FORTIFIED®

...for safer living.

BUILDER'S GUIDE

2008 Edition

A program of the Institute for Business & Home Safety
www.ibhs.org

Legal Notice

About the Institute for Business & Home Safety

The Institute for Business & Home Safety (IBHS) is a nonprofit association that engages in communication, education, engineering, and research.

Mission
The Institute for Business & Home Safety's mission is to reduce the social and economic effects of natural disasters and other property losses by conducting research and advocating improved construction, maintenance, and preparation practices.

Vision
The Institute for Business & Home Safety envisions a nation that promotes resiliency from natural disasters and other property losses by developing an infrastructure that is damage-resistant and through personal and corporate action that helps minimize disruption to normal life and work patterns.

Membership
Our members are insurers and reinsurers that conduct business in the United States or reinsure risks located in the United States. Associate membership is open to all others who support our mission.

IBHS HQ
Tampa, Florida

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1. INTRODUCTION

Thank you for your interest in the Institute for Business & Home Safety's ***Fortified … for safer living®*** (***Fortified***) homebuilding program. The ***Fortified*** program specifies construction, design, and landscaping guidelines to increase a new home's resistance to natural, catastrophe-level perils most likely to occur in the area where the structure is located. In addition, ***Fortified*** criteria and recommendations exist for reducing damage caused by non-catastrophe-level perils, such as fire inside the home, burglary, water loss, and electrical surge.

Briefly, the natural, catastrophe-level perils addressed by the ***Fortified*** program are:

Severe Wind – Practically every part of the US is subject to some type of severe wind hazard that can readily exceed minimum requirements of even the best building codes. This includes:

i. **Hurricanes** – Catastrophic hurricanes can produce winds in excess of 150 MPH. Hurricanes have resulted in thousands of deaths and injuries to residents in the Gulf and Atlantic coastal areas and they are responsible for a large portion of the billions of dollars of damage to structures due to wind. On the immediate coast, storm surge accounts for much of the damage and loss of life that result from hurricanes. The ***Fortified*** program offers effective solutions to reduce a building's vulnerability to hurricanes.

ii. **Tornadoes** – Tornadoes can occur in nearly any part of the country but are most common in areas of the country where design level wind speeds in the building code are at the lowest levels. Over 1,000 people are injured or killed by tornadoes each year in the US and hundreds of structures are either damaged or destroyed – many of these structures would have survived with only moderate improvements as featured in the ***Fortified*** program.

iii. **Severe Thunderstorms** – Thunderstorms not only spawn tornadoes, but can also produce damaging gust winds in excess of 110 MPH. This level of wind is at least 20 MPH greater than the 50-yr design wind speeds used in most areas of the country where thunderstorms are frequent events. Downbursts, which are also associated with thunderstorms, can produce tornado-like damage. Hail is also a hazard associated with thunderstorms and causes significant damage to the exteriors of thousands of structures each year. The ***Fortified*** program provides improved resistance to these and other hazards associated with severe thunderstorms.

Earthquakes – Unlike severe wind events, earthquakes come with no warning. There is little opportunity to take cover or vacate an unsafe building. In places like California, design level earthquakes may occur several times in a lifetime. In other parts of the country, big earthquakes occur with less frequency, but have happened in several regions in the not so distant past. This type of earthquake is often the cause of significant damage and injury because it is "unexpected." In other words, the threat is forgotten with the passing of a generation or two. Earthquake hazard in these areas, as well as California, are reflected in the latest earthquake hazard maps (Appendix E). The ***Fortified*** program addresses this significant and sometimes uncertain hazard with easily implemented solutions.

Floods – Structures built in the inland or coastal 100-year floodplain are in serious jeopardy of complete loss in the event of a flood. For this reason, significant measures are necessary to protect structures from this potential hazard. Therefore, the ***Fortified*** program only applies to structures that comply with the strictest condition in the National Flood Insurance Program for both coastal and inland floodplains, when building is permitted in these areas.

Wildfires – Every year, and even more so in recent years, wildfires have threatened and destroyed hundreds of structures and lives. While some wildfires are naturally ignited from lightening or other causes, many are the result of carelessness or arson. Simple site design, material usage, and landscape features of the ***Fortified*** program can protect a home against this serious hazard.

Severe Winter Weather – In some regions of the country extreme weather develops that causes severe damage to structures from heavy snow and cold. Even parts of the Southern U.S. can be at risk of certain freezing weather-related damage. The ***Fortified*** program provides practical protection for structures from the damaging effects of this hazard.

Building Code Requirements

Building codes set minimum standards for the construction of a home. The requirements of the ***Fortified*** program exceed the most recent International Residential Code (IRC) in certain areas to provide improved disaster resistance. The ***Fortified*** program promotes best available practices for disaster resistance, and also requires compliance with accepted designation standards regarding residential construction, plumbing, mechanical, electrical fuel-gas, and energy conservation.

To ensure compliance, structures built in locales that have a Building Code Effectiveness Grading Schedule (BCEGS) of 6 or higher may require additional inspections outside the ***Fortified*** program and assurance that electrical and plumbing work is completed by certified professionals.

Statement of Land Use Policy

The ***Fortified*** program will be governed by local and municipal policy concerning where it is deemed safe to build residential structures. ***Fortified*** structures cannot be designated in the following areas: low-lying barrier islands and coastal regions, close proximity to known seismic fault lines, close proximity to major levees, and steep slopes potentially subject to either erosion or wildfire.

*The **Fortified** Compliance Process*

The process starts with the design of the home to meet ***Fortified*** requirements for a specific location. A registered designer creates a suitable design, and completes a ***Fortified*** Design Checklist. Next, a ***Fortified*** design reviewer checks the design, completes a ***Fortified*** Design Review Checklist, and develops a suitable field inspection plan.

Note: these activities must be completed BEFORE construction begins.

Note: for a design to be acceptable, it must be:

- ✓ Legible.
- ✓ Complete.
- ✓ Sealed by the Professional of Record.

Note: the ***Fortified*** Design Checklist and the Design Review Checklist are intended to assure that all requirements of the ***Fortified*** program are included in the project design. Both documents are provided by IBHS, after a formal project application has been submitted and approved.

Note: a ***Fortified*** inspector must verify that all items identified in the inspection plan have been correctly installed in the home. The inspector will visit the site at least four times during construction to verify compliance with ***Fortified*** standards.

Note: the design, Design Checklist, Design Review Checklist, inspection plan, and inspection reports must be submitted electronically to IBHS for Quality Assurance.

Note: after satisfactory completion/submission of all designs, checklists, reviews, and inspections, and other supporting documentation, the applicant will receive a designation from IBHS verifying compliance with the ***Fortified*** program (Figure 1-1).

Note: for instructions on how to obtain a project application, visit http://www.disastersafety.org/ and review the ***Fortified*** section of the website.

Figure 1-1: Sample ***Fortified*** Designation

2. DEFINITIONS OF PERIL REGIONS BY STATE

The following are descriptions of the areas of the country where each of the ***Fortified … for safer living®*** (***Fortified***) perils apply. Note that one of the three wind perils (Hurricane, Tornado, or High Wind) will apply, depending upon the home's geographic location within the US. The ***Fortified*** Wind Peril Map (Figure 3-1) defines the regions where each of these three wind perils applies.

