor connector clips, 9-in.-wide minimum by 3-ft-long strips of modified bitumen cap sheet should be placed over the conductor and attached to the membrane. If the strips are torch-applied, do not overheat the conductors. Start the strips 3 in. from either side of the air terminal base. Follow the next strip with a 3-in.-wide break in between strips along the conductor.

Option 2: Adhesive-applied conductor connectors that do not rely on prongs must be spaced no more than 6 in. o.c. in the corner zones of the roof and shall be spaced no more than 12 in. o.c. in the field and perimeter (zones designated by ASCE 7).

3.1.7.2 Mechanically attached single-ply membranes

Conductor and conductor connectors must be placed parallel with and within 8 in. of the membrane fastener row. When a conductor falls between or is perpendicular to membrane fastener rows, install additional row of membrane fasteners where the conductor will be located. Install a cover strip over the membrane fasteners. Place the conductor over the cover strip and secure using one of the following methods (Note: Air terminal base plates must be attached with pourable sealer (type recommended by the manufacturer):

Option 1: Instead of conductor connector clips, 9-in.-wide (minimum) by 3-ft-long strips of modified bitumen cap sheet should be placed over the conductor and attached to the membrane. If the strips are torch-applied, do not overheat the conductors. Start the strips 3 in.

from either side of the air terminal base. Follow the next strip with a 3-in.-wide break in between strips along the conductor.

Option 2: Adhesive-applied closed (looped) conductor connectors that do not rely on prongs must be spaced no more than 6 in. o.c. in the corner zones of the roof and shall be spaced no more than 12 in. o.c. in the field and perimeter (zones designated by ASCE 7).

3.1.7.3 Standing seam metal roofs

Pre-manufactured mechanically attached clips (panel clips) shall be used and anchored to the roof panel ribs. The air terminal base plates and closed (looped) connectors shall be attached to the panel clips. These connections shall be spaced no more than 6 in. o.c. in the corners and 12 in. o.c. in the perimeter and field (zones designated by ASCE 7).

3.1.7.4 Conductor splice connectors

Bolted splice connectors are required in lieu of pronged connectors. If strips of flashing membrane are used to connect the terminal to the membrane, the strip must start 3 in. from the splice to minimize the conductor movement. If closed connectors are used, they shall be placed 3 in. from the splice.

3.1.8 Low-Sloped (≤ 10°) Roof-Mounted Safety Rails

All low-sloped roof-mounted safety rails and their connections must be designed in accordance with IBC 2015/2018 and ASCE 7-10/7-16.

A calculation set must be submitted to the FORTIFIED Commercial Evaluator including all wind design parameters, member selection and design, connection details, and capacity verification, and the supporting structural member calculations. Shop drawings must be submitted. The FORTIFIED Commercial Evaluator may request more information to determine the safety rail system compliance with the standards.

3.1.9 Low-Sloped Roof Equipment Screens

Low-sloped roof equipment screens and their connections shall be designed to meet the ASCE 7 building-specific parameters outlined in section 3.1.1.3.1.

3.2 FORTIFIED Silver

All Roof requirements shall be satisfied.

3.2.1 Openings

3.2.1.1 Windows, curtain walls, sliding doors, and commercial doors

In **hurricane-prone regions,** windows, curtain walls, sliding doors, and commercial doors including roll-up, sectional doors, and entrance doors must be pressure rated for pressures associated with the ASCE 7 design wind speed and exposure category “C” or “D” to match the walls below. All openings located within 30 ft of grade shall be impact rated or protected with an impact-rated protection system that, at a minimum, meets ASTM E1886 cyclic pressure and E1996 large missile impact requirements. Glazing 30 ft or higher above grade shall be rated for the design pressure and small missile impact.

In **high-wind-prone regions**, windows, curtain walls, and doors including roll-up, sectional doors, and entrance doors must be capable of resisting the loads and load combinations specified in ASCE 7 as outlined in section 3.1.1.3.1. Impact resistance is not required in high-wind-prone regions.

3.2.1.2 All glazed openings and exterior personnel doors

In **hurricane-prone regions**, all glazed openings, including windows, sliding glass doors, and exterior personnel doors with or without windows located within 30 ft of grade, shall be impact rated or protected with an impact-rated protection system that, at a minimum, meets ASTM E1886 cyclic pressure and E1996 large missile impact requirements. Glazing 30 ft or higher above grade shall be rated for the design pressure and small missile impact.

