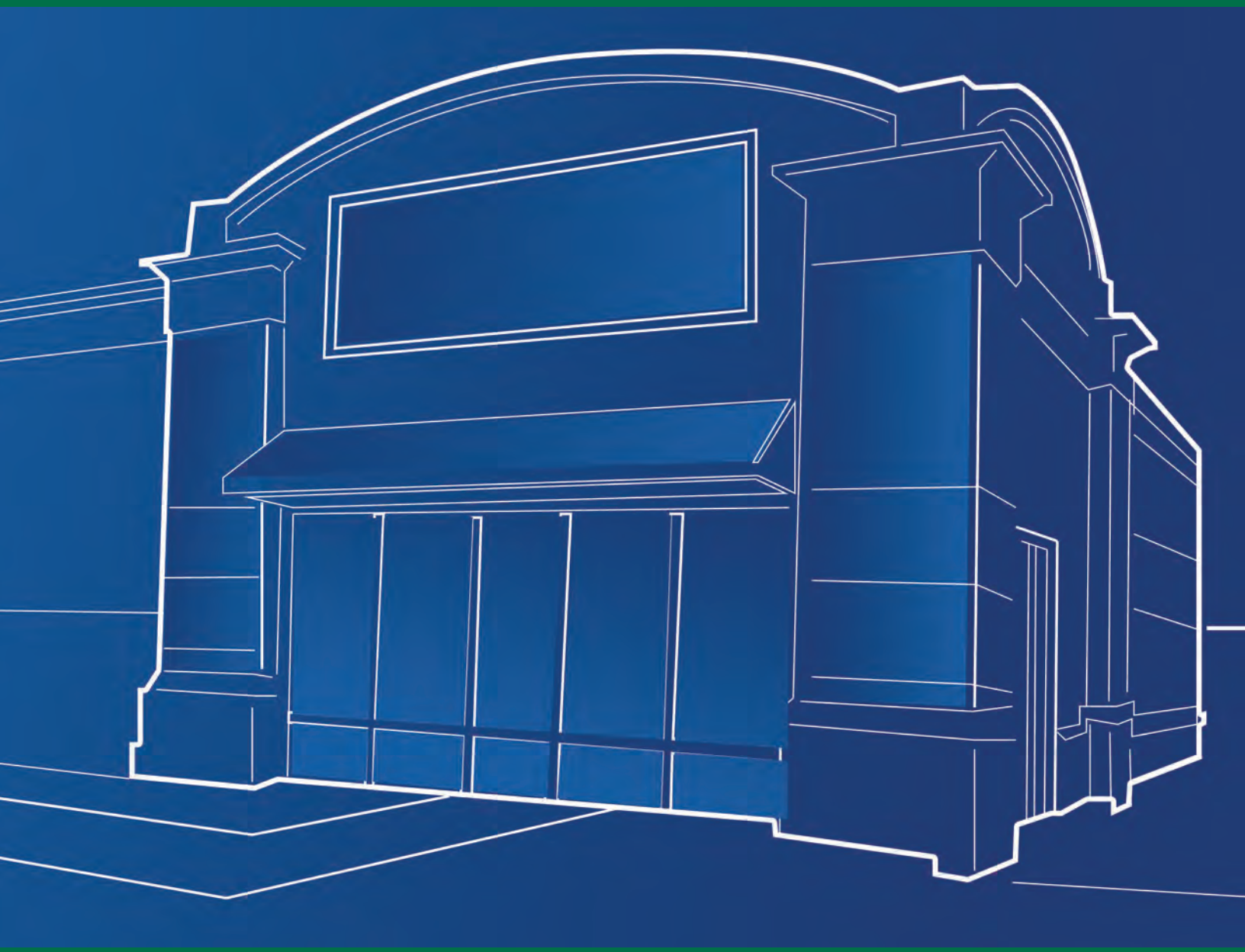
Revised 2014

FORTIFIED for Safer Business™ Standards



FORTIFIED is a program of the Insurance Institute for Business & Home Safety

Volume I: Standards

Insurance Institute for Business & Home Safety

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1 INTRODUCTION

Developing a FORTIFIED for Safer Business™ compliant building begins in the design phase. By designing the building to be compliant and developing appropriate specifications, when it is most cost effective to incorporate FORTIFIED features, the design team, contractor and building owner can: avoid costly change order fees; achieve faster completion of the design; and provide more efficient bidding.

A successful high performance resilient building program will include design review and construction compliance inspection protocols. Both of which are essential to ensuring the building will deliver the disaster resilience that is desired. FFSB Standards Volumes I & II provide tools for establishing the design review and compliance verification processes. The inspection process includes the creation of a documentation file that will be crucial when seeking future designations or other benefits from insurance companies, lenders, Realtors®, appraisers, etc.

Key participants in the FORTIFIED compliance process:

Building owner or representative
Design professional
Builder
Third-party plan reviewer
Third-party inspector

FFSB includes two valuable resources:

Volume I - The FORTIFIED for Safer Business™ Standards
Volume II - The FORTIFIED for Safer Business™ Appendices

Reading through Volume I - The FORTIFIED for Safer Business™ Standards, which provide the FFSB specific requirements, will help you make an informed decision in pursuit of building a FFSB compliant property.

Volume I includes an introduction to the program and the identification of natural hazards for a specific site. These natural hazards include high winds, hurricanes, floods, wildfires, freezing weather, hail, and earthquakes. It provides the design criteria standards and requirements that address these natural hazards as well as hazards inherent to all buildings such as interior fire, building envelope water and air management, burglary, and electrical surge. Reference standards and IBHS contact information also are included.

Volume II includes documentation forms, design and field inspection checklists, and additional resources required for the project.

1.1 Natural hazards addressed by FORTIFIED for Safer Business™ Standards:

Wind - impacts practically every region in the United States. As a result, various types of severe wind hazards can readily exceed minimum modern building code requirements in many areas. **FORTIFIED** standards take the next step needed to address these costly hazards:

1 **Hurricanes -** are powerful storms that can produce winds in excess of 150 mph. Hurricanes cause thousands of deaths and injuries to residents along the Gulf and Atlantic Coasts, and are a leading cause of wind-related damage that results in billions of dollars in property losses each year. On the immediate coast, hurricane-related storm surge also is responsible for extensive property damage and loss of life. **FORTIFIED** standards address these and other risks associated with hurricane-force winds and wind-driven rains.

2 **Tornadoes -** are responsible for more than 1,000 deaths and injuries annually and the damage or destruction of thousands of structures. Although any region of the country can experience a tornado, the majority often occur in areas where design level wind speeds in the building code are at the lowest levels. **FORTIFIED for Safer Business™** criteria will offer enhanced protection for about 90 percent of the areas affected by tornadoes in any given year, considering 77 percent of tornadoes have wind speeds less than 110 mph, according to the National Climatic Data Center. However, the

program is not intended to provide the kind of personal life safety protection needed in stronger tornadoes, such as an EF-4 or EF-5. In those intense tornadoes, storm shelters designed to the level of protection established by ICC 500 or FEMA 321 provide the most credible personal protection.

3 **Severe Thunderstorms/ Hail -** are storm systems that not only spawn tornadoes, but also can produce damaging wind gusts of more than 90 mph. This level of wind frequently causes damage to buildings built to the minimum standards of modern building codes. Microbursts, also produced by thunderstorms, can cause wind gusts of more than 110 mph and tornado-like damage. Another major threat associated with thunderstorms is hail, which causes millions of dollars in damage to properties annually. The **FORTIFIED** program provides improved resistance to these and other hazards associated with severe thunderstorms.

Earthquakes - can cause the ground to move with little or no warning, leaving little opportunity to take cover or vacate an unsafe building. In places like California, design level earthquakes may occur at various locations several times during a person's lifetime. Therefore, building code requirements do a relatively good job of addressing the risk. In other parts of the country, stronger earthquakes occur with less frequency, but remain a risk based on major events in recent history. However, the earthquake risk may not be addressed by the building codes in place in these areas. Appendix A includes the latest earthquake hazard map, which is used by the **FORTIFIED** program.

Floods - can significantly impact buildings in the inland or coastal 100-year floodplain, causing serious damage and extended loss of use. Increasing elevation levels of the bottom occupied floor and all utilities are the best ways to mitigate the risk. The program requires compliance with the strictest guidelines of the National Flood Insurance Program for both coastal and inland floodplains, when building is permitted in these areas.

Hail - causes approximately 3,000 hailstorms annually in the United States, resulting in average insured losses of $1.6 billion. Significant hailstorms result in millions - and sometimes billions - of dollars in damages to roofs, siding, outdoor and roof mounted equipment, etc. An IBHS review of research and testing related to hail damage found considerable variation in the impact resistance of different types of roof coverings. Lab tests and field observations indicate most low slope commercial roof coverings are not typically damaged by hail less than 1.25 in. in diameter, however, 3-tab asphalt shingles on steep slope roofs may be damaged by hail as small as 1 in. Extensive damage has also occurred to outdoor and roof mounted equipment as a result of hailstorms. Aging and weathering can accelerate the deterioration of non impact-rated skylights and make them become brittle, increasing their vulnerability to cracking, leakage, and shattering from hail. In 2011, IBHS created maps illustrating hailstorm patterns in the last decade and in the last 55 years to help identify areas at risk from hail damage. The maps are featured in the hail section of these standards.

Wildfires - are a risk in 38 states and pose a significant threat to structures and lives in the Wildland Urban Interface. In recent years, construction has been on the rise in these areas and that trend is expected to continue. When a building is constructed in an area that is vulnerable to wildfire, site design, careful selection of building and landscape materials, and proper maintenance of vegetation promoted by the **FORTIFIED** program can reduce the likelihood of a business being destroyed by wildfire.

Severe Winter Weather - is a risk in many regions of the country, even portions of the typically warmer southeastern U.S. In many areas it is not uncommon for weather patterns to develop that result in severe damage to structures from heavy snow, ice, and unusually cold temperatures. The program provides practical protection for structures from the damaging effects of this hazard.

1.2 Building Code Requirements

Building codes set minimum standards for the construction of a commercial property. In the United States, commercial properties are generally designed to meet the requirements of the International Building Code (IBC) and the **FORTIFIED for Safer Business™** program expects that the building will be designed and

built to meet or exceed all the requirements of the IBC. The requirements of the **FORTIFIED for Safer Business™** program do exceed certain requirements of the most recent edition of the IBC in order to provide improved disaster resistance. The **FORTIFIED** program promotes best available practices for disaster resistance, and also requires compliance with accepted certification standards regarding construction, plumbing, mechanical, electrical fuel-gas, and energy conservation.

1.3 Statement of Land Use Policy

FORTIFIED for Safer Business™ is not intended to supersede local and municipal policy concerning where it is deemed safe to build commercial structures. Additionally, IBHS believes that it is unwise to construct any building in the following areas that are especially prone to natural hazards: low-lying barrier islands and coastal regions, close proximity to known seismic fault lines, close proximity to major levees, and close proximity to steep slopes potentially subject to either erosion or wildfire. Not building a **FORTIFIED** structure in the aforementioned areas can reduce the risk of damage, but it cannot eliminate it.

1.4 FORTIFIED for Safer Business™ Compliance Process

The Insurance Institute for Business & Home Safety does not currently offer a FORTIFIED for Safer Business™ designation. Users of the FORTIFIED for Safer Business Standards are encouraged to establish a plan review and compliance inspection process using the model, checklists and forms provided in Volumes I & II. The following describes the recommended process for creating a **FORTIFIED for Safer Business™** compliant building.

1 Natural hazards are identified that must be addressed in the design and construction processes. ***Note:*** *Wind, building envelope and water/air management, interior fires, burglary, electrical surge protection, flood, and wildfire risks should be assessed for all buildings.*

2 A design professional (Registered Architect or Professional Engineer) designs the structure to comply with the FFSB program requirements.

3 The design professional (Registered Architect or Professional Engineer) also will complete checklists and accompanying documents and submit documentation to the plan reviewer.

4 A plan reviewer[1] independent from the design team will review and notify the applicant of completeness, errors and omissions.

5 Resubmittals may be required.

6 An independent field inspector[1] will verify that all items identified on the project-specific inspection checklists have been correctly addressed for the structure, through a combination of field inspections and submitted photographs and documentation provided by the project coordinator/engineer (if such inspections are required by the program).

7 The inspection checklist for each peril is then submitted to the plan reviewer[1] for verification.

8 A documentation file of all compliance activities is presented to the owner. Documentation includes (but is not necessarily limited to):

   a. Photographs of key system upgrades after installation but prior to concealment by finished materials
   b. Test reports
   c. Product spec. sheets
   d. Specifications
   e. Change orders
   f. Signed and sealed design documents
   g. Completed and signed checklists

2 IDENTIFYING HAZARDS FOR A SPECIFIC SITE

The following are descriptions of the areas of the country where each of the **FORTIFIED for Safer Business™** natural hazards apply. Note that one of the three wind hazards (hurricane, tornado, or high wind) will apply to every structure, depending upon the structure's geographic location. The Wind Hazard Map (Figure 3-1) defines regions where each of these three wind risks may apply. Also note, flood and wildfire hazards may apply anywhere in the country.

2.1 Hurricane Regions

Hurricane-prone regions for the U.S. mainland are defined as areas along the U.S. Atlantic Ocean and Gulf of Mexico coasts where the basic wind speed is greater than 90 mph. This includes areas along the entire Atlantic and Gulf Coasts in all states that border these bodies of water. In addition, hurricane-prone regions include Hawaii, and the U.S. territories of Puerto Rico, Virgin Islands, Guam, and American Samoa. **FORTIFIED for Safer Business™** hurricane provisions are required in all areas where the ASCE 7-05 basic wind speed is 100 mph or greater. In addition, **FORTIFIED for Safer Business™** hurricane provisions are required within one mile of "coastal mean high water" where the basic wind speed is between the 90 and 100 mph contours on the ASCE 7-05 wind map (Figure 6-1 of ASCE 7-05). This last requirement affects properties located along certain parts of the coast of Maine, a tiny stretch of the coast of New Hampshire, and some areas in Maryland and Virginia that border on the broad waters of Chesapeake Bay.