Hurricane Prone Region

ASCE 7-02 defines hurricane prone regions for the US as areas along "the US Atlantic Ocean and Gulf of Mexico coasts where the basic wind speed is greater than 90 MPH…." These regions include the Atlantic and Gulf Coasts, Hawaii, and the US territories of Puerto Rico, Virgin Islands, Guam, and American Samoa. The ***Fortified*** program uses a slightly modified version of the ASCE 7-02 definition to delineate areas where ***Fortified*** structures meet Hurricane Requirements as described in this manual. Simply put, the ***Fortified*** hurricane provisions are required in all areas where the ASCE 7-02 basic wind speed is 100 MPH or greater. In Florida, they are required in all counties, regardless of basic wind speed. In addition to these counties, the ***Fortified*** 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 7-02 wind map (Figure 6-1 of ASCE 7-02). The maps are re-produced with color bands indicating 10 MPH intervals in Appendix A.

Tornado and Hail Region

From the eastern ranges of the Rocky Mountains to the Atlantic Coast, severe thunderstorms have a known history of spawning over 1000 tornados each year. These are some of the most destructive forces of nature. Since hailstorms are born under the same weather conditions as tornados, ***Fortified*** considers all Tornado regions to be Hail-Prone regions as well.

Generally speaking, the ***Fortified*** program defines the Tornado and Hail region as being between the Rocky Mountains and the Appalachian Mountains, in addition to the coastal plains and piedmont of Georgia, the Carolinas, and Virginia. This roughly encompasses all areas of the US where, according to the NOAA National Severe Storm Laboratory, tornados occur within a 25 mile radius an average of 0.6 times per year or more.

Although the previously described region partially overlaps the Hurricane-Prone region along the Atlantic and Gulf Coasts, hurricane provisions take precedence over tornado and hail provisions in all such areas. This is due to the fact that such areas are more likely to be affected by hurricanes than by tornados, and is reflected in the ***Fortified*** Wind Peril Map (Figure 3-1). ***Fortified*** structures in the Tornado and Hail region must meet the ***Fortified*** requirements for tornados and hail, including structural reinforcement, and impact-resistant roofing materials.

High Wind Regions

While not at immediate risk of hurricanes or tornados, 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 nonetheless at risk of high winds from other causes, including mid-latitude cyclonic activity, severe thunderstorms, and localized weather phenomena. Because of this, the ***Fortified*** program considers these to be High Wind Regions, and structures built within them must be built according to the High Wind provisions of Section 3. Requirements for ***Fortified*** structures in these regions include the structural elements necessary for wind loading, but do not require wind-borne debris protection or impact resistant roofing materials.

Earthquake Regions

Structures designated as ***Fortified*** are built to withstand the lateral loading caused by at least 110 MPH gust winds regardless of geographic location. For the most part, they are therefore capable of withstanding the lateral loading caused by slight-to-moderate ground accelerations as well (i.e., ground accelerations between 17% and 50% of the acceleration due to gravity). For this reason, only ***Fortified*** structures built in regions of significant seismic risk are required to adhere to the seismic criteria. In the ***Fortified*** program, regions of significant seismic risk are defined on a county and state basis (Appendix F).

Wildfire

Fortified wildfire criteria may apply anywhere in the country where a home is located in proximity to areas of natural vegetation. Applicability is determined by site-specific risk assessments of vegetation, topography, and many other factors. Such assessments are conducted using the Wildfire Risk Assessment form found at www.ibhs.org. If, by using this assessment form, it is determined that the home is at a “moderate”, “high”, or “extreme” risk from wildfire, the home must be built, and the yard must be landscaped according to the prescriptive requirements of Section 5.

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 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*** Flood Criteria. Your community floodplain management official, mortgage lender, or insurer/insurance agent can help you determine the applicable flood zone for your site. Structures not in a Special Flood Hazard Area are exempt from the ***Fortified*** flood criteria.

Severe Winter Weather

Severe Winter Weather criteria specifically addresses the potential for damage from ice dams in areas prone to snowfall accumulations greater than 12”. Areas where the ***Fortified*** criteria for Severe Winter Weather are required are shown in Figure 7-1. The boundary of the so-called Severe Winter Weather Region outlined on this map follows state and county boundaries, and is roughly based on a combination of 1) the 20 degree isotherm of the 97½ % winter design temperature map in the IRC, and 2) a 20-lb/sq. ft. ground snow load from the 2000 International Residential Code. The northern boundaries of NC, TN, AK, OK, NM, and AZ 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.

Table 2-1: ***Fortified*** Perils by State

Alabama: 100 MPH and greater - Hurricane Other areas – Tornado and Hail	**Hawaii:** Hurricane Seismic	**Michigan:** Tornado and Hail Severe Winter Weather
Alaska: High Wind Severe Winter Weather Seismic	**Idaho:** High Wind Severe Winter Weather Seismic (most counties)	**Minnesota:** Tornado and Hail Severe Winter Weather
Arizona: High Wind Seismic (some western counties)	**Illinois:** Tornado and Hail Severe Winter Weather Seismic (some southern counties)	**Mississippi:** 100 MPH and greater – Hurricane Other areas – Tornado and Hail Seismic (some northern counties)
Arkansas: Tornado and Hail Seismic (northeastern & central counties)	**Indiana:** Tornado and Hail Severe Winter Weather Seismic (some southwestern counties)	**Missouri:** Tornado and Hail Severe Winter Weather Seismic (some southeastern counties)
California: High Wind Severe Winter (north & east counties) Seismic	**Iowa:** Tornado and Hail Severe Winter Weather	**Montana:** High Wind Severe Winter Weather Seismic (some western counties)
Colorado: Tornado and Hail Severe Winter Weather Seismic (some counties)	**Kansas:** Tornado and Hail Severe Winter weather	**Nebraska**: Tornado and Hail Freezing Weather
Connecticut: Hurricane (most counties) Tornado and Hail (Litchfield County) Severe Winter Weather	**Kentucky:** Tornado and Hail Severe Winter Weather Seismic (western counties)	**Nevada:** High Wind Severe Winter (most counties) Seismic
Delaware: Hurricane (Sussex County) High Wind (all other counties) Severe Winter Weather	**Louisiana:** 100 MPH and greater – Hurricane Other areas – Tornado and Hail	**New Hampshire:** Hurricane (Rockingham County) Other areas – High Wind Severe Winter Weather
District of Columbia: High Wind Severe Winter Weather	**Maine:** Within 1 mile of Atlantic Coast – Hurricane Other areas – High Wind Severe Winter Weather	**New Jersey:** 100 MPH and greater – Hurricane Other areas – High Wind Severe Winter Weather
Florida: Hurricane	**Maryland:** Hurricane (some southeastern counties) Other areas – High Wind Severe Winter Weather	**New Mexico:** Tornado and Hail Seismic (some counties)
Georgia: 100 MPH and greater – Hurricane Other areas – Tornado and Hail	**Massachusetts:** 100 MPH and greater – Hurricane Other areas – High Wind Severe Winter Weather	**New York:** 100 MPH and greater – Hurricane Other areas – High Wind Severe Winter weather Seismic (some northern counties)