In **high-wind-prone regions**, windows, curtain walls, and doors including roll-up, sectional doors, and entrance doors must be pressure rated for pressures associated with the ASCE 7 design wind speed and exposure category “C” or “D” to match the walls below. Impact resistance is not required in high-wind-prone regions.

3.2.2 Wall Systems

Exposure Category shall be a minimum “C” or “D” as defined by ASCE 7.

3.2.2.1 Exterior walls

Exterior walls shall be capable of resisting ASCE 7 wind loads for the appropriate wall wind pressure zone.

3.2.2.2 Wall impact resistance

In **hurricane-prone regions**, wall impact resistance shall be adequate to meet the requirements of ASTM E1886 and ASTM E1996 for the impact of a 9-lb nominal 2-in. x 4-in. lumber missile impacting end-on at 34 mph (50 ft/s) [large missile impact level D]. Systems that meet the intent of this requirement include but are not limited to: reinforced concrete block masonry; precast concrete; cast-in-place concrete; solid insulated concrete forms; reinforced brick; brick with concrete block backing; metal panel; insulated metal panels; ¾-in. plywood; ≥$^{7}/_{16}$-in. wood structural panel sheathing with one of the following finishes: brick veneer, ½-in. stucco, ½-in.-thick wood, or ½-in. fiber-cement-based planking; and ≥⅝-in.-thick wood structural panel sheathing with vinyl or aluminum siding.

In **high-wind-prone regions**, impact resistance is not required.

3.2.2.3 Exterior insulating finishing systems (EIFS)

In **hurricane-prone regions**, exterior insulating finishing systems (EIFS) installed on a metal or wood frame shall not be permitted unless they are a **Miami-Dade County Approved** system. EIFS installed over masonry are acceptable.

In **high-wind-prone regions**, EIFS are permitted.

For all existing EIFS that meet these criteria, a qualified professional shall inspect the EIFS and provide supporting documentation regarding its condition. EIFS that are not visibly damaged, deteriorated, chipped or cracked, that have structurally sound horizontal and vertical seals including around windows and penetrations, are free of leaks, and have at least 5 years of useful life remaining are eligible for a FORTIFIED Silver designation. EIFS that do not meet these conditions and/or do not have at least 5 years of useful life remaining will require repairs or replacement to be eligible for a FORTIFIED Silver designation.

3.2.2.4 Parapets

Parapets and false fronts shall be designed for the ASCE 7 wind speed and associated design pressure. Parapets and false fronts greater than 3 ft shall include internal or external bracing with supporting documentation.

3.2.3 Gable Ends

3.2.3.1 Gable end wall strength

Gable end walls shall be designed in accordance with ASCE 7 for the site-specific conditions.

3.2.3.2 Gable end wall sheathing

Gable end wall sheathing shall have sufficient strength and fastening to resist wall design wind pressures specified in ASCE 7 for the site-specific conditions. The wall system shall, at a minimum, provide the resistance to wind pressures and debris impact of a $^{7}/_{16}$-in. OSB wood structural panel attached to wood wall framing.

3.2.3.3 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.

3.2.3.4 Gable end overhangs

Gable end overhangs must be constructed and attached to gable framing to resist the site-specific ASCE 7 wind uplift loads. Additional calculations are required for overhangs greater than 12 in.

3.2.3.5 Gable end rake soffits

Gable end rake soffits shall be unvented.

3.2.4 Electrical and Mechanical Systems and Connections (Flood Protection)

All electrical and mechanical equipment and connections necessary to operate critical systems shall be elevated at minimum above the 500-year flood level, if known, or 3 ft above the base flood elevation (BFE) for the property. If the equipment cannot be sufficiently elevated as described above, permanent dry flood protection such as flood gates, walls, doors, or similar devices shall be used to prevent water intrusion to the heights described above. Flood depth, duration, velocity, and condition of water shall be considered (including floating debris).

3.2.5 Electrical Connections for Backup Power

In **hurricane-prone regions**, electrical connections shall be installed with a transfer switch or docking station (sometimes referred to as a storm switch) in order to support connection of backup power for critical electrical and mechanical systems All connections shall be located above the 500-year flood level if known, or 3 ft above the known base flood elevation (BFE) or design flood elevation (DFE) for the property.

In **high-wind-prone regions**, it is recommended (not required) that electrical connections be installed with a transfer switch or docking station (sometimes referred to as a storm switch) in order to support connection of backup power. All connections should be located above the 500-year flood level if known, or 3 ft above the known base flood elevation or design flood elevation for the property.