2.2 Tornado and Hail Regions

From the eastern ranges of the Rocky Mountains to the Atlantic Coast, severe thunderstorms have a known history of spawning more than 1,000 tornadoes annually.

In all areas where the Tornado and Hail Regions overlaps the Hurricane Regions, hurricane provisions take priority because these areas are more likely to be adversely affected by hurricanes. **FORTIFIED** structures in the Tornado and Hail Regions must meet the program requirements for tornadoes and hail, including structural reinforcement and impact-resistant roofing materials. In the **FORTIFIED for Safer Business™** program, regions of significant hail risk are defined on a county and state basis (**Appendix D**).

2.3 High Wind Regions

While not at immediate risk of hurricanes or tornadoes, areas 1) west of the Rockies, 2) in the northern Great Lakes region, 3) in the Appalachian Mountains, and 4) in interior areas of New England are at risk from other types of high winds: mid-latitude cyclonic activity, severe thunderstorms and localized weather phenomena. Because of this, the **FORTIFIED for Safer Business™** program considers these to be High Wind Regions. Structures built within these regions must follow the Wind Provisions of **FORTIFIED for Safer Business™**, including having the structural elements necessary for wind loading. This does not include the requirement of wind-borne debris protection or impact-resistant roofing materials.

2.4 Earthquake Regions

Structures designated as **FORTIFIED for Safer Business™** are built to withstand the lateral loading caused by at least 110 mph wind gusts, regardless of geographic location. Since the program targets light commercial properties, for the most part they are capable of withstanding the lateral loading caused by slight-to-moderate ground accelerations as well. For this reason, only **FORTIFIED for Safer Business™** structures built in regions of significant seismic risk are required to adhere to the enhanced seismic criteria. In the **FORTIFIED for Safer Business™** program, regions of significant seismic risk are defined on a county and state basis (**Appendix F**). Within these regions, seismic design needs to address

specific performance goals that are related to the risk of events of certain magnitude. IBHS guidance for seismic performance is developed by specifying a larger design ground motion, and then following the standard seismic design requirements corresponding to that larger ground motion.

2.5 Wildfire

FORTIFIED for Safer Business™ Wildfire Criteria may apply anywhere in the country where a structure is located in proximity to wildfire-prone areas. Applicability is determined by a site-specific hazard assessment of vegetation, topography, fire history and other factors. Such assessments are conducted using the Wildfire Risk Assessment Checklist. If, by using this assessment form, it is determined that the structure is in a "moderate", "high", or "extreme" (sometimes also referred to as "very high") wildfire hazard zone, the building must be built in accordance with the program requirements associated with that hazard zone. The requirements of this section do not apply for downtown urban areas.

2.6 Flood Zones

Structures in Special Flood Hazard Areas (A or V zones), as determined by the Flood Insurance Rate Map (FIRM) from the National Flood Insurance Program (NFIP), or that have been identified as being at risk by a FEMA Advisory Document, such as the Recovery Flood Maps issued after major hurricanes, must meet the **FORTIFIED for Safer Business™** Flood Criteria. To determine your flood exposure, you can go to DisasterSafety.org and there are step by step instructions on how to use the Federal Emergency Management's (FEMA) free Flood Map Service. Your community floodplain management official, mortgage lender, or insurer/insurance agent can also help you determine the applicable flood zone for your site. Structures not in a Special Flood Hazard Area are exempt from the **FORTIFIED for Safer Business™** Flood Criteria.

2.7 Severe Winter Weather

Severe Winter Weather criteria specifically address the potential for damage from ice dams in areas prone to snowfall accumulations greater than 12 in. Areas that are required to meet **FORTIFIED for Safer Business™** Severe Winter Weather Criteria are shown in Figure 3-6. The Severe Winter Weather Region boundary outlined on this map follows state and county lines, and is roughly based on a combination of 1) the 20 degree isotherm of the 97½% winter design temperature map in the International Residential Code, and 2) a 20-lb/sq ft. ground snow load from the 2006 International Building Code. The northern boundaries of AK, AZ, NC, NM, OK and TN roughly define a geographic line, where the danger of ice dams from snow accumulation and freezing weather are most likely to occur. In California, ice dams are a factor in the northern and western mountain regions.

2.8 Other Hazards

Building envelope and water/air management, interior fire, burglary, and electrical surge protection are building hazards also addressed in the **FORTIFIED for Safer Business™** program.

Table 2-1: FORTIFIED Perils by State*
(***All areas outside of a hurricane region are considered to be High Wind Regions. With the exception of Florida and Hawaii, all states include an exposure to High Wind hazard)***

Alabama: - Hurricane (100 mph+) - Hail - Tornado - Seismic (Lauderdale County)	**Hawaii:** - Hurricane - Seismic	**Michigan:** - Severe Winter Weather - Hail - Tornado
Alaska: - High Wind - Severe Winter Weather - Seismic	**Idaho:** - Severe Winter Weather - Seismic (most counties)	**Minnesota:** - Severe Winter Weather - Hail - Tornado
Arizona: - High Wind - Seismic (some western counties)	**Illinois:** - Hail - Tornado - Severe Winter Weather - Seismic (some southern counties)	**Mississippi:** - Hurricane (100 mph+) - Hail - Tornado - Seismic (some northern counties)
Arkansas: - Hail - Tornado - Seismic	**Indiana:** - Hail - Tornado - Severe Winter Weather - Seismic (some counties)	**Missouri:** - Hail - Tornado - Severe Winter Weather - Seismic (some counties)
California: - Severe Winter - Seismic	**Iowa:** - Hail - Tornado - Severe Winter Weather	**Montana:** - Severe Winter Weather - Seismic (some counties)
Colorado: - Hail - Tornado - Severe Winter Weather - Seismic (some counties)	**Kansas:** - Hail - Tornado - Severe Winter weather	**Nebraska**: - Hail - Tornado - Freezing Weather
Connecticut: - Hurricane (100 mph+) - Hail (Litchfield County) - Tornado - Severe Winter Weather	**Kentucky:** - Hail - Tornado - Severe Winter Weather - Seismic (western counties)	**Nevada:** - High Wind - Severe Winter (most counties) - Seismic
Delaware: - Hurricane (100 mph+ Sussex County) - Severe Winter Weather	**Louisiana:** - Hurricane (100 mph+) - Hail - Tornado	**New Hampshire:** - Hurricane (Rockingham County) - Severe Winter Weather
District of Columbia: - Severe Winter Weather	**Maine:** - Hurricane (< 1 mile of Atlantic Coast) - Severe Winter Weather	**New Jersey:** - Hurricane (100 mph+) - Severe Winter Weather
Florida: - Hurricane - Hail (some counties)	**Maryland:** - Hurricane (100 mph+ & 1-mile wide stretches along Chesapeake Bay 90 mph+) - Severe Winter Weather	**New Mexico:** - Hail - Tornado - Seismic (some counties)
Georgia: - Hurricane (100 mph+) - Hail - Tornado	**Massachusetts:** - Hurricane (100 mph+) - Severe Winter Weather - Hail (Berkshire & Hampden counties)	**New York:** - Hurricane (100 mph+) - Severe Winter weather - Hail - Seismic (northern counties)

North Dakota: - Hail - Tornado - Severe Winter Weather	**Texas:** - Hurricane (100 mph+) - Hail - Tornado - Seismic (some counties)
Ohio: - Severe Winter Weather	**Utah:** - Severe Winter Weather - Seismic (most counties)
Oklahoma: - Hail - Tornado	**Vermont:** - Severe Winter Weather - Seismic (Franklin & Grand Isle counties)
Oregon: - Severe Winter Weather - Seismic (most counties)	**Virginia:** - Hurricane (100 mph+ and some one-mile wide stretches along Chesapeake Bay 90 mph and greater) - Severe Winter Weather - Hail - Tornado
Pennsylvania: - Severe Winter Weather - Hail (some counties)	**Washington:** - Severe Winter Weather - Seismic (most counties)
Rhode Island: - Hurricane - Severe Winter Weather	**West Virginia:** - Severe Winter Weather - Hail
South Carolina: - Hurricane (100 mph+) - Hail - Tornado - Seismic (most counties)	**Wisconsin:** - Severe Winter Weather - Hail - Tornado
South Dakota: - Hail - Tornado - Severe Winter Weather	**Wyoming:** - Severe Winter Weather - Hail (some counties) - Tornado - Seismic (some counties)

**** Regions of hail and seismic risk are defined on a county and state basis (Appendix N and O).***

Note 1: In states where hurricane and tornado/other high wind regions exist, the dividing line will be defined in the vicinity of the 100 mph wind contour on the ASCE 7-05 map. Exceptions occur in Main, New Hampshire, Maryland and Virginia where hurricane criteria are required within one mile of the mean high water line of tide water where design wind speeds are 90 mph or higher on the ASCE 7-05 map.

Note 2: Wildfires, floods, and lightning occur in all states and are determined by a site specific risk assessment using forms mentioned in explanations that preceded this chart.

3 FORTIFIED for Safer Business™ DESIGN CRITERIA

3.1 Wind Design Requirements Common to all Hurricane, High Wind and Tornado/Hail Areas

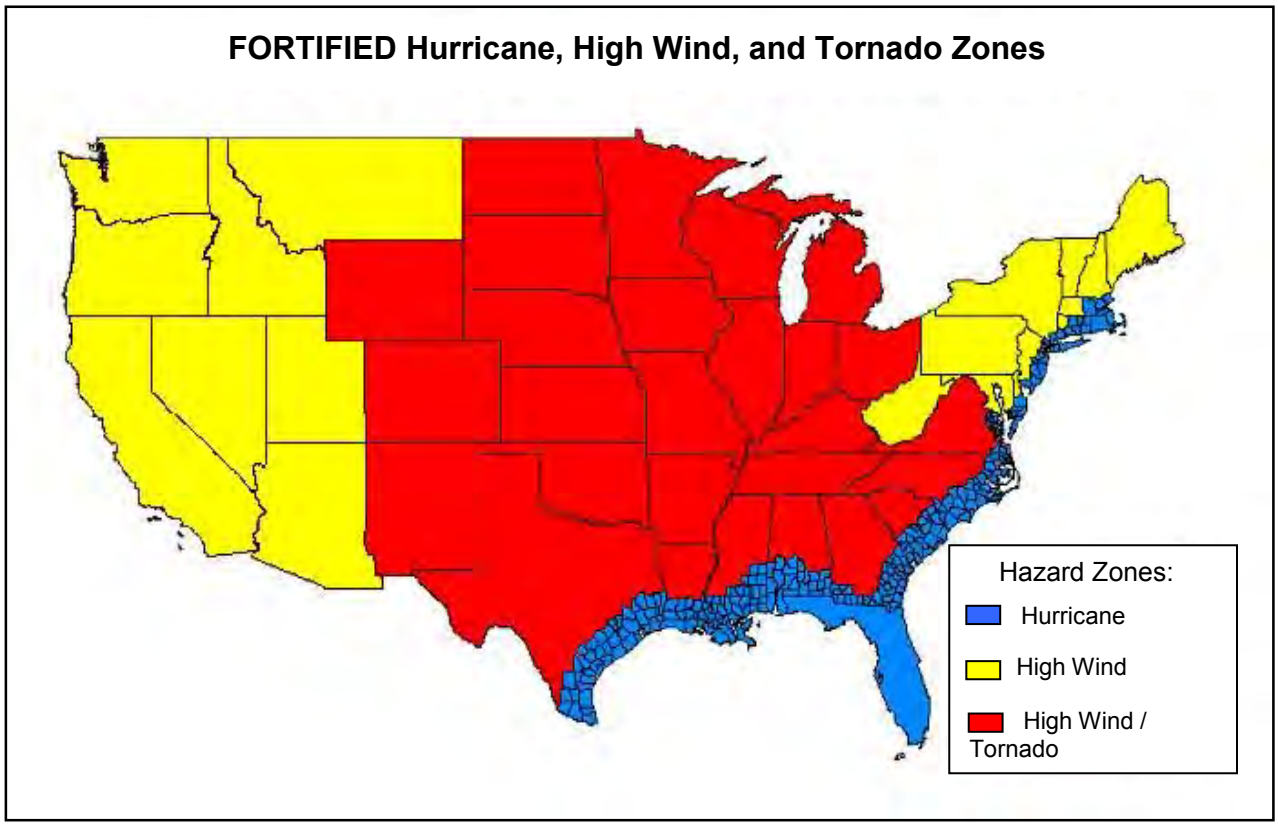

Figure 3-1: Hurricane, High Wind, and Tornado regions as defined by IBHS FORTIFIED program.

Figure 3-1 provides a general graphic description of the areas of the continental United Stated associated with the Hurricane, High Wind and Tornado/Hail wind provisions of the **FORTIFIED for Safer Business™** program. The following section provides wind design requirements that are common to all these areas. This is followed by a listing of the requirements that are specific to each of the different wind hazard areas.

1. **FORTIFIED design wind speeds** shall be equal to the ASCE 7-05 (American Society of Engineers "Minimum Design Loads for Buildings and Other Structures") basic wind speed (or locally adopted basic wind speed in special wind zones, if higher) of **plus 20 mph**.

   For area **where the ASCE 7-05 basic wind speed is 100 mph or greater**, in addition to meeting the requirements below, **see also Hurricane Specific Design Requirements**, Section 3.2.

Table 3-1: FORTIFIED design wind speeds – Add 20 mph to ASCE 7-05 design wind speeds.