North Carolina: 100 MPH and greater – Hurricane Other areas – Tornado and Hail Seismic (some southwestern counties)	**Tennessee:** Tornado and Hail Seismic (some western and eastern counties)
North Dakota: Tornado and Hail Severe Winter Weather	**Texas:** 100 MPH and greater – Hurricane Other areas – Tornado and Hail
Ohio: Tornado and Hail Severe Winter Weather	**Utah:** High Wind Severe Winter Weather Seismic (most counties)
Oklahoma: Tornado and Hail	**Vermont:** High Wind Severe Winter Weather
Oregon: High Wind Severe Winter Weather Seismic (most counties)	**Virginia:** 100 MPH and greater – Hurricane Other areas – Tornado and Hail Severe Winter Weather
Pennsylvania: High Wind Severe Winter Weather	**Washington:** High Wind Severe Winter Weather Seismic (most counties)
Rhode Island: Hurricane Severe Winter Weather	**West Virginia:** High Wind Severe Winter Weather
South Carolina: 100 MPH and greater – Hurricane Other areas – Tornado and Hail Seismic (most counties)	**Wisconsin:** Tornado and Hail Severe Winter Weather
South Dakota: Tornado and Hail Severe Winter Weather	**Wyoming:** Tornado and Hail Severe Winter Weather Seismic (some counties)

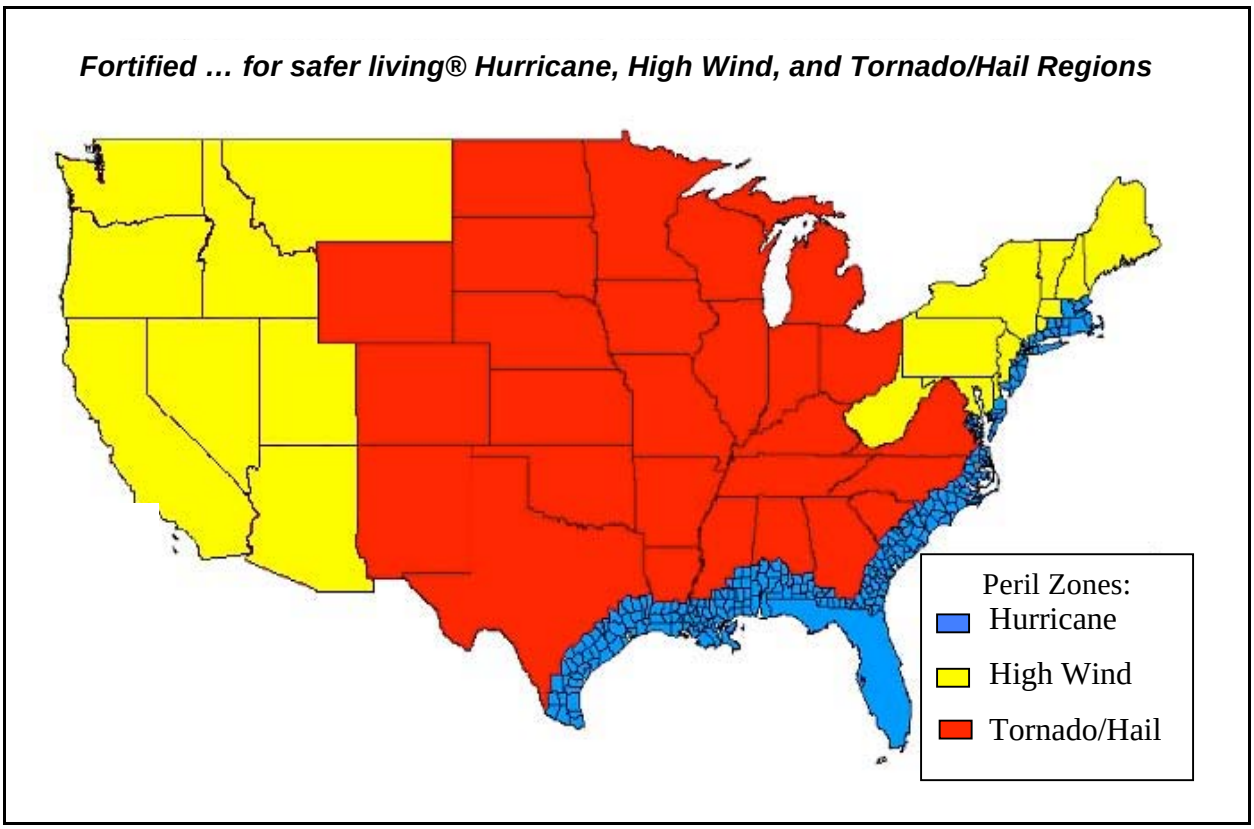
Note 1: In states where both hurricane and tornado/other high wind regions exist, the dividing line will be defined in the vicinity of the 100 MPH wind contour on the ASCE 7-02 map. One exception is in Maine, where areas within one mile of the mean high water line of tidewater are considered Hurricane Prone regions, regardless of basic wind speed.

Note 2: Wildfire & Flood occur in all states and are determined by a risk assessment form and flood maps, respectively.

3. HURRICANE/TORNADO AND HAIL/HIGH WIND CRITERIA

The following sections summarize the Hurricane, Tornado and Hail, and High Wind requirements developed by IBHS for the ***Fortified … for safer living®*** (***Fortified***) program. Collectively these will be referred to as "wind requirements" throughout the Builder's Guide. Regions where each of these sets of criteria applies are identified using the map given in Figure 3-1. In addition, Appendix A provides wind speed maps specific to hurricane-vulnerable states.

Figure 3-1: Hurricane, High Wind, and Tornado/Hail regions as defined by the ***Fortified*** program



The ***Fortified*** wind requirements are founded on evidence that structures designed and built following modern engineering based high wind standards have performed much better in high wind events than structures built using conventional construction methods. The ***Fortified*** program requirements may be met by any building system that meets the requirements of the "Program." This includes but is not limited to: Insulating Concrete Forms (ICF), reinforced masonry, solid poured in place concrete walls, cold formed steel framing (CFSF), Structural Insulated Panels (SIP), and wood frame. Each system must meet either:

1. The prescriptive requirements published by the appropriate organization responsible for translating engineering based design into specific "cookbook" type of guidance for the subject material or system (Table 3-1)

OR

2. Specific detailed designs produced by a competent design professional using ASCE 7 provisions and accepted engineering principles for the subject material or system.

Table 3-1: Construction type and appropriate prescriptive document(s)

Construction Type	Prescriptive Document
Insulating Concrete Forms (ICF)	Insulating Concrete Forms Construction Manual. *Prescriptive Method for Insulating Concrete Forms in Residential Construction (2nd Edition)* . http://www.forms.org/index.php?act=estoredetails&itemid=17
Reinforced masonry (CMU)	ACI 318-05 Building Code Requirements for Structural Concrete IBHS Guidelines for Hurricane Resistant Residential Construction
Solid Concrete	ACI 318-05 Building Code Requirements for Structural Concrete
Cold-Formed Steel Framing (CFSF)	American Iron and Steel Institute (AISI), *Standard for Cold-Formed Steel Framing- Prescriptive Method for One and Two Family Dwellings* (COFS/PM)
Structural Insulated Panels (SIP)	The 2007 IRC Supplement and subsequent editions of the code include prescriptive standards for SIP wall construction in Section R614
Wood Frame	American Forest and Paper Association, American Wood Council: Wood Frame Construction Manual high wind guides, available at: http://www.awc.org/Standards/wfcm.html IBHS Guidelines for Hurricane Resistant Residential Construction
Note: If a prescriptive design method is used, it must be completely followed.	