3.3 FORTIFIED Gold

All FORTIFIED Roof and FORTIFIED Silver requirements must be satisfied.

3.3.1 Continuous Load Path

A continuous and adequate load path from the roof to the foundation of the building shall be provided. The building shall have positive connections from the roof to foundation to transmit wind uplift and lateral loads safely to the ground. This includes providing:

- Continuous load path through the wall to the foundation on inter-story connections in multi-story structures.

The load path shall be designed by a licensed professional engineer and installed per design with supporting documentation verifying the installation.

3.3.2 Structural Members of Cantilever Overhangs

Structural members of cantilever overhangs must be adequately anchored and designed for the ASCE 7 design wind pressures as outlined in section 3.1.1.3.1.

3.3.3 Attached and Accessory Structures

Convenience store canopies, car ports, porte cocheres, or any other vehicle-type drive-through structures shall have adequate load path members and connections to resist the loads and load combinations specified in ASCE 7 as outlined in section 3.1.1.3.1.

3.3.4 Securing Chimneys

Ensure that other attached structures such as chimneys shall have adequate load path members and connections must be capable of resisting the loads and load combinations specified in ASCE 7 as outlined in section 3.1.1.3.1.

3.3.5 Backup Power

Backup power shall be available and capable of powering critical electrical and mechanical systems that maintain vital business operations. All equipment shall be installed in accordance with the requirements of Electrical Systems (Flood) described in section 3.2.4.

Note: In some cases where life support functions are necessary (i.e., nursing homes, rehab centers, assisted/independent living facilities, hospital or similar) HVAC shall be considered a critical system to maintain business operation.

4 Supporting Documentation

Supporting documentation to be reviewed by the FORTIFIED Commercial Evaluator is needed for each FORTIFIED Commercial requirement and may include any one or a combination of the following:

- Design/development building drawing
- 100% construction drawings signed and sealed by a licensed professional engineer
- A confirmation letter with supporting documentation from a licensed professional engineer stating that the installation meets a specific requirement; the professional engineer should have a license from the state where the referenced building is located
- Photographs
- Building material submittals including but not limited to structural decks and roofing components
- Roof cover attachment details provided by manufacturer/contractor
- Any requested structural engineering calculations
- FORTIFIED Commercial Compliance Forms (including “New Construction Form,” “Low-Sloped Re-Roofing” and “Steep-Sloped Re-Roofing”) completed by a licensed architect or professional engineer
- Any other documents requested by the FORTIFIED Commercial Evaluator or IBHS

5 Appendix A: Approved and Performance Tested Systems

5.1 Hail-Impact-Related Performance Criteria (Recommended)

IBHS **recommends** the following hail impact-resistant roof covers:

Roof covers for low-sloped roofs (≤10° or less than 2/12 pitch):

- FM Approval Standard 4470 with a Class 1-SH or 1-VSH
- UL 2218 Class 4

Roof covers for steep-sloped roofs (>10° or greater than 2/12 pitch):

- FM Approval Standard 4473 Class 4
- UL 2218 Class 4

IBHS recommends the following for PV system hail damage resistance:

- Flexible PV modules that are FM Approved for hail or meet FM Approval Standard 4476 that includes a Severe Hail rating.
- Rigid PV modules that are FM Approved for hail or meet FM Approval Standard 4478 that includes a Class 4 rating.
- Rigid modules that meet UL 1703 Standards for Flat-Plate Photovoltaic Modules and Panels.

5.2 Fire-Rated Approved Roof Systems

Eligible tested and approved roof covers include those that are class A fire-rated by:

- ASTM
- FM
- UL

5.3. Approved Low-Sloped Continuous Roof Covers

Eligible tested and approved roof cover systems include those that are:

- Florida Product Approval (FPA) approved

- FM Approved
- ICC-Evaluation Services (ICC-ES) approved
- Miami-Dade Approved
- Texas Department of Insurance (TDI) approved
- UL Rated

Search tools are listed below in each of the following approved system.

5.3.1 Florida Product Approval (FPA) Approved Systems

- Multiple Systems: Select separate FPA-approved systems rated for each area: field, perimeter, and the corner.

- Single System: Select an FPA-approved system rated for the corner area uplift pressures and use it for the entire roof.

- Single System - Enhanced Fastening: In some instances, FPA does permit edge (perimeter/corner) enhancements. Enhancements must follow provisions stated in corresponding active FPA Evaluation Report.

Please refer to the roof selection example from section 5.3.8 of Appendix A.