ASCE 7 Wind Speed	Building Code Design Wind Speed (or interpolate between values)	FORTIFIED Design Wind Speed
< 90 mph	**90 mph**	**110 mph**
90 – 100 mph	**100 mph**	**120 mph**
101 – 110 mph	**110 mph**	**130 mph**
111 – 120 mph	**120 mph**	**140 mph**
121 – 130 mph	**130 mph**	**150 mph**
131 – 140 mph	**140 mph**	**160 mph**
141 – 150 mph	**150 mph**	**170 mph**
> 150 mph	**150 mph**	**170 mph**

2. **Component and cladding loads** shall be determined for the **FORTIFIED** design wind speed defined in Section I and Table 3-1 above, assuming terrain Exposure C, regardless of the actual local exposure, and applying the appropriate Importance Factor when using ASCE 7-05.

3. The **Main Wind Force Resisting Systems (MWFRS) design loads** shall be allowed to be determined for the actual terrain exposure of the building site as defined by ASCE 7-05 or the International Building Code (IBC).

4. **Roof Zones:** In accordance with ASCE 7-05, all references to roof field, perimeter, and corner areas may also be defined as Zones 1, 2, and 3 respectively. The following requirements shall be met:

    a. For roof slopes ≤ 10°, use eave height and for slopes > 10°, use mean roof height.

    b. For roof heights ≤ 60 ft. (18 m), Zone 2 width is the smaller of 0.1 times the building lesser plan dimension or 0.4 times the mean roof height, and never less than 4% of the least horizontal dimension, or 3 ft. (0.9 m). Zone 3 is a square with dimensions equal to Zone 2 width.

    c. For roof heights > 60 ft., the width of Zone 2 and Zone 3 areas is 0.1 times the building lesser plan dimension, but not less than 3 ft. (0.9m). Zone 3 area is an ell with length dimensions twice the width.

    d. Where multi-level roofs meet at a common wall, the edge of the upper roof is treated as roof Zone 2 and Zone 3 if the difference in height is ≥ 3 ft. The lower roof strip where it meets a higher wall is treated as a field area, except for the square areas at each end, which are treated as Zone 2 perimeters.

5. **Wall Zones:** Wall field and corner areas may also be defined as Zones 4 and 5 respectively. The following requirements shall be met:

    a. For roof slopes ≤ 10°, use eave height, and for slopes > 10°, use mean roof height in the determination of the velocity pressure for negative or outward acting wall pressures and negative internal pressures. For positive inward acting wall pressures and positive internal pressures use of actual height of cladding element or wall shall be allowed.

    b. For roof heights ≤ 60 ft. (18 m), Zone 5 is the smaller of 0.1 times the building least plan dimension or 0.4 times h, but not less than 4% of the least plan dimension, or 3 ft. (0.9 m).

c. For roof heights > 60 ft. (18 m), ‘‘a’’ is 0.1 times the building lesser plan dimension, but not less than 3 ft. (0.9 m).

6. **Partially Enclosed Buildings:** For design purposes and in accordance with ASCE 7-05, buildings will be considered “partially enclosed” if they meet **both** the following conditions:

   a. The total area of openings in a wall that receives positive external pressure exceeds the sum of the area of openings in the balance of the building envelope (walls and roof) by more than 10%, and

   b. The total area of openings in a wall that receives positive external pressure exceeds 4 sq ft. (0.37 m^2) or 1% of the area of that wall, whichever is smaller, and the percentage of openings in the balance of the building envelope do not exceed 20%.

      Openings are considered any apertures or holes in the building envelope that allow air to flow through the building envelope and that are designated as ‘‘open’’ during design winds as defined by ASCE 7-10 provisions. This includes fans, louvers, and any other ventilation system that remains in the open position.

      For roof design pressures, openings are only considered when located on the story immediately below the roof.

7. **Open Buildings:** For design purposes, buildings will be considered “open” if the building has each wall at least 80% open.

8. **Enclosed Buildings:** For design purposes, buildings will be “enclosed” if the building does NOT meet the criteria for “partially enclosed” or “open.”

9. **Soffits and ceilings** of canopy areas shall be capable of resisting the component and cladding design wind pressure for the adjacent wall areas and installed according to the manufacturer’s instructions for that pressure rating.

10. **Rooftop structures, equipment and their attachments** shall be designed to resist wind loads in accordance with ASCE 7-10 Section 29.5.1, “Rooftop Structures and equipment for buildings with $h \leq 60$ ft;” equations 29.5-2 and 29.5-3 for the **FORTIFIED** design wind speed, and provide an uplift resistance with a minimum factor of safety of 2.0 assuming terrain Exposure C.

11. **Gutter, down spouts, and hold downs** shall be noncombustible. They shall be designed and detailed for the **FORTIFIED** design wind speed and provide an uplift resistance with a minimum factor of safety of 2.0 assuming terrain Exposure C. Installation shall meet the requirements of the Single Ply Roofing Industry (SPRI) – ANSI/SPRI GD-1 “Structural Design Standard for Gutter Systems Used with Low-Slope Roofs”

12. **Skylights** shall be designed and detailed for the **FORTIFIED** design wind speed and provide an uplift resistance with a minimum factor of safety of 2.0 assuming terrain Exposure C. Installation shall meet the requirements of ASTM E330, E331, E283.

13. **Other attached and/or exposed structures** shall be designed and detailed for **FORTIFIED** design wind speed and provide an uplift resistance with a minimum factor of safety of 2.0 assuming terrain Exposure C. This includes but is not limited to:

    - Roof towers

    - Signs, their attachments, and support structures

- Flag poles
- Covered walkways or canopies
- Porte Cochere (Covered areas for passenger loading and unloading)
- Architectural feature(s) requiring structural reinforcement and/or attachment

14. **Buildings more than 60 ft. in height** or having long span roofs with **spans exceeding 150 ft.** shall have a peer review of their structural design.

15. **Structural Metal Panel Roofs:** Structural metal panel roof systems, including lap seam / through fastened or standing seam, shall be designed for the **FORTIFIED** design wind speed component and cladding wind pressure. Panel uplift resistance shall include a minimum factor of safety of 2.0 in the field, perimeter and corners of the roof relative to the **FORTIFIED** design uplift pressure from ASCE 7-05 assuming terrain Exposure C.

    In addition, one of the following must be met:

    a. The system is FM Approved and shall meet the applicable design and installation requirements of FM Global Property Loss Prevention Data Sheet 1-31.

    b. The system is Miami-Dade County Approved with a current Notice of Acceptance and shall meet the applicable design and installation requirements of Florida Building Code Roof Application Standard (RAS) 133.

    c. The system is listed in the Texas Department of Insurance, “Product Evaluation Index for Roof Coverings” with a current product evaluation, and shall meet the specified design and limitations for use of the product as well as specified installation methods.

    d. The system is tested with satisfactory results in accordance with FM Approvals Standard 4471 or ASTM E1592. The system meets the applicable design and installation requirements of FM Global “Property Loss Prevention Data Sheet” 1-31.

16. **Low Slope Roof Decks:** Low Slope (≤10°) structural roof deck attachments shall be designed for the **FORTIFIED** design wind speed component and cladding wind pressures. Deck uplift resistance shall include a minimum factor of safety of 2.0 in the field, perimeter and corners of the roof relative to the **FORTIFIED** design uplift pressure from ASCE 7-05 assuming terrain Exposure C. When using allowable stress design (ASD), use the standard industry safety factor normally associated with the fastener or weld being used as long as it is greater than 2.0. If using Load and Resistance Factor Design (LRFD), use a wind load factor of 2.0 instead of 1.6 for design of the fastener or weld being used. This includes but is not limited to: wood, steel, light weight insulating concrete on steel form, light weight structural concrete on steel form, gypsum, cementitious wood panels, precast concrete “T” panels, structural concrete, etc. In addition, the following must be met:

    a. Wood roof decks shall be sheathed with panels rated for maximum deflection between supports, under a 100 pound per square foot uniform load, of the span between supports divided by 160 (span/160). Note: Nominal 5/8 in. thick wood structural panels (plywood or OSB) installed on joists spaced less than or equal to 24 in. o.c. will meet this criteria.

    b. Structural roof decks shall be tested in accordance with applicable FM Approvals Standard 4450, 4454, or UL 580.

17. **Low Slope Roof Cover Systems:** Low Slope (≤10°) roof cover systems shall be designed for the **FORTIFIED** design wind speed component and cladding wind pressures. Cover uplift resistance shall include a minimum factor of safety of 2.0 in the field, perimeter and corners of the roof relative to the **FORTIFIED** design uplift pressure from ASCE 7-05 assuming terrain Exposure C. This includes but is not limited to: modified bitumen, built-up, single ply, liquid applied, spray applied, etc. Unreinforced PVC membrane covers are not permissible.

    Products with any of the following product approvals/notice of acceptance corresponding to the **FORTIFIED** design wind speed/uplift pressure may be used.

    - FM Approved
    - Miami-Dade County Approved with a Notice of Acceptance
    - Florida Product Approved
    - Listed in the Texas Department of Insurance, "Product Evaluation Index for Roof Coverings"
    - UL Approved

    Material substitutions and deviations from the approved system's design criteria are not acceptable. The entire system must be installed in accordance with approval or product evaluation description, and shall meet the specified design and limitations for use of the product as well as specified installation methods.

    a. **Metal edge securement** for low slope membrane roof systems shall be designed for the **FORTIFIED** design wind speed with a minimum factor of safety of 2.0 for the associated design pressure. The perimeter /edge flashing, coping, etc. may be FM or MDCA Approved. The installation should be in accordance with one the following:

        - ANSI/SPRI/FM4435/ES-1, "Wind Design Standard for Edge Systems Used with Low Slope Roofing Systems"
        - NRCA Roofing Manual, Sections – "Membrane Roofing Systems" and "Architectural Metal Flashing"
        - Florida Building Code Roof RAS 111

    b. **Built-up roof cover systems** located in areas with FORTIFIED wind speeds GREATER than 110 mph are not permitted to have loose laid pea gravel. All pea gravel should be embedded in asphalt.

    c. **Fully adhered single ply roof cover systems** should have a single row of perimeter fasteners and plates installed and stripped-in approximately 1 ft. in from the edge of the building to form a "frame" of protection around the entire roof perimeter.

    d. **Ballasted low slope single ply roof systems** shall comply with ANSI/SPRI RP-4 or FM Global "Property Loss Prevention Data Sheet" 1-29, except that **no stone ballast is permitted for FORTIFIED design wind speeds greater than 110 mph.**

18. **Steep Slope Roof Systems:** Steep slope roof systems shall comply with the following requirements.

    a. **Deck/roof sheathing attachment** shall be designed for the **FORTIFIED** design wind speed component and cladding wind pressures. Deck uplift resistance shall include a minimum factor of safety of 2.0 in the field, perimeter and corners of the roof relative to the **FORTIFIED** design uplift pressure from ASCE 7-05 assuming terrain Exposure C. When using Allowable Stress Design (ASD), use the standard industry safety factor normally associated with the fastener or weld being used as long as it is greater than 2.0. If using Load and Resistance Factor Design (LRFD) use a wind load factor of 2.0 instead of 1.6 for design of the fastener or weld being used.

    Wood roof decks shall be sheathed with panels rated for maximum deflection between supports, under a 100 pound per square foot uniform load, of the span between supports divided by 160 (span/160). Note: Nominal 5/8 in. thick wood structural panels (plywood or OSB) installed on trusses or rafters spaced less than or equal to 24 in. o.c. meet this criteria.

    b. **Shingle Roofs**: Steep-slope (≥ 2/12 pitch) roof coverings using asphalt shingle roof coverings shall meet one of the test standards listed below, and be installed in accordance with the manufacturer's recommendations for high wind regions. Shingles, including hip and ridge materials, must meet one or more of the following standards:

Table 3-2: FORTIFIED Design Wind Speed and Shingle Testing Standards

FORTIFIED Design Wind Speed	Shingle Testing Standard/Classification
110 mph	ASTM D3161 Class F or MDCA TAS 107 or ASTM D7158 Class G or H
120 mph	ASTM D7158 Class G
130 mph	ASTM D7158 Class H
140 mph	
150 mph	
>150 mph	

    c. **Tile Roofs***:* Clay and concrete tile roof coverings shall be installed in accordance with the manufacturer's recommendations for high wind applications for **FORTIFIED** design wind speed.

    d. **Architectural Metal Roofs:** Architectural metal panel roof systems shall be designed for the FORTIFIED design wind speed component and cladding wind pressure. Panel system uplift resistance shall include a minimum factor of safety of 2.0 in the field, perimeter and corners of the roof relative to the FORTIFIED design uplift pressure from ASCE 7-05 assuming terrain Exposure C.

    For clip attachment (screwed) to the deck, if using Allowable Stress Design (ASD), use the standard industry safety factor normally associated with the fastener being used as long as it is greater than 2.0. If using Load and Resistance Factor Design (LRFD) use a wind load factor of 2.0 instead of 1.6 for design of the fastener or weld being used.

    In addition, one of the following must be met:

        i. The system is FM Approved and shall meet the applicable design and installation requirements of FM Global "Property Loss Prevention Data Sheet" 1-31.

ii. The system is Miami-Dade County Approved with a current Notice of Acceptance and shall meet the applicable design and installation requirements of Florida Building Code RAS 133.

iii. The system is listed in the Texas Department of Insurance, "Product Evaluation Index for Roof Coverings" with a current product evaluation, and shall meet the specified design and limitations for use of the product as well as specified installation methods.

iv. The system is tested with satisfactory results in accordance with FM Approvals Standard 4471 or ASTM E1592. The system meets the applicable design and installation requirements of FM Global "Property Loss Prevention Data Sheet" 1-31.

e. **All Other Roof Coverings:** For all other roof coverings, the designer must provide documentation showing the roof covering and the attachments were designed for the component and cladding wind pressures corresponding to the **FORTIFIED** design wind speed. All roof coverings, regardless of type, must be installed in accordance with the manufacturer's recommendations for high wind regions.