With the above in mind, the following requirements are **mandatory**:

Mandatory requirements:

I. The ***Fortified*** Design Wind Speed, which is the ASCE 7 design wind speed for the site **plus 20 MPH**, must be used.

II. Component and cladding loads (C&C) shall be determined for terrain Exposure C, regardless of the actual local exposure.

III. Main Wind Force Resisting System (MWFRS) design loads shall be determined for the actual terrain exposure.

IV. Roof sheathing attachment shall be designed to provide panel uplift resistance with a minimum factor of safety of 2.0 relative to the design uplift pressure from ASCE 7 assuming terrain Exposure C.

V. Roof coverings, underlayments and secondary water resistance:
   a. Roof coverings must meet requirements for wind and/or hail.
   b. Secondary water barrier must be provided via an acceptable underlayment or other prescriptive method.

VI. Wall system requirements:
   a. MWFRS walls must be designed to provide the required shear and uplift resistance.
   b. Exterior walls must provide the required stiffness and impact resistance.
   c. Wall members, connections, and bracing must be designed for the out-of-plane wind loads.
   d. Fasteners, connectors, and anchors in contact with treated wood or exposed to the elements must have the required corrosion resistance.

VII. In Hurricane prone regions, all building openings including entry doors, windows, and skylights must be impact rated or protected with tested and approved products in accordance with ***Fortified*** acceptance requirements. For locations with ***Fortified*** Design Wind Speeds above 160 MPH, garage doors must also be impact rated.

VIII. Soffits shall be capable of resisting the C&C design pressures for the wall below.

Strongly recommended:

I. In structures located in Zones III and IV tornado risk areas as defined in the FEMA shelter guide, it is strongly recommended that the owner consider installing a shelter that meets the requirements of the National Storm Shelter Association or as defined in FEMA 320 “Taking Shelter from the Storm.”

II. In hurricane-prone regions, outward-opening doors are strongly recommended to reduce the potential for water intrusion, plus making it easier to provide the required impact-resistance. Product approval for outward-opening doors must be verified to ensure required impact-resistance, or the doors must be protected.

Mandatory requirements in detail:

I. The ***Fortified*** Design Wind Speed shall be equal to the ASCE -7 basic wind speed **plus 20-MPH**.

Figure 3-2: Design Wind Speed Map ASCE 7

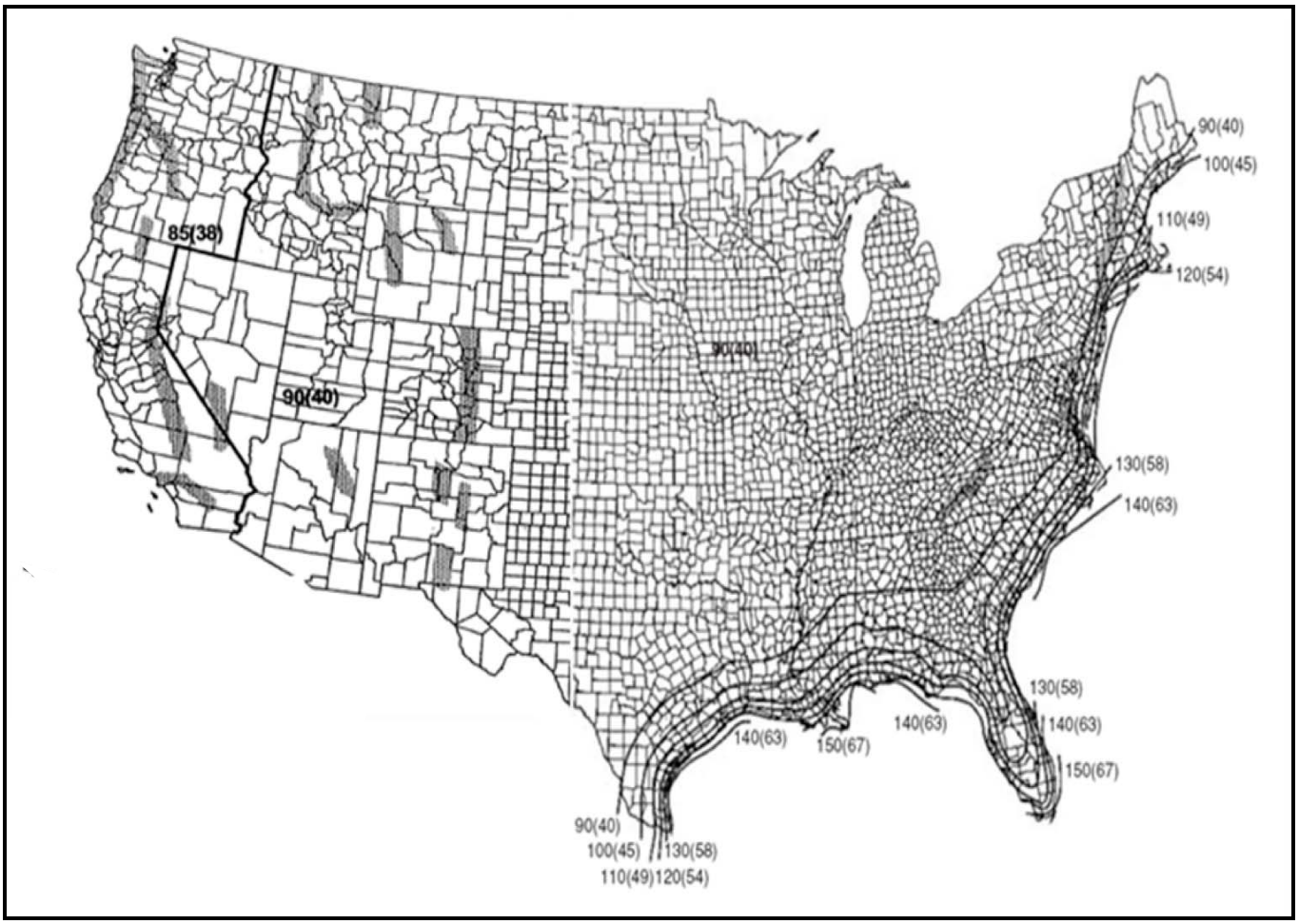
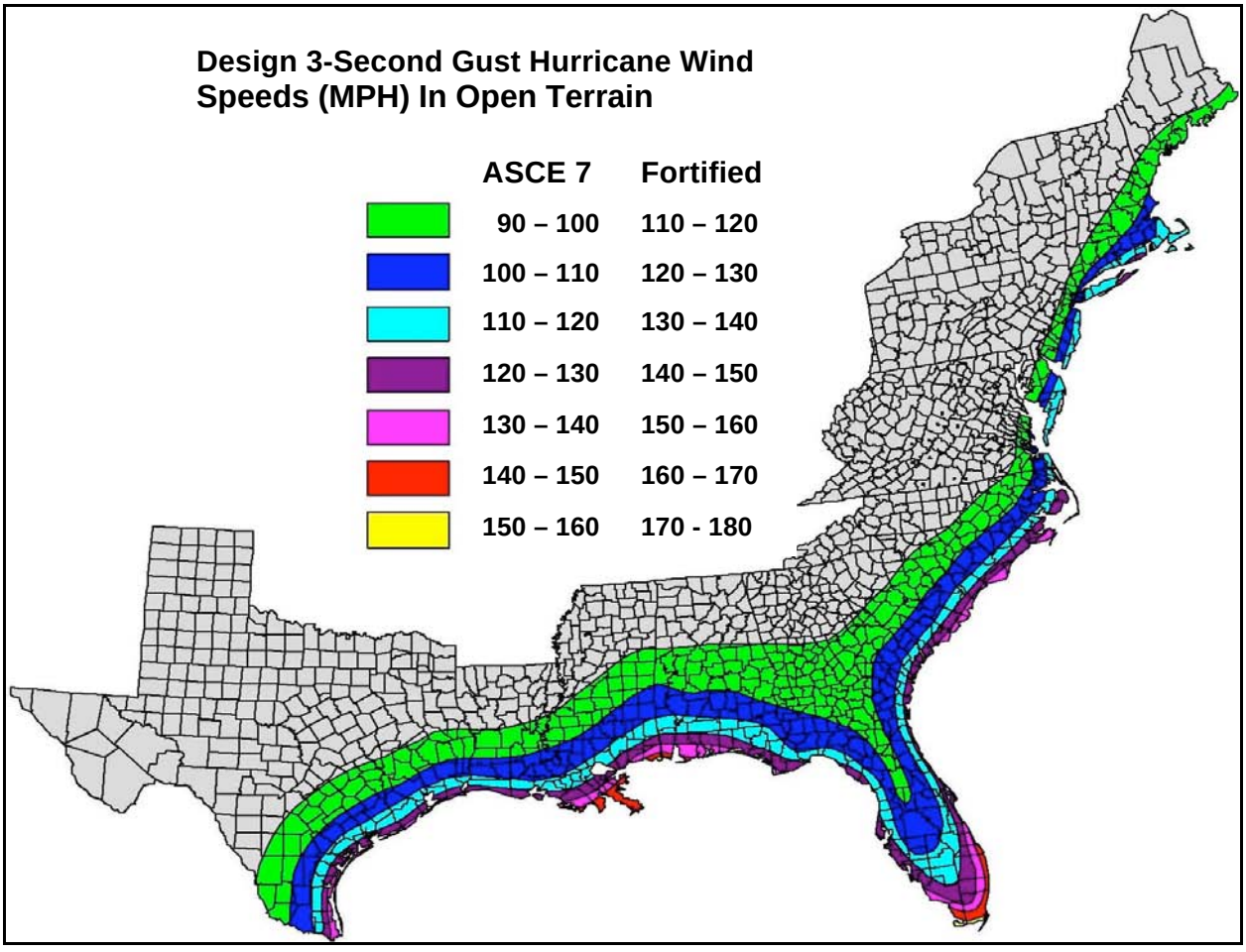