The design team shall document the following information regarding all current and active FPA-approved roof systems on the Project Construction Form & Compliance Checklist.

1. Location (field/perimeter/corner)
2. FL number
3. Uplift resistance
4. All material and securement details
5. Perimeter and corner enhancements
6. Enhancements calculations

The design team must submit a copy of the FPA Evaluation Report for each approved system to the FORTIFIED Commercial Evaluator. FPA Evaluation Reports can be found by using the search tool located at www.floridabuilding.org/pr/pr_app_srch.aspx.

5.3.2 FM Approved Systems

FM Approval Standard 4470 or 4474 with a **current and active** RoofNav number.

- Multiple Systems: Select separate FM approved systems rated for each area: field, perimeter, and the corner.

- Single System: Select an FM approved system rated for the corner area uplift pressures and use it for the entire roof.

- Note: For hurricane-prone areas, FM does not permit edge (perimeter/corner) enhancements.

Please refer to the roof selection example from section 5.3.8 of Appendix A.

The design team shall document the following information regarding all current and active FM-Approved roof systems on the Project Construction Form & Compliance Checklist.

1. Location (field/perimeter/corner)
2. FM assembly number
3. Roof system type
4. Uplift resistance
5. All material and securement details

The design team must submit a copy of the FM Assembly Report highlighting the selected assembly details for each approved system to the FORTIFIED Commercial Evaluator. FM Approved roof assemblies can be found by using the RoofNav® search tool located at www.roofnav.com.

5.3.3 ICC Evaluation Service (ICC-ES) Approved Systems

- Multiple Systems: Select separate ICC-ES–approved systems rated for each area: field, perimeter, and the corner.

- Single System: Select an ICC-ES–approved system rated for the corner area uplift pressures and use it for the entire roof.

- Single System - Enhanced Fastening: ICC-ES does not permit edge (perimeter/corner) enhancements.

Please refer to the roof selection example from section 5.3.8 of Appendix A.

The design team shall document the following information regarding all current and active ICC-ES–approved roof systems on the Project Construction Form & Compliance Checklist.

1. Location (field/perimeter/corner)
2. ESR report number
3. Division number
4. Section number
5. Table and system number

6. Uplift resistance
7. All material and securement details

The design team must also submit a copy of the ICC-ES Report for each approved system to the FORTIFIED Commercial Evaluator. ICC-ES Approved roof assemblies can be found by using the search tool located at www.icc-es.org/evaluation-report-program/reports-directory.

5.3.4 Miami-Dade County Approved Systems

Must have a **current and active** Notice of Acceptance (NOA). Please refer to Miami-Dade Product Control Search.

- Multiple Systems: Select separate Miami-Dade County approved systems rated for each area: field, perimeter, and the corner.

- Single System: Select a Miami-Dade County system rated for the corner area uplift pressures and use it for the entire roof.

- Edge (Perimeter/Corner) Enhancements: Select a system rated for the field. Perimeter and corner enhancements can be made in accordance with the Miami-Dade County Notice of Acceptance.

Please refer to the roof selection example from section 5.3.8 of Appendix A.

The design team shall document the following information regarding all current and active Miami-Dade Approved roof systems on the Project Construction Form & Compliance Checklist.

1. Location (field/perimeter/corner)
2. NOA number
3. Uplift resistance
4. All material and securement details

The design team must also submit a copy of the NOA Report for each approved system to the FORTIFIED Commercial Evaluator. Miami-Dade Approved roof assemblies can be found by using the search tool located at www.miamidade.gov/building/pc-search_app.asp.

5.3.5 Texas Department of Insurance (TDI) Approved Systems

- Multiple Systems: Select separate TDI-approved systems rated for each area: field, perimeter, and the corner.

- Single System: Select a TDI-approved system rated for the corner area uplift pressures and use it for the entire roof.

- Note: TDI does not permit edge (perimeter/corner) enhancements.

Please refer to the roof selection example from section 5.3.8 of Appendix A.

The design team shall document the following information regarding all current and active TDI-approved roof systems on the Project Construction Form & Compliance Checklist.

1. Location (field/perimeter/corner)
2. TDI Evaluation ID (RC-xxx)
3. Assembly number
4. Uplift resistance range
5. All materials and securement details

The design team must also submit a copy of the TDI Product Evaluation Report for each approved system to the FORTIFIED Commercial Evaluator. TDI Approved roof assemblies can be found by using the search tool located at www.tdi.texas.gov/wind/prod/indexrc.html.