19. **Walls:** Wall systems shall be designed using the following requirements.

a. **Design loads** shall be determined using the **FORTIFIED** design wind speed for component and cladding wind pressures in Zones 4 and 5 derived from ASCE 7-05 assuming terrain Exposure C.

b. **Impact Resistance:** For hurricane prone regions (FORTIFIED design wind speed is 120 mph or greater), the wall system shall successfully pass and resist the impact of ASTM E1996 Level "D" 9-pound 2x4 at 50ft./sec (34 mph).

Wall systems that will meet the intent of this requirement include: reinforced and unreinforced concrete block masonry; precast concrete; cast in place concrete; solid insulated concrete forms; brick; brick with concrete block backing; 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, ½ in. fiber cement based planking; and ≥5/8 in. thick wood structural panel sheathing with vinyl or aluminum siding.

c. Masonry wall systems shall be designed and reinforced to meet National Concrete Masonry Association Standards.

d. Metal wall systems shall be designed and tested for resistance in accordance with ASTM E1592. Each assembly shall be tested for a load equal to 1.5 times the design pressure.

e. Sandwich Panel wall systems shall meet the International Code Council (ICC) Evaluation Service – Acceptance Criteria for Sandwich Panels AC04. Any adhesives used shall comply with ASTM D 2559 or the ICC Acceptance Criteria for Sandwich Panel Adhesives AC05.

f. Flat Insulated Concrete Form (ICF) systems. Insulating concrete form material used for forming flat concrete walls shall conform to ASTM E 2634.

g. A continuous and adequate load path from the roof to the foundation of the building must exist. The building must have positive connections from the roof to foundation as a means to transmit wind uplift and lateral loads safely to the ground. This includes providing roof-to-wall connection hardware (for example: hurricane straps for wood) with the required roof uplift resistance as determined by the designer or specified in the prescriptive method being used.

h. Inter-story connections in multi-story structures shall have a continuous load path through the wall to the foundation.

i. **Gable End Walls:** Failure of gable end walls has been quite common in hurricanes when adequate bracing is not installed. To significantly reduce damage in non-hurricane prone areas and potentially reduce construction costs, full height gable end walls are **recommended but not required** in the **FORTIFIED** program.

Gable end walls should be structurally continuous between points of lateral support (Figures 3-2A and 3-2B). Gable end walls adjacent to cathedral ceilings should be continuous from the uppermost floor to the ceiling diaphragm or to the roof diaphragm. For masonry, ICF and solid concrete walls, that means the wall should be solid between the floor and roof deck (preferred), or to the ceiling diaphragm — for flat and cathedral ceilings. For wood or steel stud construction, this means balloon framing to the roof deck (preferred) or ceiling diaphragm where lateral bracing can be installed. A number of engineered solutions can be used for gable end wall bracing; please contact program staff for details.

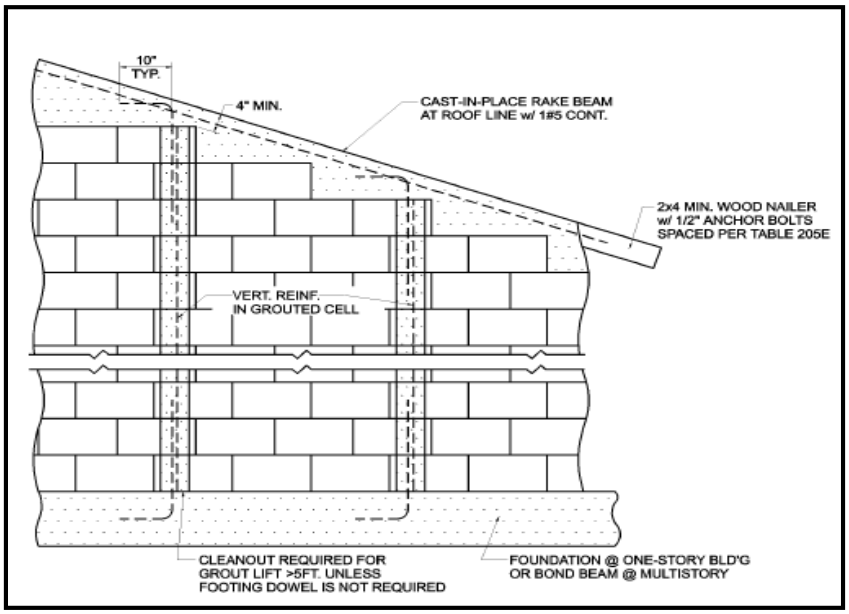

Figure 3-2A: Continuous gable end wall reinforcement for single- and multi-story. Sources: ICC and IBHS

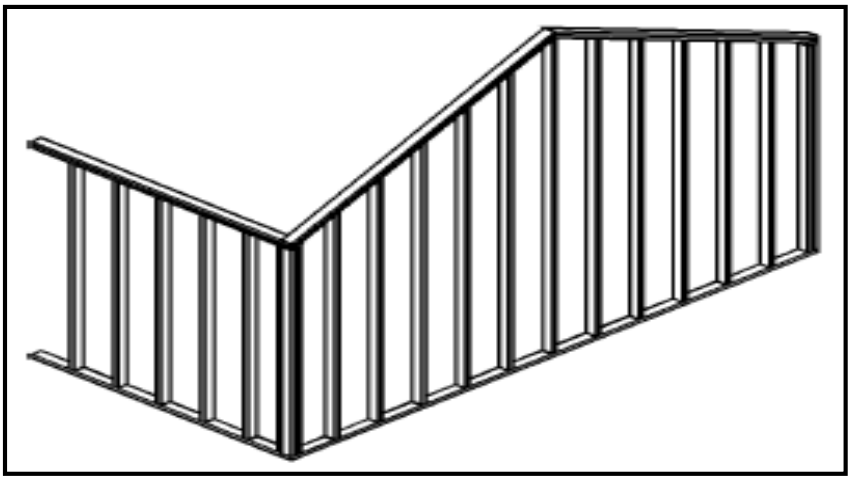

Figure 3-2B: Gable end wall, balloon framing, preferred method of construction. Sources: ICC and IBHS

j. **Corrosion-Resistant Connectors:** Connectors used in exterior wall construction shall meet the following requirements:

i. Sheet metal connectors should be a minimum of ASTM A-653 type G185 zinc coated galvanized steel or equivalent when used with treated wood.

ii. In Coastal A and V flood zones (Section C. Flood), all exposed hardware and fasteners must be stainless steel.

iii. Dissimilar metals shall not be used in contact with each other. Thus, if stainless steel hardware is used, the fasteners used with it shall also be stainless steel.

20. **Windows:** Windows / glazing systems and their attachments shall be designed using the **FORTIFIED** design wind speed for component and cladding wind pressures in Zones 4 and 5 derived from ASCE 7-05 assuming terrain Exposure C.

    The window assembly shall meet the specified design load requirements and be installed according to the specified installation methods. It shall not violate limitations for use of the product.

21. **Doors:** Doors shall meet the following requirements.

    a. All doors and door jambs shall be designed using the **FORTIFIED** design wind speed for component and cladding wind pressures in Zones 4 and 5 derived from ASCE 7-05 assuming terrain Exposure C.

    b. Doors such as roll up, overhead, and sectional shall be tested in accordance with ASTM E 330 or ANSI/ DASMA108, and shall meet the acceptance criteria of ANSI/DASMA 108. Each assembly shall be tested for 10 seconds at a load equal to 1.5 times the design pressure.

    c. Roll up and overhead doors shall include “windlocks.”

    d. For regions with FORTIFIED design wind speeds ≥ 130, installation shall also be tested in accordance with ANSI/DASMA 115.

3.2 Hurricane Specific Design Requirements

Hurricane provisions are required in all areas where the ASCE 7-05 basic wind speed is 100 mph or greater (**FORTIFIED** design wind speed is 120 mph or greater). The requirements are specified below:

1. **Windows / Openings / Wind-Borne Debris Protection:** All glazed openings (windows, doors and skylights) shall meet the following requirements.

    a. All glazed openings (windows, doors and skylights) **<u>within</u>** 60 ft. of the ground shall meet or be protected by an impact resistant system that meets one of the following:

    - ASTM E1886/1996 rated “D” 9-pound 2x4 @ 50 ft. /sec (34 mph)
    - Florida Building Code TAS 201 (for large missile impact), TAS 202, TAS 203
    - Miami - Dade Protocols PA 210, 202, 203
    - FM Approvals Standard 4350 rated HM-LM

b. All glazed openings (windows, doors and skylights) **above** 60 ft. of the ground shall meet or be protected by an impact-resistant system that meets one of the following:

- ASTM E1886/1996 rated "A" small missile
- Florida Building Code TAS 201 (for small missile impact), TAS 202, TAS 203
- Miami - Dade Protocols PA 210, 202, 203
- FM Approvals Standard 4350 rated HM-SM

2. **Water Intrusion Resistance of Windows, Doors and Skylights:** For buildings in areas where the **FORTIFIED** design wind speed is ≥ 150 mph, windows, doors and skylights must meet AAMA 520-09, "Voluntary Specification for Rating the Severe Wind Driven Rain Resistance for Windows, Doors and Unit Skylights."

3. **High Wind-Rated Roof Covers:** Wind resistant roof covers are a key part of creating a hurricane resistant building. Roof covers must meet the following requirements:

   a. **Shingle Roofs:** Steep slope (≥ 2/12 pitch) where **FORTIFIED** design wind speeds are 120 mph or higher, each strip shall be attached to the roof deck with no less than 6 roofing nails. Where the **FORTIFIED** design wind speed is greater than 140 mph, shingles within 1 ft. of the rake edges shall be manually adhered to the underlying surface with 1in. diameter dabs of asphalt roof cement at a spacing of 2 in. o.c. Shingles, including hip and ridge materials, must meet one or more of the standards in Table 3.2.

   b. **Tile Roofs:** Clay and concrete tile roof coverings shall be installed in accordance with the manufacturer's recommendations for high wind applications for the **FORTIFIED** design wind speed. Mortar-set attachment is not permitted. Nailer boards or a manufactured product designed and approved for installation of roof tile on hip and ridge applications (see Figure 3-3), shall be installed along all hips and ridges. Wood nailer boards shall be installed with at a minimum, 1.5 in. wide, 26 gauge galvanized steel straps screwed to the roof deck with two #8 wood screws at a maximum spacing of 37 in.

Figure 3-3: Metal hat section alternative to nailer boards. Source: IBHS

Tile installed on ridges and along hip edges of the roof shall be fastened to the nailer board with mechanical fasteners plus, either foam adhesive or a clip designed to restrain the bottom edge of the tile.

Along the roof eaves, tile installed with mechanical fasteners shall also be restrained with either an acceptable foam adhesive applied following guidelines for "High Wind Installations" or a clip that is designed to restrain the bottom edge of the tile against uplift.

Foam adhesives specifically designed for clay or concrete roof tile installations are acceptable when used in the manner prescribed by the manufacturer for the highest wind resistance applications listed in their installation instructions.

When foam adhesives are used for clay or concrete roof tile installations, tiles along the roof eave shall be fully embedded in the foam adhesive or shall be additionally restrained using a clip that is designed to restrain the bottom edge of the tile against uplift.

c. **All Other Roof Coverings:** For all other roof coverings, the designer must provide documentation showing the roof covering and the attachments were designed for the component and cladding wind pressures corresponding to the FORTIFIED design wind speed (up to 150 mph) and Exposure C conditions. All roof coverings, regardless of type, must be installed in accordance with the manufacturer's recommendations for high wind regions.

4. **Sealed Roof Deck:** For steep sloped roofs in regions where the FORTIFIED design wind speed is 120 mph or higher and a roof cover is installed over a wood deck, the wood deck shall be sealed using one of the following methods. In cases where the manufacturer of the roof covering to be used specifies more stringent underlayment requirements than given below, the more stringent procedures shall be followed. Nail spacing shall be no greater than 6 in. along the laps and 12 in. in the interior of each strip using low profile roofing nails with load distribution disks or capped head nails. Roofs within 3,000 ft. of salt water require hot dipped galvanized fasteners for attachments of all roof coverings, including the underlayment.

   a. For the Atlantic and Gulf Coast states of North Carolina, South Carolina, Georgia, Florida, Alabama, Mississippi, Louisiana and Texas, the preferred underlayment system (that also serves as the sealed roof deck) is a full layer of self-adhering polymer modified bitumen membrane meeting ASTM D1970. Appropriate attic ventilation must be provided.

   b. Several manufacturers offer reinforced synthetic roof underlayment products to be used in lieu of 15# or 30# felt. These products frequently display much higher tear resistance and are suitable for longer exposure to the elements without deteriorating. For use in the FORTIFIED program, with the intent of qualifying as providing the sealed roof deck, these materials and the installation must meet the following requirements:

      - The reinforced synthetic underlayment must have an ICC approval as an alternate to ASTM D226 felt paper meeting ASTM D1970 nail sealing requirements and have minimum tear strength per ASTM D1970 or ASTM D4533 of 20-lbs. The synthetic underlayment must also pass a liquid water spray test as prescribed in ASTM D 4869.

      - This underlayment shall be attached using annular ring or deformed shank roofing fasteners with minimum 1 in. diameter metal or plastic caps at 6 in. spacing along all laps and 12 in. spacing in the field; or, a more stringent fastener schedule if required by the manufacturer for high wind installations.

      - End laps shall be 6 in. All seams must be sealed with a compatible adhesive or a compatible 4 in. wide tape.