Table 3-2: Adding 20 MPH to ASCE 7 basic wind speeds for ***Fortified*** Design Wind Speed requirements

ASCE 7 Wind Speed	Building Code Design Wind Speed (or interpolate between values)	*Fortified* Design Wind Speed
< 90	90	110
90 - 100	100	120
100 – 110	110	130
110 – 120	120	140
120 – 130	130	150
130 – 140	140	160
140 – 150	150	170
> 150	150	170

Figure 3-3: ASCE 7 and ***Fortified*** Design Wind Speeds for Hurricane Prone Region



Note 1: As indicated above, **add 20 MPH** for ***Fortified*** Design Wind Speed.
Note 2: Wind-borne debris protection is required in all of Florida.
Note 3: In other coastal states when the ASCE 7 Design Wind Speed is between 90 and 100 MPH, wind-borne debris protection is required within 1 mile of the coast.

II. Exposure Category for Component and cladding: loads shall be determined for the ***Fortified*** Design Wind Speed defined in I above assuming terrain Exposure C, regardless of the actual local exposure**.**

III. Exposure Category for the Main Wind Force Resisting System: MWFRS design loads shall be allowed to be determined for the actual terrain exposure of the building site as defined by ASCE 7 or the IBC/IRC.

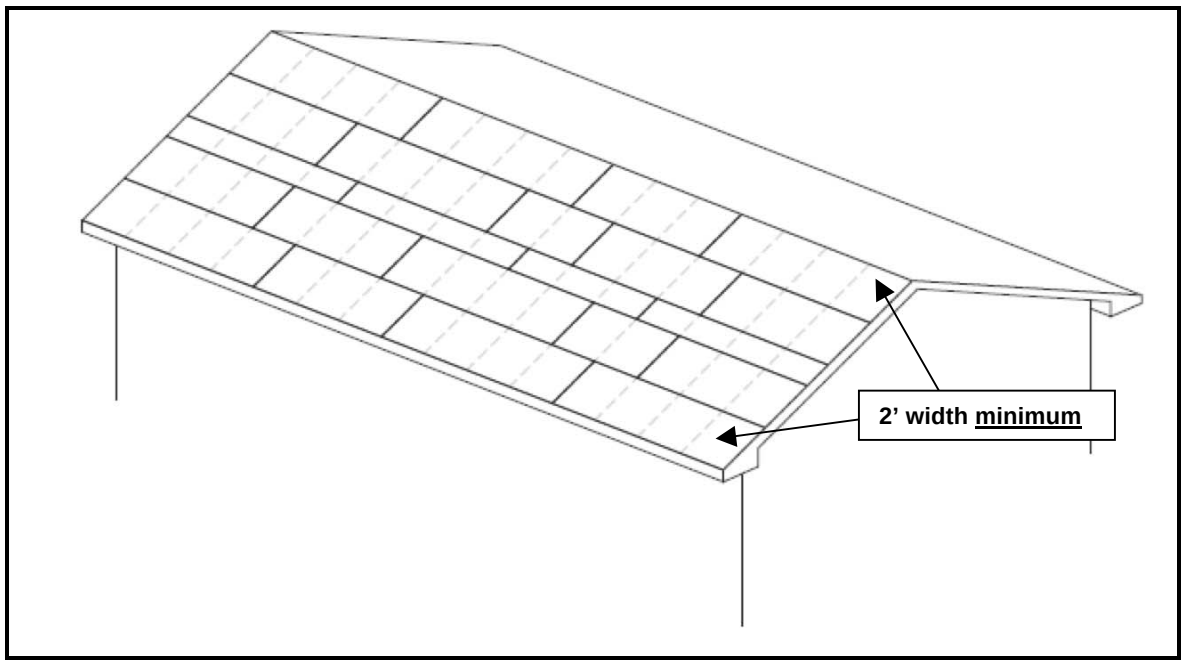
IV. Roof Decks (sheathing):

Note on Span Rating from APA:

"For APA Rated Sheathing, the Span Rating looks like a fraction, such as 32/16. The left-hand number denotes the maximum spacing of supports (in inches) when the panel is used for roof sheathing, and the right-hand number denotes the maximum spacing of supports when the panel is used for subflooring. Sheathing panels with roof Span Ratings of 24 or greater may be used vertically or horizontally as wall sheathing over studs at 24" on center (o.c.). Those with roof Span Ratings of less than 24 may be used vertically or horizontally over studs at 16" o.c. APA Rated Sheathing may also be manufactured specifically for use as wall sheathing. These panels are identified Wall-24. Horizontal edges of all wall sheathing must be blocked when panels are used as bracing."