5.3.6 UL Rated and Approved Systems

Tested and approved UL systems must meet the testing procedures outlined in either UL 580 - Tests for Uplift Resistance of Roof Assemblies or UL 1897 - Uplift Tests for Roof Covering Systems. Per UL, the appearance of a company's name or product in this database does not in itself assure that products so identified have been manufactured under UL's Follow-Up Service. Only those products bearing the UL Mark should be considered to be Certified and covered under UL's Follow-Up Service. Always look for the Mark on the product.

- Multiple Systems: Select separate UL-approved systems rated for each area: field, perimeter, and the corner.

- Single System: Select a UL-approved system rated for the corner area uplift pressures and use it for the entire roof.

- Note: UL-rated systems do not permit edge (perimeter/corner) enhancements.

Please refer to the roof selection example from section 5.3.8 of Appendix A.

The design team shall document the following information regarding all current and active TDI-approved roof systems on the Project Construction Form & Compliance Checklist.

1. Location (field/perimeter/corner)
2. UL product number (found on the top right of the product specification report)

3. Option number (each report includes several assembly options with corresponding uplift capacities)
4. Uplift resistance
5. All materials and securement details

The design team must submit a copy of the UL Product Specification Report for each approved system to the FORTIFIED Commercial Evaluator. Product Specification Reports can be found by using the UL search tool located: http://productspec.ul.com/index.php

5.3.7 Directory of Roof Assemblies

As an option to search for roofing systems, Single Ply Roofing Industry (SPRI) has created Directory of Roof Assemblies (DORA). DORA is a web application database of roof systems tested in accordance with standards referenced in Chapter 15 of the International Building Code (IBC). This service lists tested ultimate wind uplift load capacities on single-ply and modified bitumen roof systems. Assemblies may be searched, viewed, saved, and printed.

It is important to note that the uplift capacities within DORA are ultimate pressures and will require to be divided by 2 for design uplift pressures required by section 3.1.1.3

5.3.8 Roof Cover Selection Example

The following example, along with Tables A-1 and A-2, can be used to help determine the system needed based on uplift values.

Building Parameters:

- Width: 100 ft
- Length: 100 ft
- Height: 60 ft
- Roof Slope: ≥7° (Low-sloped roof)
- Wind Velocity: 160 mph
- Wind Exposure Category: D
- Risk Category: III
- Escarpment: Flat

Note: Although this is an example of a low-sloped roof without overhangs, roof peaks for roofs with a steep slope (>10°) and overhangs must be addressed when applicable.

Use the ASCE 7-10 figures 30.5-1 (net design wind pressures) to obtain the components and cladding wind pressures for Zone 1, Zone 2, and Zone 3. Use the adjustment factor (λ) from the same figure to account for building height and exposure category. Results

are listed in *Table 2. Roof Selection Example Using Wind Design Pressures LRFD and ASD.*

Table A-1. Roof Selection Example Using Wind Design Pressures LRFD and ASD

Zone	Ultimate (LRFD) Pressure (psf) from Figure 30.5-1 @ 10 sq ft	Adjustment Factor (h=60 ft and Exposure=D)	Adjusted Ultimate (LRFD) ASCE 7-10 Design Pressures (psf)	Adjusted Allowable (ASD) ASCE 7-10 Design Pressures (psf) [Ultimate x 0.6]
Zone 1	18.7/-46.1	1.87	35.0/-86.2	21.0/-51.7
Zone 2	18.7/-77.3	1.87	35.0/-144.6	21.0/-86.8
Zone 3	18.7/-116.3	1.87	35.0/-217.5	21.0/-130.5
Zone 4	46.1/-50.0	1.87	86.2/-93.5	51.7/-51.6
Zone 5	46.1/-61.7	1.87	86.2/-115.4	51.7/-69.2

Using Table A-2. FM/FPA/ICC-ES/Miami-Dade/TDI Roof Selection/UL as a guide, use the newly calculated ASD values to select an appropriate FM or Miami-Dade system.

Multiple Systems

Using multiple FM approved systems, Zone 1 (51.7 < 60) shall be a minimum of FM 1-105 rated, Zone 2 (86.8 < 90) shall be a minimum of FM 1-180, and Zone 3 (130.5 < 135) shall be a minimum of FM 1-270.

Using multiple UL approved systems, Zone 1 (51.7 < 60) shall be a minimum of 105 rated, Zone 2 (86.8 < 90) shall be a minimum of 180, and Zone 3 (130.5 < 135) shall be a minimum of 270.