      - Horizontal seams on steep **SLOPE** roofs with the overlap listed in Table 3-3 do not have to be sealed with adhesive or tape.

   c. A sealed roof deck can be provided by self adhesive modified bitumen tape applied directly to the roof deck to seal the horizontal and vertical joints in the roof deck (see Figure 3-4). This self-adhering polymer modified bitumen tape must be at least 4 in. wide and must comply with ASTM D1970 "Standard Specification for Self-Adhering Polymer Modified Bituminous Sheet Materials Used as Steep Roofing Underlayment for Ice Dam Protection."

d. The requirements for the sealed roof deck can be met by an asphalt impregnated 30# felt underlayment installed with annular ring or deformed shank roofing fasteners with minimum 1 in. diameter metal caps at 6 in. spacing along all laps and 12 in. spacing in the field and covered with either an approved self-adhering polymer modified bitumen cap sheet or an approved cap sheet applied using an approved hot-mop method.

e. The requirements for sealed roof deck can also be achieved by applying a closed cell urethane based foam adhesive/insulation to the attic side of all joints between roof sheathing panels.

Table 3-3: Lapping Requirements for Synthetic Underlayment to Avoid Sealing Horizontal Laps

ASCE 7 Design Wind Speed mph	Fortified Design Wind Speed mph	Roof Pitch								
		5:12	6:12	7:12	8:12	10:12	12:12	14:12	16:12	18:12
		Required Overlap for "High Performance" Underlayment to Avoid Sealing Edges								
		inches	inches	inches	inches	inches	inches	inches	inches	inches
90	110	15	13	12	11	9	8	8	7	7
100	120	18	16	14	13	11	10	9	9	9
110	130	22	19	17	15	13	12	11	10	10
120	140	25	22	19	17	15	14	13	12	12
130	150	NA	25	22	20	17	16	15	14	13
140	160	NA	NA	25	23	20	18	17	16	15
150	170	NA	NA	NA	NA	22	20	19	18	17

NA = Not Allowed - overlap is greater than 25 in.

Figure 3-3: Installation of sealed roof deck using self-adhering strips. Source: IBHS

3.3 Hail & Tornado Specific Design Requirements

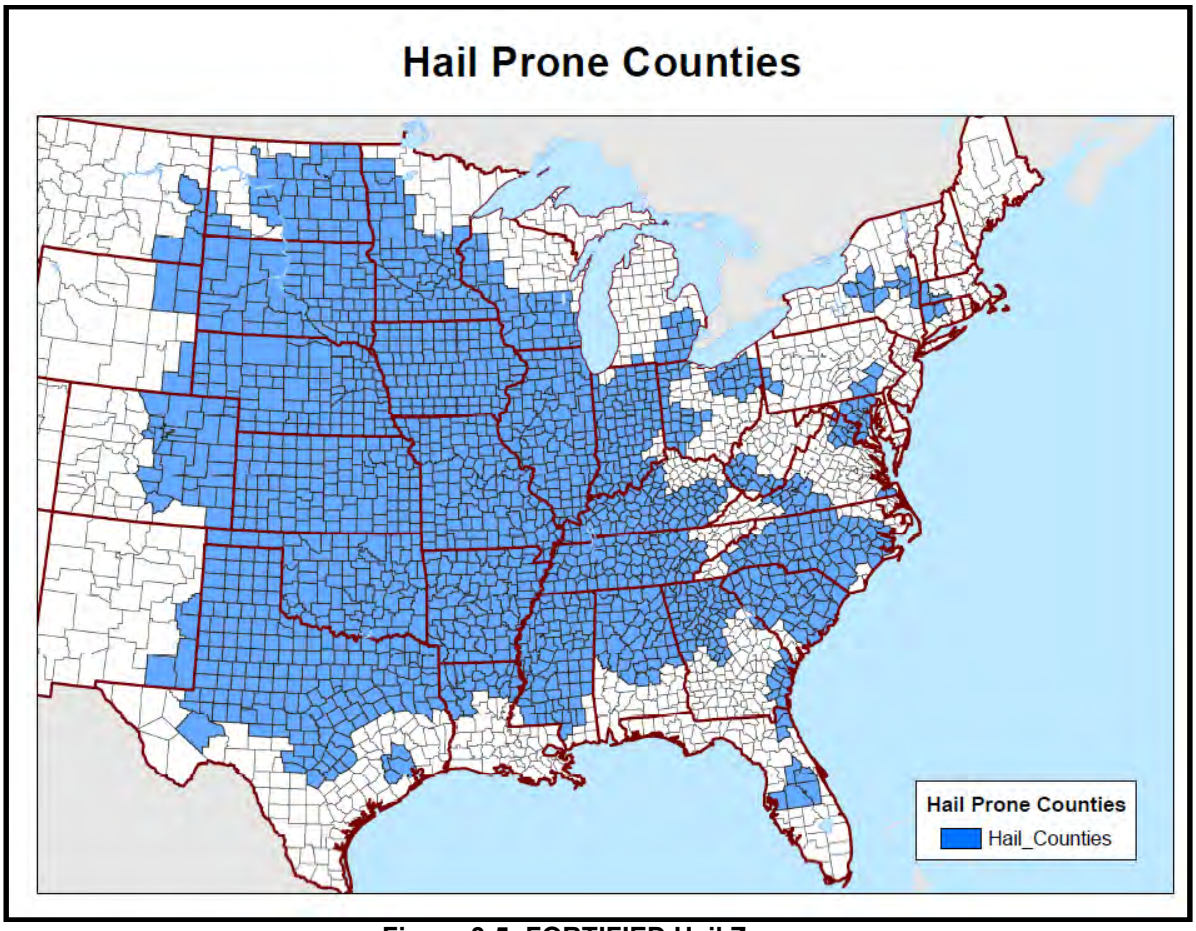

Figure 3-5: FORTIFIED Hail Zones.
The hail prone counties listed here are based on hail reports compiled by the Storm Prediction Center. Counties in blue are subject to a high frequency of damaging hail storms with a maximum hail stone size of 1 in. or lager.
Source: IBHS

HAIL - Mandatory Requirements

1. Roof Covers for **Low Slope** (≤10° or less than 2/12 pitch) **Roofs**.
   a. Roof covers in hail-prone areas as defined by Figure 3-5 must meet one of the following:
      - FM Approvals Standard 4470 with a Class 1-SH
      - UL 2218 Class 4
      - Pass ASTM D3746 Standard Test for Bituminous Roofing Systems
   b. In all other areas as defined by Figure 3-5 there is no hail requirement.
2. Roof Covers for **Steep Slope Roofs**.

a. Roof covers in hail-prone areas as defined by Figure 3-5 must meet one of the following:

   - UL 2218 Class 4
   - FM Approvals Test Standard 4473 Class 4

b. In all other areas as defined by Figure 3-5 there is no hail requirement.

TORNADO - Recommended Criteria

1. For businesses located in tornado-prone areas, as defined by Figure 3-1, the installation of a tornado shelter is recommended but not required.

2. If a tornado shelter is installed, it is recommended that it meet the requirements of FEMA 320 "Taking Shelter From the Storm: Building a Safe Room For Your Home or Small Business," FEMA 361 "Design and Construction Guidance for Community Safe Rooms," or the International Code Council & National Storm Shelter Association (ICC/NSSA) - ICC-500 "Standard on the Design and Construction of Storm Shelters."

3.4 Flood Specific Design Requirements

For purposes of this document, flood prone areas are considered to be all FEMA Zone Designations other than Un-shaded X or C. Buildings built in flood prone areas shall comply with the following design requirements.

1. The building shall comply with all of the provisions of the FEMA National Flood Insurance Program or FEMA Coastal Construction Manual, as appropriate.

2. For flood prone areas, foundations shall be designed for flood forces as required by ASCE 24, Flood Resistant Design and Construction, for the FORTIFIED Design Flood Elevation (FDFE).

3. Foundations in the Coastal A Zone shall be the same as required in the Coastal V Zone.

4. For flood prone areas (not X Unshaded or C) the finished floor elevations must be equal the FDFE, which shall be greater than or equal to the highest of the following:

   a. 3 ft. above the Base Flood Elevation (BFE)

   b. 3 ft. above the Advisory Base Flood Elevation (ABFE)

   c. The 500-year flood elevation (if known).

5. Buildings located in flood prone areas will have a check valve or similar back flow device installed at the point of entry into the building on the main discharge sewer line to prevent sewage from potentially flowing back into the building during a flood event. An alternative is to provide a drain plug device for all floor drains located in basements and first floor.

6. All mechanical equipment and utility connections shall be above the FDFE. Vertical runs shall be protected by columns, or other structural elements that are not part of any break away wall system, and shall not be connected to any break away elements.

3.5 Severe Winter Weather Specific Requirements

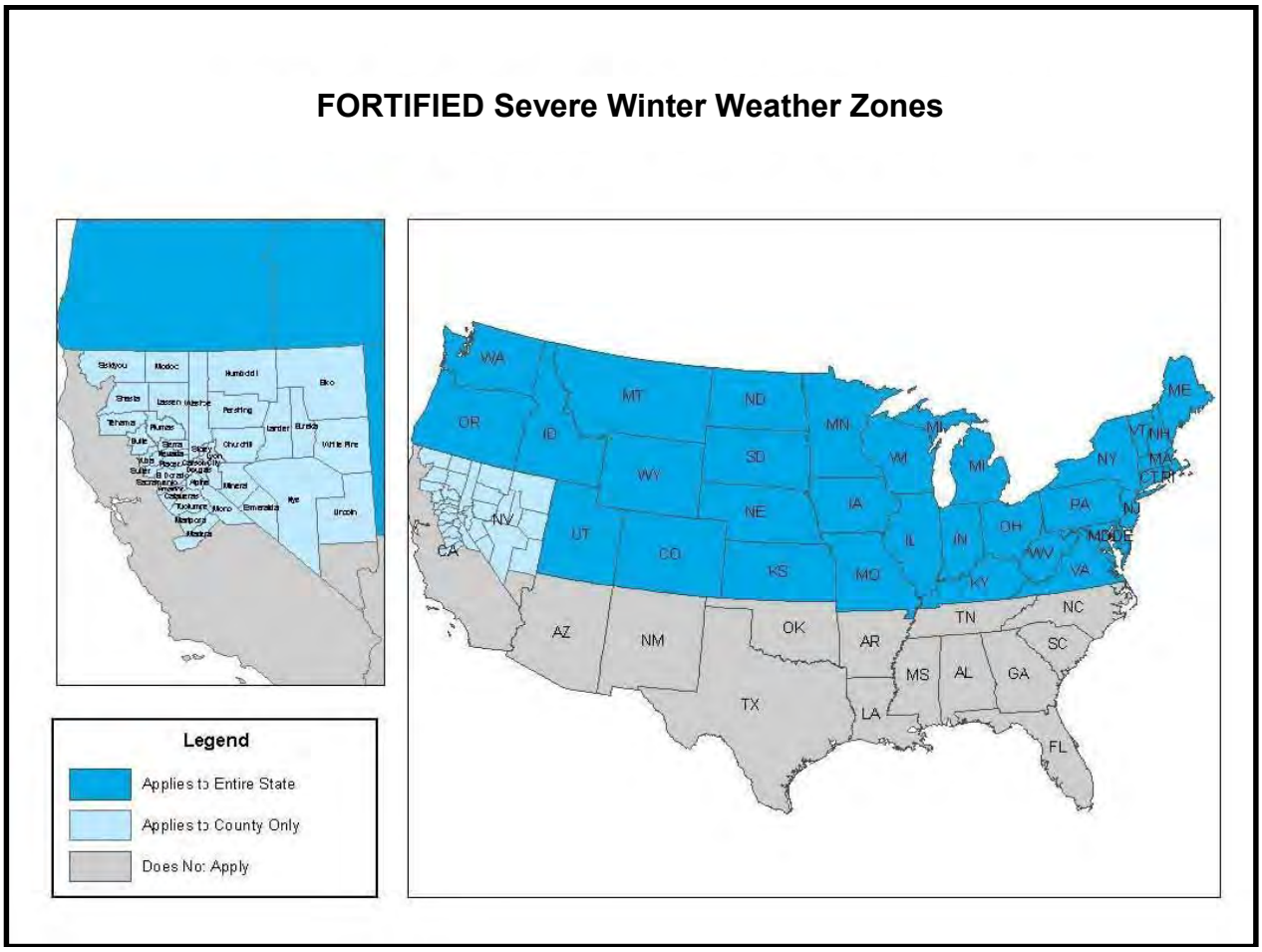

Figure 3-6: FORTIFIED Severe Winter Weather Zones. Source: IBHS

SEVERE WINTER WEATHER – Mandatory Requirements

1. The **FORTIFIED** ground snow loads used to design the building shall be 1.2 times the ground snow loads (P_g) shown in ASCE 7 (or the locally adopted ground snow loads in Case Study areas).

2. Unless already included because of other risks, an additional moisture barrier shall be applied to the roof deck of steep slope roofs along the eaves of the roof to prevent intrusion caused by ice dams. This moisture barrier shall extend from the roof edge to at least 2 ft. towards the interior of the building, beyond the exterior wall enclosing conditioned space.

3. No localized heat source shall be installed in non-conditioned attic space such that it creates localized heating of the roof surface.

4. Un-insulated recessed lights shall not be installed where they could cause localized heating of the roof surface.

5. All attic or roof access doors between conditioned and non-conditioned space shall be treated as exterior doors, properly insulated, sealed and weather-stripped or gasketed.

6. All attic penetrations (stack vents, partition walls, electrical chases, etc.) shall be properly sealed and insulated.

7. Protection from Frozen Pipes: Water pipe runs are prohibited in exterior walls and unheated spaces.

SEVERE WINTER WEATHER - Recommended Criteria

1. All roof drains on low-slope roofs (≤10°) should have heating strips (heat trace) installed around them in such a way that it prevents blockage of the drains by ice or ice dams.