Roof decks must be sheathed with panels rated for maximum deflection between supports, under a 100-lb/sq. ft uniform load, of the span-length between supports divided by 160 (span/160). For the ***Fortified*** program, this means 5/8 (nominal) 40/20 rated sheathing. If required due to roof geometry, piecework (panels ripped lengthwise to a width less than 4') should be located in a strip close to the center of the roof (away from the ridge-to-eve). In any case, the sheathing at the ridge and eve must not be less than 2' wide. No sheathing panel must be supported by less than three framing members and every effort should be made to install full sheets at the eaves, ridges and gable ends. Figure 3-4 illustrates the recommended layout and sizing of sheathing.

Figure 3-4: Sheathing Layout



To achieve the required uplift resistance for the ***Fortified*** program, when wood roof framing is used, sheathing must be fastened to roof framing with 8d ring-shank nails at 6" o.c. at edges and 6" o.c. at intermediate framing. Two exceptions are listed below:

1. Where Group III species (spruce pine fur) framing lumber is used, spacing of ring-shank fasteners shall be 4" o.c. in roof deck sheathing zone 3 (shown in Figures 3-5 and 3-6 below) for 130 MPH or greater ***Fortified*** Design Wind Speeds (see Figures below for zones).

2. Where diaphragm requirements necessitate a closer fastener spacing (see Figures below for zones).

Figure 3-5: Roof deck sheathing zones for Gable Roof (from ASCE 7)

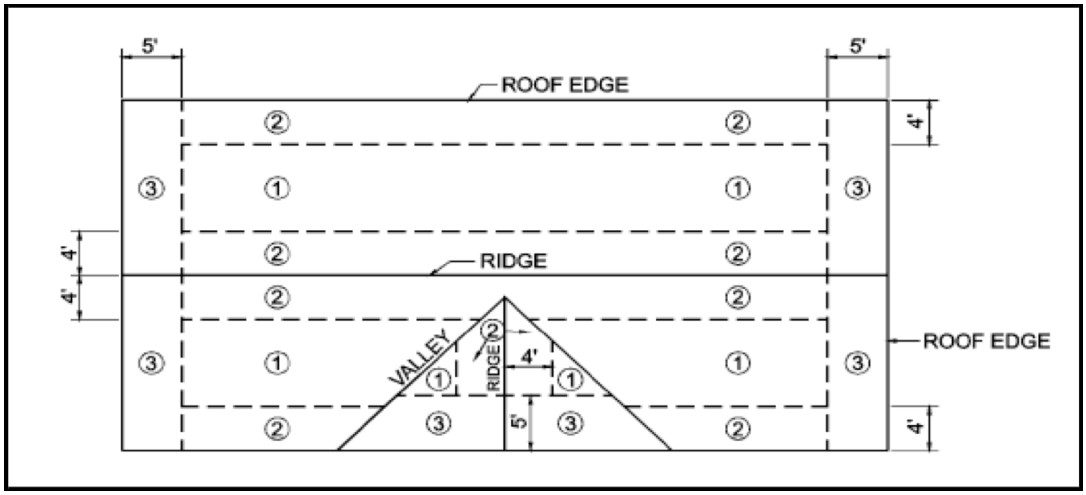
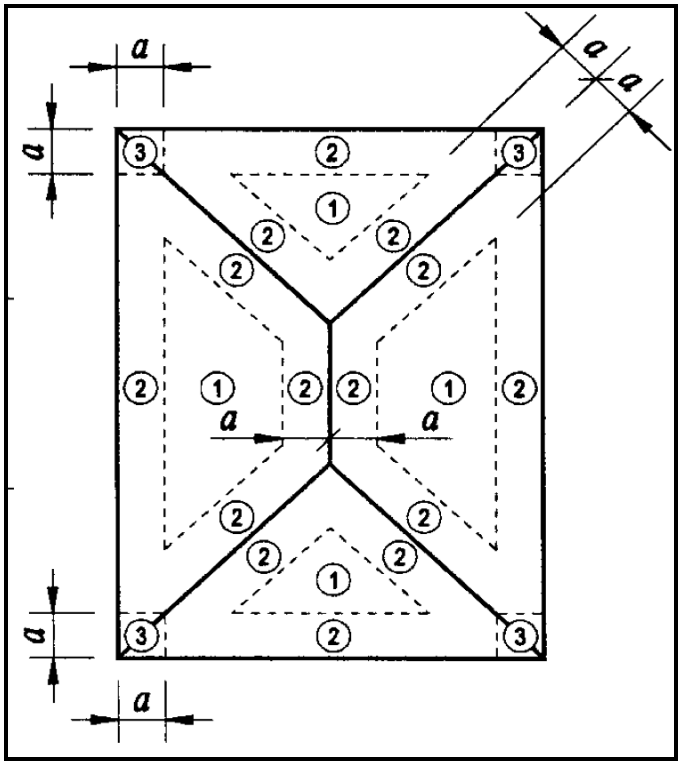


Figure 3-6: Roof deck sheathing zones for Hip Roof (from ASCE 7)



All nails shall be installed such that they do not protrude out the side of the wood framing members. No more than one missed or side split nail per 4' of rafter/truss is acceptable in the ***Fortified*** program. Figure 3-7a is an example of unacceptable nails. For screw connections to cold-formed steel framing members, screws shall extend through the steel connection a minimum of three (3) exposed threads (Figure 3-7b).

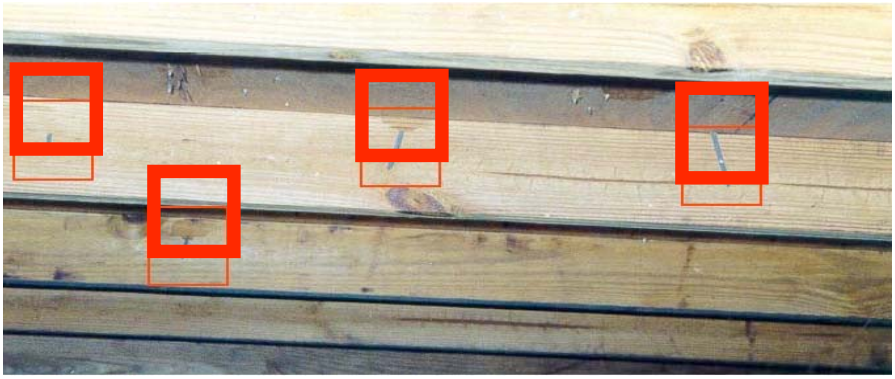


Figure 3-7a: Avoid sidesplitting nails (shiners) in deck-to-rafter connections. The number of misses causes the roof deck to be very vulnerable to wind damage.

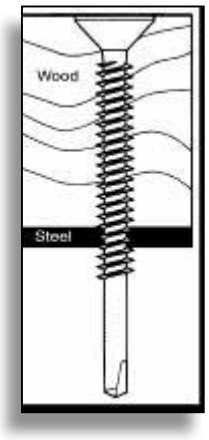


Figure 3-7b: Screw fastener in steel framing.