Using multiple FPA/ ICC-ES/Miami-Dade/TDI approved systems (see section 3.1.2.1 for more information), Zone 1 shall be a minimum of 51.7 rated, Zone 2 shall be a minimum of Miami-Dade 86.8 rated, and Zone 3 shall be a minimum of 130.5 rated.

Single System

Using a single system, select a roof cover that is sufficient for the corner (Zone 3 [130.5 < 135]) wind uplift pressures. Use an FM 1-270, a UL 270 rating, or an FPA/ ICC-ES/ Miami-Dade/ TDI 135 for all zones of the roof.

Edge (Perimeter/Corner) Enhancements

In some cases, FPA does permit edge (perimeter/corner) enhancements. Enhancements must follow provisions stated in corresponding active FPA Evaluation Report.

FM edge (perimeter/corner) enhancements are not permitted.

ICC-ES/ TDI/ UL does not permit edge (perimeter/corner) enhancements.

Using a Miami-Dade approved system, select a roofing system rated for the field. If permitted by the Notice of Acceptance (NOA), edge enhancements may be provided. To calculate these enhancements, refer to the specific system NOA.

Table A-2. FM/FPA/ICC-ES/ Miami-Dade/TDI/UL Roof Selection

ASCE 7-10 Uplift Values (LRFD) (psf)	ASCE 7-10 Uplift Values (ASD) (psf)	Minimum FM Rated	UL Approved	Minimum FPA/ ICC-ES/ Miami-Dade/TDI Rated
≤50	≤30	1-60	60	30
≤62.5	≤37.5	1-75	75	37.5
≤75	≤45	1-90	90	45
≤87.5	≤52.5	1-105	105	52.5
≤100	≤60	1-120	120	60
≤112.5	≤67.5	1-135	135	67.5
≤125	≤75	1-150	150	75
≤137.5	≤82.5	1-165	165	82.5
≤150	≤90	1-180	180	90
≤170.8	≤102.5	1-205	205	102.5
≤175	≤105	1-210	210	105
≤195.8	≤117.5	1-235	235	117.5
≤200	≤120	1-240	240	120
≤212.5	≤127.5	1-255	255	127.5
≤225	≤135	1-270	270	135
≤237.5	≤142.5	1-285	285	142.5
≤250	≤150	1-300	300	150
≤262.5	≤157.5	1-315	315	157.5
≤275	≤165	1-330	330	165
≤287.5	≤172.5	1-345	345	172.5
≤300	≤180	1-360	360	180
≤312.5	≤187.5	1-375	375	187.5
≤325	≤195	1-390	390	195
≤337.5	≤202.5	1-405	405	202.5

Note: Available uplift values and approvals may exceed the values included in this table.

5.4 Approved Structural and Architectural Metal Roof Panel Systems

Approved structural metal panel roof systems on spaced supports and nonstructural architectural metal roof panels on solid wood sheathing include those approved by the following:

- Florida Product Approval (FPA)
- FM Approved
- ICC-Evaluation Services (ICC-ES)
- Miami-Dade Approved
- Texas Department of Insurance (TDI)
- UL Rated

5.5 Additional Approved Photovoltaic (PV) Systems

The following are additional approved PV systems:

- Rigid PV modules that are FM Approved or meet FM Approval Standard 4478 (wind uplift, combustibility from above the deck).
- Flexible PV modules that are FM Approved or meet FM Approval Standard 4476.
- PV system with an ICC AC 428 Evaluation Report
- Must meet UL 1703 and UL 2703

6 References

American Architectural Manufacturers Association (AAMA)

American Society for Civil Engineers - Minimum Design Loads for Buildings and Other Structures

American Wood Council - National Design Specifications (NDS) for Wood Construction

Federal Emergency Management Agency - 2006 Rooftop Attached Lightning Protection Systems in High-Wind Regions

Federal Emergency Management Agency - Flood Map Service Center (https://msc.fema.gov/portal/home)

Florida Building Code

Florida Department of Business & Professional Regulation- Florida Product Approvals (FPA)

Florida High Wind Concrete and Clay Tile Installation Manual; Fifth Edition

FM Approvals

FM Global Data Sheets

ICC Evaluation Services

Miami-Dade County Approvals - Regulatory & Economic Resources

National Fire Protection Agency (NFPA) 780 - Standard for Installation of Lightning Protection Systems

Single Ply Roofing Industry

Texas Department of Insurance (TDI)

TRI/FRSA Installation Manual

Underwriters Laboratories