3.6 Seismic Specific Design Requirements

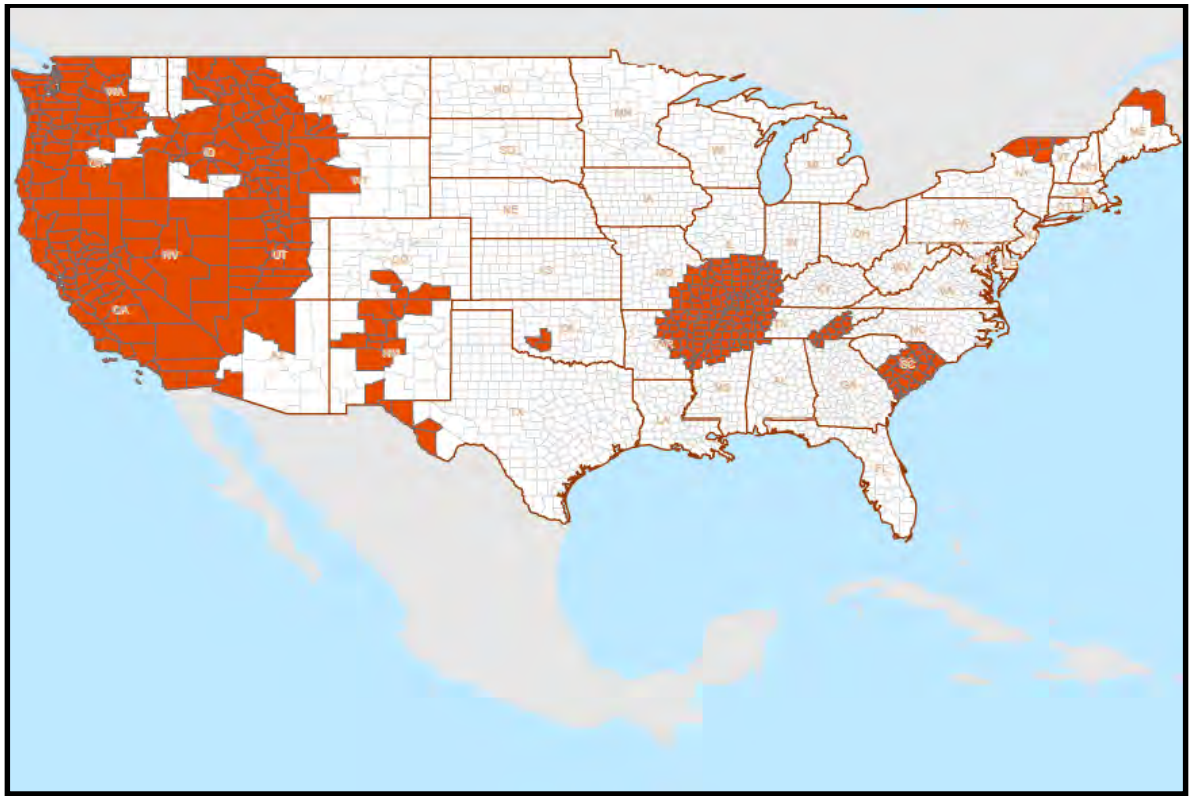

Figure 3-7: Based on design maps for the International Building Code (2012) prepared by the U.S. Geological Survey: the highlighted counties contain areas with a Risk-Targeted Maximum Considered Earthquake (MCER) Ground Motion Response Acceleration equal to or greater than 40% [0.2-Second Spectral Response Acceleration (5% of Critical Damping), Site Class B].

See **Appendix O** for a list of state and counties considered to have an earthquake exposure.

Engineers should establish target performance levels and design the structure to achieve that performance level for a specific probability based event scenario or scenarios. Each performance level should be related to a certain magnitude event and probability of occurrence.

Typical performance levels include:

1. Little or no damage and the ability to continue operations without disruption.

2. Non-structural damage that will require repair and may interrupt operations for a relatively short period of time (days to weeks).

3. Structural damage without collapse or significant life safety risk.

IBHS is currently re-evaluating the seismic requirements to achieve performance goals through rational design. In the interim, the following mandatory requirements should be followed.

SEISMIC Mandatory Requirements

1. **Seismic Design Loads:** A 20% increase in the mapped spectral response acceleration parameters, S_S and S_1, is required in seismically active regions of the U.S. These seismically active regions of the U.S. are identified as areas where the ASCE 7 mapped 0.2 sec spectral response acceleration parameter, S_S, is greater than or equal to 0.50g. In these seismically active areas, the spectral response acceleration parameters used to design the structure shall be 1.2 times the mapped spectral response acceleration parameters, S_S and S_1, as shown in ASCE 7 (Figures 22-1 and 22-2).

2. **Increased Spectral Acceleration:** The increased mapped spectral response acceleration shall be used to determine the appropriate Seismic Design Category for the building. The appropriate design considerations for the resulting Seismic Design Category and **FORTIFIED** Seismic Ground Motion shall be used in the design of the building.

3. **Construction Not Permitted on Known Faults: FORTIFIED** designated buildings are, where fault zones (areas subject to severe ground dislocations) have been established and mapped (for example, areas of California).

4. **Site Specific Geotechnical Report:** Where Seismic Hazard Zone maps have been developed (such as in California), or in ASCE Seismic Design Categories C through F, a site specific geotechnical report complying with the provisions of ASCE 7 Section 11.8 is required and the building shall be designed by a licensed professional engineer.

5. **All glazing** shall be tempered glass or have a safety film applied on the interior surface.

6. **Flexible Gas Lines:** At the interface of adjacent structures or portions of the same structure that may move independently, natural gas and propane lines shall be provided with adequate flexibility to accommodate the anticipated differential movement between the ground and the structure.

7. **Masonry chimneys** shall be connected to structural members of exterior walls and provided with adequate restraint for the expected loads on the chimneys. Unreinforced chimneys shall not extend more than 24 in. above the rooftop.

8. **Underground Utilities and Utility Interfaces:** Specific attention shall be given to the vulnerability of underground utilities and utility interfaces between the structure and the ground in all situations where the assigned Site Class is E or F and the **FORTIFIED** S_{DS} is 0.40 and greater, and for all other Site Classes where the **FORTIFIED** S_{DS} is greater than 0.50g.

9. **Nonstructural component anchorage** shall meet the requirements of Section 13.4 of ASCE 7.

10. **Architectural component anchorage** shall meet the requirements of Section 13.5 of ASCE 7.

11. **Anchorage of mechanical and electrical components** [water heaters, air side (fans, air handlers, AC units, heaters, etc.) and wet side (boilers, furnaces, chillers, heat exchangers, etc.) HVAC equipment, generators, roof mounted chimneys, stacks, motor control centers, switch gear, piping, ductwork, conduit, bus trays, etc.] shall meet the requirements of Section 13.6 of ASCE 7.

12. **Automatic sprinkler systems** shall meet or exceed bracing, design, and installation requirements of NFPA 13 *Standard for the Installation of Sprinkler Systems or* FM Global Property Loss Prevention Data Sheet 2-8 *Earthquake Protection For Water Based Fire Protection Systems.*

SEISMIC – Strongly Recommended Criteria

1. **Automatic Gas Shutoff Valves:** Companies capable of re-lighting (without the intervention of local gas utilities) gas-fired equipment should install automatic shut-off device.

3.7 Wildfire Specific Design Requirements

Note: The requirements of this section do not apply for downtown urban areas.

Because many designers are not as familiar with wildfire risks, as compared to other risks, **FORTIFIED for Safer Business™** Standards provide the following background information. This information includes details on wildfire risks and describes a coupled approach, which deals with both the building and surrounding vegetation. Specific design requirements for various wildfire risk levels are provided following the Background and Definitions section below.

3.7.1 Background and Definitions

Building ignitions during wildfires occur when a component of a building is exposed to one or more of the three basic wildfire exposures: burning embers (also called firebrands), direct flame contact, and radiant heat.

Risks Associated with Burning Embers

Burning embers are the most important cause of building ignitions. They can ignite nearby vegetation or accumulated debris, or enter the building through openings, such as an open window or attic vent. Once inside, embers can ignite furnishings or other combustible materials and accumulated debris stored in unoccupied spaces, such as an attic. Nearby ignitions can subject some portion of the a building to either a direct flame contact exposure, where the flames touch the building, or a radiant heat exposure – the heat you feel when standing near a campfire or fireplace.

Risks Associated with Radiant Heat

The vulnerability of a building to radiant heat depends upon the intensity *and* duration of the exposure. If the radiant heat level is high enough, and duration long enough, it can result in the ignition of a combustible product (for example, wood siding), or it can break the glass in a window. Exposures to lower levels of radiant heat can pre-heat materials, making them easier to ignite from a direct flame contact exposure. Once the component ignites or fails, it is easier for the fire to enter the building through the stud cavity, the fire can spread vertically up the wall and impinge on and possibly break the window glass, or the fire can enter the attic through the eave or eave vent. Once the glass in a window breaks, embers can readily enter the building and ignite interior furnishings.

Risks Associated with Ember Transport

Burning embers can travel for a mile or more before landing on or near a building. Because of the ability

of wind-driven burning embers to travel long distances, the requirements for FORTIFIED for Safer Business™ include provisions to 1) make buildings less vulnerable to ember exposures, 2) reduce the opportunity for the flames from the fire front of the wildfire, or spot fires caused by embers, to reach the building, and 3) minimize the opportunity for radiant heat exposures from landscaping vegetation or outbuildings to threaten the business.

Provisions that address the vulnerability of a building to embers are provided in the FORTIFIED mandatory building requirements for all fire hazard severity zones and the near-building (0 to 5 ft) defensible space requirements. The near-building zone is very important since any ember ignitions in this zone would very likely result in a direct flame contact exposure to the side of the building. Provisions addressing the direct flame contact and radiant heat exposures are included in the other defensible space requirements outlined in these standards.

3.7.2 Terms used in, or applicable to, this section:

Authority Having Jurisdiction (AHJ): From NFPA 1144 (2009), "an organization, office, or individual responsible for enforcing the requirements of a code or standard, for approving equipment, materials, or installation and a procedure."

Bird-Stop / Bird-Stopping: Used to describe the application of a material to fill the space between the roof covering and roof deck to minimize the accumulation fine debris in that area. These materials can also limit the intrusion of embers during wildfires.

Defensible Space: The area between a building and an approaching wildfire, where vegetation has been managed to reduce the wildfire threat and improve the likelihood of a building surviving without assistance from firefighters, as described in "Fire Adapted Communities: The Next Step in Wildfire Preparedness," University of Nevada Cooperative Extension, Publication SP-10-10.

Defensible Space Zones: Each of the three zones in a defensible space plan acts as a layer of protection between your business and the approaching wildfire.

Zone 1: 0-5 ft. (also referred to as near-building, noncombustible or low-combustible zone)

The objective of this zone is to reduce the chance that ignition will result in a direct flame contact exposure to the building. Because this zone is closest to the building it requires the most careful selection and intensive management of vegetation and materials.

1. Install hard surfaces in this zone (e.g., concrete walkway), or use noncombustible mulch products (e.g., rock mulch).

2. Landscape vegetation recommended for this zone includes irrigated lawn and low-growing herbaceous (non-woody) plants. Shrubs and trees, particularly conifers, are not recommended for use in this zone.

3. Remove dead plant material from plants. Plants adjacent to combustible siding and foundation vents, as well as plants under or next to windows and soffit vents or interior corners present the greatest hazard.

Zone 2: 5-30 ft. (or to the property line)

The objective of vegetation management in this zone is to prevent the fire from climbing into the crown or upper portions of trees or shrubs, and to stop the fire from burning directly to the building. Trees and shrubs in this zone should be in well spaced groupings and well maintained. Eliminating ladder fuels and creating separation between plants, or plant groupings, are techniques used to fulfill this objective.

1. Dead plant material and tree branches should be removed from vegetation on a regular maintenance schedule.

2. Create islands or groupings of vegetation that will result in a discontinuous path of vegetation thereby making it difficult for the fire to burn directly to the building. Embers may still be able to ignite individual islands of plants in this zone, which is why plant selection and maintenance is so critical in the 0-5 ft. zone.

3. Lower tree branches and nearby shrubs (the ladder fuels) should be removed so that a surface fire cannot reach the tree crown. Trees located within this area shall be maintained with a minimum horizontal spacing of 10 ft. between crowns. Branch removal should not exceed 1/3 of the tree height.

4. Locate outbuildings (e.g., for storage) at least 30 ft. away from the building, or create defensible space within 10 ft. around the outbuilding.

5. Paved parking areas surrounding commercial developments can serve as fire breaks, stopping the fire front from burning directly to the buildings.

Zone 3: 30-100 ft. (or to the property line)

1. The goal of this zone is to slow down and reduce the energy of the wildfire. Tree and brush spacing should force the fire in the tree (shrub) crowns to drop to the ground. Dead trees and shrubs should be removed.

2. The rate of spread and flame length is affected by slope. A steeper slope will result in a faster moving fire, with longer flame lengths. Determine the slope of the land around the building:

    - At the top of a slope, the building should be set back a minimum of 15 ft. for a single story structure and 30 ft. for two story structure.

    - Buildings located mid-slope, or with inadequate set-back at the top of slope, should utilize an enhanced fuel modification zone up to 150 or 200 ft. for slopes greater than 40%. Trees located within this area shall be maintained with a minimum horizontal spacing of 10 ft. between crowns.

Fire Hazard Severity Zone (FHSZ): The Fire Hazard Severity Zone represents an evaluation of the wildfire hazard (not risk) in a particular area. The fire hazard severity zones are often determined and mapped by a given authority having jurisdiction (AHJ) in wildfire prone areas. For the purpose of FORTIFIED for Safer Business™, the fire hazard severity zones have been classified as moderate, high, or extreme (sometimes also referred to as very high).

Guidance regarding general characteristics associated with each severity zone is provided in each section. However, the first step in determining a given FHSZ rating should be to contact the local AHJ and request any information that has already been developed, including the FHSZ rating.

Use any FHSZ rating as predetermined by local AHJ in executing FORTIFIED for Safer Business™ requirements.

Ignition Resistant Building Material (IRM): As defined in the International Wildland Urban Interface Code (IWUIC 2009), an ignition resistant building material is one that resists ignition or sustained flaming combustion as determined by testing in accordance with provisions outlined in Section 503.2 of the IWUIC or Section 3.3.13, NFPA 1144, 2008 Edition. An ignition resistant building material has been tested for an extended 30-minute flame spread test according to procedures provided in ASTM E 2768, Test for Extended Duration Surface Burning Characteristics of Building Materials (30 minute Tunnel Test).

Materials with this designation have typically been subjected to an accelerated weathering procedure (IWUIC Section 503.2.1.1.3) prior to testing to the extended 30-minute flame spread test. A list of compliant materials is maintained by the California Office of the State Fire Marshal Building Listing Program (http://osfm.fire.ca.gov/strucfireengineer/strucfireengineer_bml.php).

Noncombustible: A noncombustible material is one that complies with the provisions given in ASTM E-136, Standard Test Method for Behavior of Materials in a Vertical Tube Furnace at 750°C.

Combustible Material: Combustible materials will ignite and burn when subjected to fire or elevated temperatures. Two properties are helpful in characterizing and comparing the relative combustibility of different materials. These include the flame spread index (ASTM E 84) and heat release rate.

Vegetation: Vegetation consists of naturally occurring plant materials, as well as species introduced into the area. Vegetation is often a primary source of wildfire fuel and has a profound influence on fire behavior.

Attributes that contribute to vegetation's fire hazard rating include:

- Plant age.
- Moisture content.
- Amount and distribution of dead materials (i.e., ratio of live to dead material).
- The ratio of the surface area of the vegetation components to volume of the same vegetation (i.e., the size of leaves, twigs and branches).
- Geometry and arrangement of the plant.
- Chemical content (i.e., the amount of volatiles or extractives in the component).

Plant characteristics associated with higher combustibility include:

- Narrow leaves or needles (often evergreen).
- Volatile resins and oils, as indicated by leaves that have an aromatic odor when crushed.
- Accumulation of fine, twiggy, dry, or dead material on the plant or on the ground under the plant.
- Loose or papery bar that often falls off and accumulates on the ground (for example, palms and eucalyptus).

Plant characteristics associated with lower combustibility include:

- High moisture content in leaves.
- Low oil or resin content (little or no aromatic odor when leaves are crushed).
- Drought tolerance or drought resistance – deeply rooted plants with thick heavy leaves.
- Minimal seasonally accumulation of dead vegetation (foliage, twigs, small branches).
- Open or loose branching habit.
- Plant is short enough to enable easy maintenance and pruning.

Vegetation Management Plan (VMP): A Vegetation Management Plan provides information (narrative and figures) about topography (slope and aspect), location of building(s) on the parcel, proposed fuel treatment details and location, presence of noxious weeds on site and in the vicinity, environmentally sensitive concerns (e.g., threatened and endangered species, as well as state listed sensitive species and wetlands), vegetation maintenance and monitoring programs. The VMP shall provide information on how the three defensible space zones will be developed and maintained.

A local authority having jurisdiction (e.g., fire marshal, urban forester, or fuels management officer) should be consulted regarding vegetation options beyond the information provided in this document.

A landscape professional should be consulted in developing the VMP. Depending on the site, a forester, range management, or natural resource specialist could be consulted.

Fuel Modification Zone: There are a number of kinds of fuel modification zones, including defensible space around a home or building, community fuel breaks, fuels treatment along an access road, and a community safe area. For the purpose of this document, the fuel modification zone is related to the defensible space zones surrounding a building. Fuel modification includes actions taken in terms of selecting, locating and maintaining vegetation, and decisions regarding storage of combustible items to reduce or otherwise modify fuel loading. It is a critical component in making and maintaining effective defensible space. For these FORTIFIED standards, the principal objective of fuel modification and reducing fuel loading is to minimize the ability of the flame front of a wildfire to burn to the building, and reduce the opportunity for vegetation ignited by embers to create a flame contact and/or radiant exposure to the building.

The VMP should address all vegetation on the property, both naturally occurring and landscape, and not just that in association with the defensible space. This applies to developments within large tracts of land.

A summary of the building and vegetation management requirements are given in Table 3-3.

Table 3-3. Summary of the hierarchical structure for building and vegetation management requirements for FORTIFIED for Safer Business™ as a function of the Fire Hazard Severity Zone (FHSZ). NR = Not Required.

Designated FHSZ	Requirements		
	Mandatory (required for all FHSZs)	High	Extreme (Very High)
Moderate	Required	NR	NR
High	Required	Required	NR
Extreme (Very High)	Required	Required	Required

3.7.3 WILDFIRE – MANDATORY REQUIREMENTS: ALL FIRE HAZARD SEVERITY ZONE AREAS

1. **Vegetation Management Plan:** A Vegetation Management Plan shall be submitted for review and approval.

2. **Building Related Properties and Requirements:** Building finishes and components shall meet the following requirements.

    a. **Roof coverings** shall have a Class A fire rating based on testing to ASTM E-108, UL 790 or FM 4470.

    b. **Any openings between the roof covering and roof deck** at the roof edge and/or ridge shall be plugged using a noncombustible material (i.e., bird-stopped).

c. **Projections from sloped roofs** (e.g., a dormer) shall be clad with a noncombustible or ignition resistant material.

d. **Exposed roof valley flashings** shall not be less than 0.019 in. (No. 26 galvanized sheet gage) corrosion-resistant metal installed over a minimum 36 in. wide underlayment consisting of one layer of No. 72 ASTM cap sheet running the full length of the valley.

e. **Gutters and downspouts** shall be of noncombustible materials. Typical aluminum gutters and downspouts are acceptable. The gutter shall incorporate an integral metal flashing at the roof edge, or a separate angle flashing shall be used at the roof edge. Clearing debris from gutters shall be incorporated into a routine maintenance and upkeep plan for the building(s) in the development.

f. **Eave construction** shall incorporate a soffited design using a horizontal return from roof edge to the exterior wall.

g. **Soffit Vent Openings:** Noncombustible, corrosion-resistant screening with a mesh size no greater than 1/8-in. shall be used to cover the attic, sub-floor and other vent openings on the wall. When vent opening is integrated within the soffit material, an individual vent opening shall not exceed 1/8-in. diameter or 0.05 in^2. Vents designed for use in wildland urban interface areas that have been accepted for use by the AHJ shall be allowed for use.

h. **Operational windows** shall have screens covering those sections that can open.

i. **Vehicle access (garage) doors** shall be weather sealed around the perimeter to minimize entry of embers.

j. **Storage of Combustible Materials:** Combustible materials shall not be stored under attached decks.

k. **Deck Boards:** Solid wood, plastic, or wood-plastic composite deck boards shall comply with the requirements of Chapter 7A, California Building Code. A listing of compliant products can be found in the California Office of the State Fire Marshal WUI *Products Handbook* (http://osfm.fire.ca.gov/strucfireengineer/pdf/bml/wuiproducts.pdf).

l. **Spark arrestors** with ½-in. mesh screening shall be installed at the outlet of all chimneys.

m. **Interior fire protection system** with monitored smoke alarms and heat sensors shall be in accordance with “Interior Fires” requirements in this Design Guide (Section H).

2. **Parcel/Surroundings Requirements:** The following requirements relate to Control of flammable materials on the Parcel / Surrounding area.

a. **Defensible space** shall be created and maintained as previously outlined and as provided in the Vegetation Management Plan.

b. **Signage** shall be made from a noncombustible material. Street numbers shall be at least 4 in. high, reflective, applied on a contrasting background, at each driveway entrance, and be visible from both directions of travel.

c. **Firewood storage and liquefied propane (LP) gas containers** must be at least 30 ft. from the structure. The firewood shall not serve as ladder fuel into nearby vegetation. LP gas containers shall have a 10-ft noncombustible zone extending out from the outside edge of the container. Alternatively, the container can be surrounded by a CMU block wall, with wall height equaling the container height. The wall must provide ventilation at the bottom to reduce the accumulation of LP gas should a leak occur.

d. **Entrances and driveways** must be at least 12 ft. wide with at least 13.5 ft. of vertical clearance. The angle of approach and departure shall be designed to allow for emergency vehicle access without damaging the equipment when entering or leaving the driveway.

e. **If property is gated**, the gate must open inward and have an entrance at least 2 ft. wider than the driveway. Any gate shall be located at least 30 ft. from a roadway intersection. If secured, the gate must have a key box or lock of a type approved by the local AHJ.

f. **Flammable Liquids:** Small quantities of combustible and flammable liquids stored outside shall be located in UL or FM Approved fire rated cabinets and labeled with appropriate signage.

g. **Fire hydrants** shall be located within 250-500 ft, or as approved by the fire authority having jurisdiction (FAHF), of the building connected to a reliable public or private water supply.

h. **Setback of Buildings and Structures:** Buildings and structures shall be setback a minimum of 30 ft. from any property line adjacent to a national forest, state park, open space preserve or other protected wildland.

i. **Planned landscaping** planted adjacent to the building(s) should be irrigated.

3.7.4 WILDFIRE – MANDATORY REQUIREMENTS: MODERATE FIRE HAZARD SEVERITY ZONE AREAS

Moderate Fire Hazard Severity Zones have the following conditions:

- The area has been designated as a Moderate (or lower) hazard area by local or state authorities.
- Flat terrain with no grades greater than 9%.
- Limited wildland or conservation area exposure.
- No known history of wildfires in the area.

1. **Additional Building Requirements** beyond those required for All Zones:
    - The exterior siding is not restricted in this fire hazard severity zone.
    - No additional requirements.
2. **Additional Parcel / Surroundings Requirements** beyond those required for all zones.
    - No additional requirements.

3.7.5 WILDFIRE – MANDATORY REQUIREMENTS: HIGH FIRE HAZARD SEVERITY ZONE AREAS

High Fire Hazard Severity Zones have the following conditions:

- The area has been designated as a High or Significant hazard area by local or state authorities.
- Hilly terrain with grades that average 10% - 20%.
- Has a shared border with a wildland or conservation area consisting of forested, shrub or chaparral vegetation within 100 ft. of the site.

- A history of wildfires in the area.

1. **Additional Building Requirements** beyond those required for all zones and the moderate fire hazard severity zone.

    a. Exterior windows, window walls, glazed doors, and glazed openings within exterior doors shall be insulating-glass units with a minimum of one tempered pane, or glass block units, or have a fire resistance rating of not less than 20 minutes when tested according to UL 9 or NFPA 252. Glazing frames made of vinyl materials shall have welded corners, metal reinforcement in the interlock area (i.e., at the horizontal meeting rail in a hung window, vertical member in a casement windows), and be certified to ANSI/AAMA/NWWDA 101/I.S.2-97 structural requirements.

    b. Gutters shall incorporate a noncombustible gutter cover device. If the roof slope allows, the gutter cover device should be installed so that it is parallel to the plane of the roof slope (with steeper sloped roofs this may not be possible).

    c. Exterior wall coverings shall meet one of the following:

        - Combustible siding with an integral horizontal lap joint (tongue and groove, ship-lap, rabbeted bevel) is acceptable. The chinking in chinked-style log wall constructions shall be fire rated. Panelized siding with a vertical ship-lap joint will be acceptable.

        - Ignition resistant materials as defined in this document.

        - Noncombustible material in accordance with ASTM E 136.

    d. Exterior personnel doors shall be of noncombustible construction, or solid core having stiles and rails not less than 1 3/8-in. thick with interior field panel thickness no less than 1 ¼-in. thick, or shall have a fire resistance of no less than 20 minutes when tested in accordance with NFPA 252 or UL 10.

2. **Additional Parcel/Surroundings Requirements** beyond those required for all zones and the moderate fire hazard severity zone.

    a. **Outdoor Storage:**

        - High-piled storage of combustible material shall not exceed 10 ft. in height and shall be located a minimum of 50 ft. from the building.

        - Outdoor storage of large quantities of combustible and flammable liquids stored shall be located greater than 50 ft. away from the building or stored in detached noncombustible buildings.

        - Liquefied propane (LP) tanks shall be located at least 50 ft. from the building and other structures on the property. Acceptable alternatives include 1) create a 10 ft. noncombustible (rock, gravel, mulch or irrigated lawn) zone around the tank, or 2) enclose the tank using noncombustible materials, or 3) unless otherwise prevented by the local AHJ, bury the tank following requirement in NFPA 58 or FM Global Property Loss Prevention Datasheet 7-55.

    b. Buildings and structures shall be setback a minimum of 30 ft. from any property line adjacent to a national forest, state park, open space preserve or other protected wildland.

c. Any fire hydrants shall be located within 250 ft. of the building connected to a reliable public or private water supply.

3.7.6 WILDFIRE – MANDATORY REQUIREMENTS: EXTREME (VERY HIGH) FIRE HAZARD SEVERITY ZONE AREAS

Extreme Fire Hazard Severity Zones have the following conditions:

- The area has been designated as Extreme, Severe or Very High hazard area by local or state authorities.
- Steep sloped terrain with grades that average more than 20%.
- Has a shared border with a wildland or conservation area consisting of forested, shrub or chaparral vegetation within 100 ft. of the site.
- A history of wildfires in the area.

Mandatory requirements and those specified for the Moderate and High Fire Hazard Severity Zones shall also be incorporated with the requirements specified for this hazard zone.

1. **Additional Building Requirements** beyond those required for all zones and the moderate and high fire hazard severity zones.

   a. **Exterior wall assemblies** shall be clad with a noncombustible material in accordance with ASTM E 136, or with the exception of exterior-rated, pressure impregnated fire retardant treated shakes or shingles, rated as an ignition resistant material.

   b. **Floor projections** shall maintain the fire resistance of the exterior walls, or the projections shall be enclosed to the grade.

   c. **Attached decks**, such as a balcony or porch, shall meet one of the following criteria:

      - Shall consist of a noncombustible solid surface decking (e.g., light weight concrete with noncombustible top surface), and enclosed on the underside of the deck with the enclosure material being attached to the underside of the deck support structure.
      - Shall consist of a combustible decking product that complies with the requirements of Chapter 7A of the California Building Code.
      - For slopes greater than 20%, a 6 ft. tall noncombustible wall (e.g., concrete block, stone) shall be located on the down slope side of each attached deck, located between 20 ft. and 30 ft. from the outer edge of the deck and extending along the side of the building to which the deck is attached.

   d. **Exterior windows, window walls, glazed doors, and glazed openings** within exterior doors shall be insulating-glass units with tempered glass, have glass block units, or have a fire resistance rating of not less than 20 minutes, when tested according to UL 9 or NFPA 80.

2. **Additional Parcel/Surroundings Requirements** beyond those required for all zones and the moderate and high fire hazard severity zones.

   a. **For buildings built mid-slope and the slope is greater than 20%:**

i. **For slopes between 21% and 40%,** the defensible space requirements shall be increased to 150 ft. in the down slope direction, following the requirements established for the 30- to 100-ft.zone.
ii. **For slopes greater than 40%,** the defensible space requirements shall be increased to 200 ft. in the down slope direction, following the requirements established for the 30- to 100-ft. zone.

3.8 Building Envelope and Water/Air Management Specific Design Requirements

BUILDING ENVELOPE AND WATER/AIR MANAGEMENT – Mandatory Requirements

1. For **masonry construction**, a full bed of sealant shall be installed prior to setting the window or door to assure a water resistant installation.

2. For **wood frame construction**, the use of a water resistant building wrap is necessary to keep water intrusion to a minimum. Proper installation is critical and manufacturer's installation instructions must be strictly adhered to.

3. **Exterior Finishes** such as Exterior Insulating Finish Systems (EIFS), vinyl, aluminum, wood, or paint shall be installed in accordance with the manufacturer's installation instructions and product approval documents.

4. **Installation of windows and doors** must be completed in accordance with the manufacturer's installation instructions and product approval documents.

5. **Window and door flashing** for frame construction must be installed per ASTM E2112.

6. The **location of domestic water control valves** should be documented and mapped.

7. The **location of water-based fire protection control valves** should be documented and mapped.

8. **Bathrooms, water heater areas, and utility rooms** with water hookups shall have floor drains.

9. **Water heaters** are not permitted in attic spaces.

10. **Drain pans for A/C condenser units** shall be equipped with two drain lines (one to be 1-in. diameter), or a single 1.5-in. diameter drain line. They shall also be fitted with an automatic overflow sensor and shutoff switch.

11. **Corrosion sensitive plumbing materials** under the slab shall be sealed with a protective coating.

3.9 Interior Fires Specific Design Requirements

INTERIOR FIRES – Mandatory Requirements

1. **Fire protection systems must be designed and certified** by a licensed Fire Protection Engineer or a National Institute for Certification in Engineering Technologies (NICET) – Certified Technician, minimum Level 3 or 4, in Water-Based Fire Protection Systems Layout.

2. Businesses shall be equipped with a **fire protection system that meets or exceeds National Fire Protection Association (NFPA) 13** *Standard for the Installation of Sprinkler Systems* requirements for the particular building construction, occupancy, size, and use.

3. **Underground piping installation and acceptance** shall be in accordance with NFPA 24 *Standard for the Installation of Private Fire Service Mains and Their Appurtenances*. This includes completing and signing the "Contractor's Material and Test Certificate for Underground Piping."

4. **Fire alarm and detection systems** shall be installed in accordance with the International Building Code Section 907 *Fire Alarm and Detection Systems* and NFPA 72 *National Fire Alarm and Signaling Code*.

5. **Fire alarm systems shall be monitored** by an approved supervising station in accordance with NFPA 72.

6. **All fire protection equipment shall be FM or UL Approved**, bearing their approval mark.

7. **The most hydraulically remote areas and sprinkler system design requirements including sprinkler system density, hydraulic design area, and required flow and pressure,** are to be included in the plans.

8. The **hydraulic calculations** shall be based on the lesser of two hydrant flow (water supply) tests conducted during normal working hours at least seven days apart. At least one of these tests shall be performed within the nine month period prior to system acceptance.

9. **A minimum pressure safety factor in water supply of 10% or 5 psi**, whichever is less, at the flow demand of each hydraulically remote design area shall be included.

See also **Appendix A: Interior Fire Design Requirement Checklist** for more details.

3.10 Burglary Specific Design Requirements

BURGLARY – Mandatory Requirements

1. **Doors:** Wood doors installed at exterior locations shall be solid core. Provide an escutcheon plate around the door edge (for any door with a wood edge) at the dead bolt lock. Steel edged doors do not need an escutcheon plate. Doors shall be a minimum 1¾-in. thick. Steel doors, frames, and hardware reinforcing shall meet minimum performance Level 3 (Extra Heavy Duty) requirements of ANSI/SDI A250.8.

2. **Dead Bolts, Reinforcing Plates, and Strike Plates:** Unless prohibited by code requirements for panic and fire exit hardware, install ANSI/BHMA Grade 1 deadbolt locks with a minimum 1-in. long throw at all doors at exterior locations. Reinforce any wood door frame for these doors with a metal (steel or aluminum) reinforcing plate at each deadbolt lock strike plate. The strike plate shall be a high security strike plate attached with a minimum (4) 3-inch long screws to the reinforcing plate. The reinforcing plate shall extend at least 12 in. above and below the deadbolt lock location and be attached with a minimum (8) 3-in. long screws to the building wall framing.

3. **Hinges for Exterior Doors in Framed Construction:** At exterior doors, for framed wall construction, install hardwood shims at all hinge locations and every 2 ft. on each jamb and install hinges with 3-inch long screws.

4. **Wall Framing at Exterior Doors of Framed Construction:** At all exterior doors, for framed wall construction, reinforce the walls on both door jambs with horizontal framing members in the three stud spaces next to the door opening.

5. **Window Installation:** Install windows that meet ASTM F 588.

6. **A burglary and theft protection plan** should be implemented for the appropriate location specific risk factors including occupancy and probability of loss. Items that are effective means for reducing burglary and theft include but are not limited to: security alarm system that is monitored by a constantly attended UL Approved central monitoring station or proprietary monitoring station; 24 hour, 7 days a week, security personnel, motion detection, intrusion detection including window and door contacts, glass break detectors on ground floor windows, security cameras, strobe/audible alarm on the exterior of the building, outdoor security lighting, perimeter fence, etc. A combination of these security provisions should be implemented to meet the needs of the location.

7. **Outdoor security lighting** shall conform to the Illuminating Engineering Society of North America publication IESNA G-1-03, Guideline on Security Lighting for People, Property, and Public Spaces.

BURGLARY – Strongly Recommended Criteria

1. Security alarm system installations should be in accordance with NFPA 731 Standard for the Installation of Electronic Premises Security Systems.

2. For businesses with storefronts susceptible to “smash and grab” theft; install permanent or retractable bollards between exterior walls and paved areas with potential vehicle access.

3.11 Electrical Surge Protection Specific Design Requirements

ELECTRICAL SURGE PROTECTION – Mandatory Requirements

1. **The building’s electrical system** shall be installed and properly grounded in accordance with NFPA 70 - National Electrical Code.

2. **Use only screw-wired connection electrical outlets**. Back-wired connection electrical outlets are not allowed.

3. **Electrical service should be protected with a minimum of 80KA surge protection**. This surge protector should be wired in parallel and connected to a thirty ampere two pole single throw over current device. The distance of the wire from the surge protector to the breaker should not exceed 19 in. The incoming phone lines should be protected with an independent surge protection device with a minimum of one thousand amperes of protection. If the telephone service is provided by the cable company then the cable should be protected with a surge protection device. If the cable is separate from the incoming telephone lines, then the cable should also have an independent surge protection device with a minimum of three thousand amperes of capacity. All of the ground wires for the above surge protection devices should be bonded to a common point of earth ground.

4. **All buildings with a corrugated stainless steel piping (CSST) gas piping systems** require a proper bonding and grounding system designed by a licensed professional engineer knowledgeable in electrical system design. CSST piping must be installed a minimum of 2 in. away from any other metallic system (water service piping, wiring methods, HVAC ductwork, etc.). A building lightning protection system should be installed.

5. **Areas where Lightning Protection is Required:** For buildings in areas subject to an average flash density of 2 to 3 fl/sq km/yr or greater as defined in Figure 3-8 shown below, a lightning protection system shall be installed.

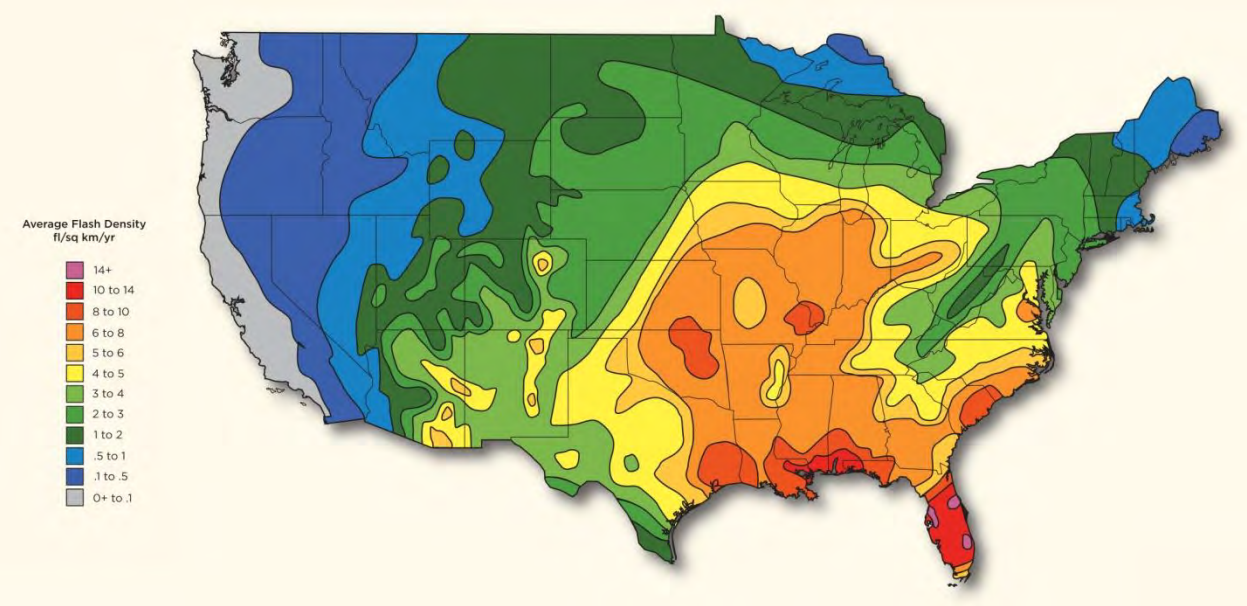

FIGURE 3-8: 1997–2007 Average U.S. Lightning Flash Density Map (flashes per square kilometer per year). Source: Vaisala, Inc.

6. If lightning protection systems are to be installed for the building(s) or structure(s), all materials shall comply in weight, size, and composition with the requirements of the UL 96 Materials Standards. All equipment shall be UL listed and properly labeled. Equipment shall be the manufacturer's latest approved design of construction to suit the application where it is to be used in accordance with accepted industry standards and with NFPA, LPI, & UL requirements.

   The lightning protection system shall be designed and installed in accordance with one or more of the following:

   - National Fire Protection Assoc. (NFPA) 780, Standard for the Installation of Lightning Protection Systems
   - Underwriters' Laboratories, Inc. (UL) Standard 96A, Installation Requirements for Lightning Protection Systems
   - Lightning Protection Institute (LPI) Standard 175, Standard of Practice for the Design – Installation – Inspection of Lightning Protection Systems

ELECTRICAL SURGE PROTECTION – Strongly Recommended Criteria

1. **Lightning Protection Installation in High Wind Areas:** In areas where the FDWS is 120 mph or higher, lightning protection systems should not be directly installed on to single ply membrane roof cover systems such as EPDM, TPO, or PVC.

3.12 Backup Electrical Power / Continuity of Business Operations

CONTINUITY OF OPERATIONS / BACK UP POWER

1. **Uninterrupted Power Supplies (UPS):** For **data centers, computer rooms, etc**., a UPS must be installed for temporary loss of power and to ensure a continuous supply of electrical power

while properly shutting down or switching over to back-up power such as a generator.

2. **Community service type organizations** (such as pharmacies, quick service restaurants, convenience stores, gas stations, retail food, table/full service restaurants, automotive, commercial habitational, etc.): Install a permanent standby generator with an automatic transfer switch capable of powering vital electrical systems that support the most critical business functions of the facility.

   An alternative is to provide at a minimum, a portable generator with appropriate electrical connections, switches or docking station (sometimes referred to as a storm switch) capable of powering vital electrical systems.

3. **For Non Community service type organizations,** or companies that do not provide a service to the local community, backup power as described above is strongly recommended but not required. For areas where the FDWS is 120 mph or higher, it is strongly recommended that a manual or automatic transfer switch/docking system be installed as a minimum. This will allow the facility to be prepared for switching to backup power from a portable, leased, or rented generator.

4. **If the building is located in a FEMA designated flood plain** (A, B, X-shaded) or unstudied areas such as D, all backup power and switching equipment shall be located above the 500 year flood level if known, otherwise 3 ft. above the known Base Flood Elevation (100 year flood level) or Advisory Base Flood Elevation.

   If the equipment is not sufficiently elevated as described as above, then dry flood protection such as flood gates, walls, doors and/ or inflatable barriers must be provided to prevent water intrusion into these vulnerable areas. Flood depth, duration, velocity, and condition of water should be considered (including floating debris). Flood protection must be provided to a minimum level of 3 ft. above the 500 year flood level if known, otherwise 3 ft. above the known Base Flood Elevation (100 year flood level) or Advisory Base Flood Elevation.

4. REFERENCE STANDARDS AND GUIDANCE DOCUMENTS

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