V. Roof coverings, underlayments, and secondary water resistance:

1. Roof Covering

Roof coverings and their attachment shall be rated for the ***Fortified*** Design Wind Speed as defined in I above and installed according to the manufacturer's instructions. Roof coverings rated for 150 MPH are acceptable where the ***Fortified*** Design Wind Speed exceeds 150 MPH.

The most common residential roof types and their respective ***Fortified*** requirements are given below. Provided that the roof covering is selected and applied in accordance with the applicable criteria given within this section, the roofing system will be deemed to comply with ***Fortified*** requirements.

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. Additionally, 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' of the rake edges shall be manually adhered to the underlying surface with 1" diameter dabs of asphalt roof cement at a spacing of 2" on center. Shingles – including hip and ridge materials – must meet one or more of the following standards:

Table 3-3: ***Fortified*** Design Wind Speed and Shingle Testing Standards

Fortified **Design Wind Speed**	**Shingle Testing Standard/Classification**
110	ASTM D3161 (Modified for 110 MPH) Class D or MDC TAS 107 or ASTM D7158 Class F, G or H
120	ASTM D7158 Class G
130	ASTM D7158 Class H
140	
150	

>150	

Clay and concrete tile roof coverings shall be installed in accordance with the manufacturer's recommendations for high-wind applications for ***Fortified*** Design Wind Speeds of 120 MPH and greater. 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, shall be installed along all hips and ridges. Wood nailer boards shall be installed with at a minimum, 1.5" wide, 26 gage galvanized steel straps screwed to the roof deck with two (2) #8 wood screws at a maximum spacing of 37".

Figure 3-8: Metal hat section alternative to "nailer boards"

- ✓ 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.

Metal panel roofing systems and their attachment shall be designed for the component and cladding wind pressures corresponding to the ***Fortified*** Design Wind Speed (up to 150 MPH) and Exposure C conditions.

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.

2. Roof Underlayment and Secondary Water Resistance

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 secondary water barrier) is a full layer of self-adhering polymer modified bitumen membrane meeting ASTM D1970.

If you are outside of these states, or the local Building Code does not allow this system, several options (listed in order of preference) exist for the ***Fortified*** program:

a. 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 secondary water protection, 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 a minimum tear strength per ASTM D1970 or ASTM D4533 of 20-lbs. This underlayment, shall be attached using annular ring or deformed shank roofing fasteners with minimum 1" diameter metal or plastic caps at 6" spacing along all laps and 12" spacing in the field; or, a more stringent fastener schedule if required by the manufacturer for high wind installations. End laps shall be 6". All seams must be sealed with a compatible adhesive or a compatible 4" wide tape. Horizontal seams on steep sloped roofs with the overlap listed in Table 3-4 do not have to be sealed with adhesive or tape.

b. A secondary water barrier can be provided by self adhesive flashing tape applied directly to the roof deck to seal the horizontal and vertical joints in the roof deck. This self-adhering polymer modified bitumen tape must be at least 4" 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." (Figure 3-9).

c. The requirements for the secondary water barrier can be met by an asphalt impregnated 30# felt underlayment installed with annular ring or deformed shank roofing fasteners with minimum 1" diameter metal or plastic caps at 6" spacing along all laps and 12" 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.

d. The requirements for secondary water protection 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.

In cases where the manufacturer of the roof covering to be used specifies more stringent underlayment requirements, the more stringent procedures shall be followed. Nail spacing shall be no greater than 6" along the laps and 12" in the interior of each strip using low profile roofing nails with load distribution disks or capped head nails. Roofs within 3000 feet of salt water require hot dipped galvanized fasteners for attachments of all roof coverings, including the underlayment.

Figure 3-9: Installation of secondary water resistance using self-adhering strips.

Table 3-4: Lapping Requirements for Synthetic Underlayment on Steep Roofs
to Avoid having to Tape the Horizontal Laps

ASCE Desig Wind MP	Fortifie Desig Wind MP	Roof X on 5:1	6:1	7:1	8:1	10:1	12:1	14:1	16:1	18:1
		Required Overlap for "High Performance" Underlayment to Avoid Sealing								
		inche	inche	inche	inche	inche	inche	inche	inche	inche
9	11	1	1	1	1	9	8	8	7	7
10	12	1	1	1	1	1	1	9	9	9
11	13	2	1	1	1	1	1	1	1	1
12	14	2	2	1	1	1	1	1	1	1
13	15	N	2	2	2	1	1	1	1	1
14	16	N	N	2	2	2	1	1	1	1
15	17	N	N	N	N	2	2	1	1	1

NA = Not Allowed - overlap is greater than

VI. Wall system Requirements:

1. Continuous Load Path

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

To be considered ***Fortified***, the building must have:

a. Hardware connectors must be provided from all roof framing members to wall frames.

   1. For wood based rafter systems, all connectors shall wrap over the top, and be installed according to the manufacturer's installation instructions.
   2. For wood trusses or cold-formed steel framing members, connections need not wrap over the top.

b. Inter-story connection hardware in multi story structures.

c. Anchorage to the foundation sufficient to allow no more than ¼" deflection at the anchor point under full design load.

d. Exterior frame walls shall be fully-sheathed with structural panels meeting the stiffness ratings and minimum thickness specified in this Builder's Guide.

e. The required minimum allowable loads for all connection hardware to be installed within the house shall be identified on the building plans and checked during the plan review.

Use of any of the design or prescriptive documents identified earlier is acceptable to determine actual connection requirements.

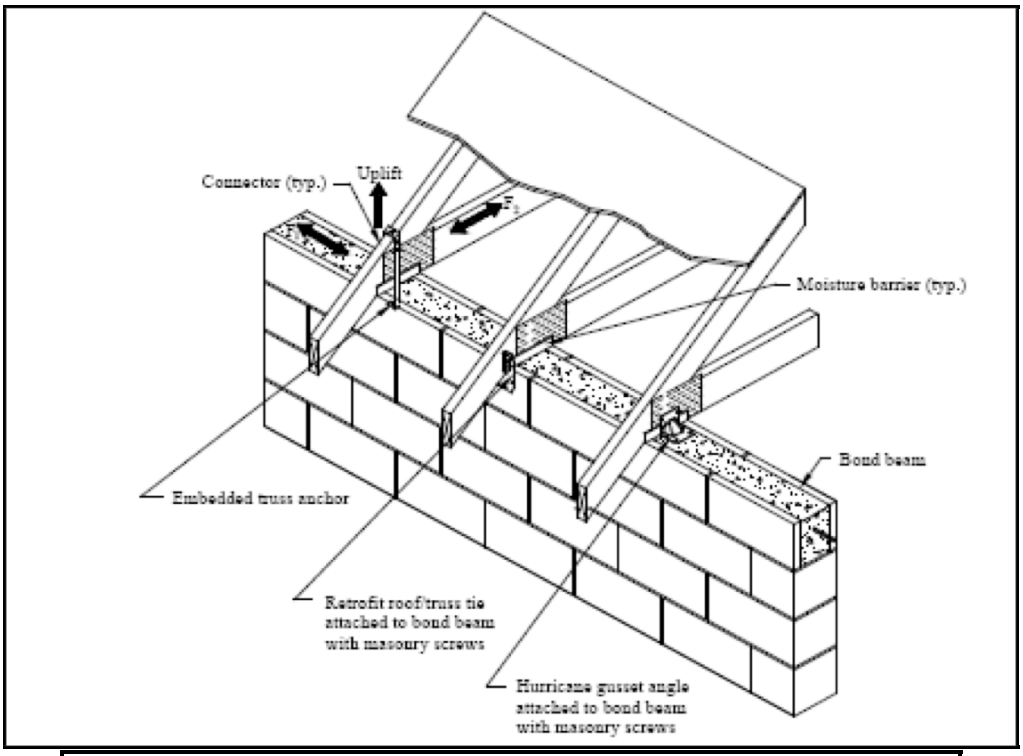
A continuous load path can be developed in wood frame construction using:

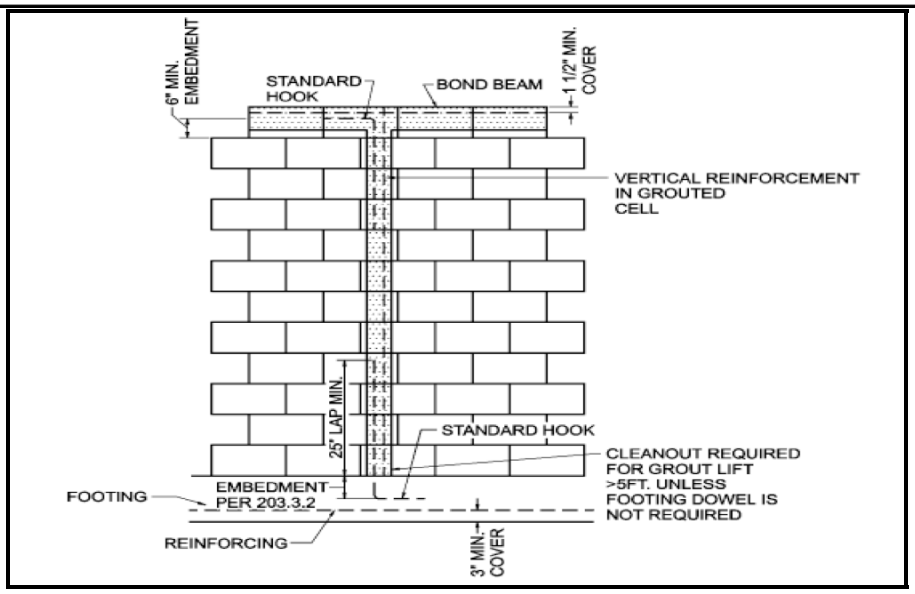
1. metal connectors between the rafters/trusses and the double top plate,
2. various systems involving connectors, sheathing, rods, hold-downs, etc to transfer loads from the top plate through the wall and into the foundation
3. properly designed and detailed foundations

A continuous load path can be developed in masonry construction using:

1. metal connectors between the rafters/trusses and the bond/tie beam,
2. horizontal re-bar installed in the bond/tie beam,
3. vertical re-bar in fully grouted cells (number and location depends on design conditions) connecting to
4. horizontal steel in the footing/foundation (Figure 3-10)

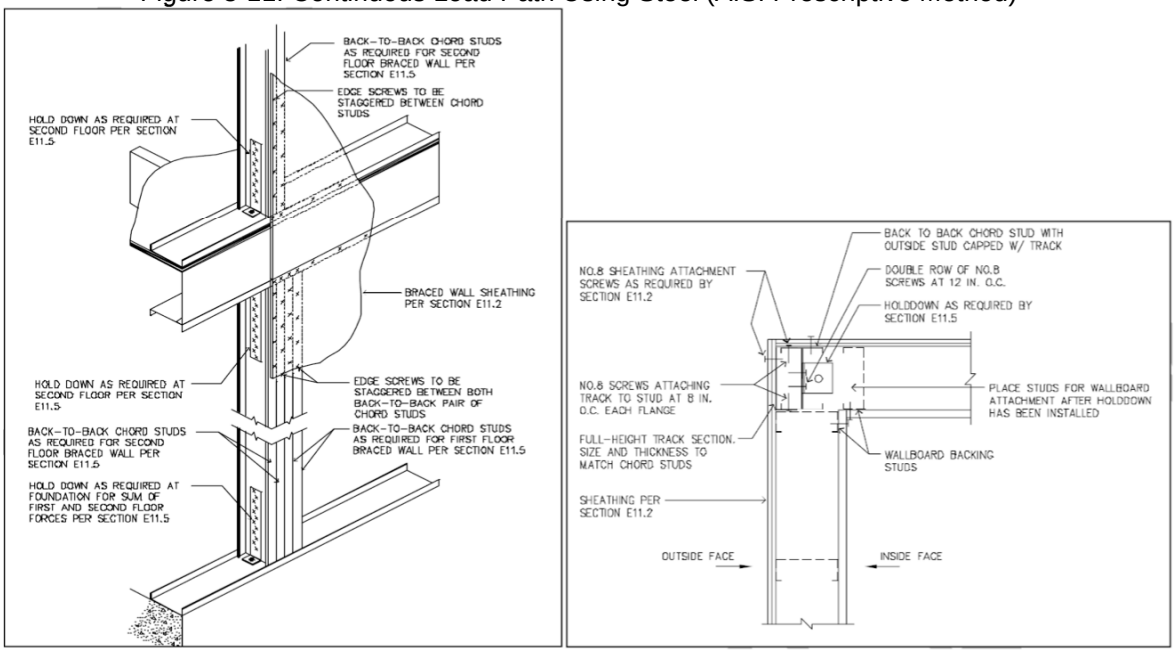
Figure 3-10: Continuous load path using masonry





A continuous load path can be developed in steel construction using the provisions from sections E11, E12, and E13 of the AISI Standard for Cold-Formed Steel Framing – Prescriptive Method. Sample details from the Prescriptive Method are shown below (Figure 3-11.)

Figure 3-11: Continuous Load Path Using Steel (AISI Prescriptive Method)



2. Shear Walls

Shear walls are required for all ***Fortified*** structures – regardless of construction materials. They must be anchored to the floor or foundation to complete the load path for uplift, lateral and shear loads. Designs must be in accordance with the prescriptive or performance standards, referenced earlier in this document, that were used for the design. Ideally, the shear wall segments, and the hold-down connectors, will be aligned vertically; however, other than limitations of the Building Code or the prescriptive design document that was used, there is no specific limitation for vertical alignment in the ***Fortified*** program.

3. Sheathing Impact Resistance

For ***Fortified*** structures, the wall system shall resist the impact of a 9-lb 2x4 striking end-on at 23 MPH without penetration. Table 3-5 identifies the minimum required thicknesses of structural wood panels required for frame or structural insulated panel (SIP) construction based on the exterior finish covering the panels.

Table 3-5: Minimum wall sheathing thickness (inches) over steel or wood studs at maximum 24” on center stud spacing

Exterior Cover	Wood Structural Panel Sheathing Thickness
Brick veneer	7/16”
½” Stucco	7/16”
½” thick wood or fiber-cement based planking	7/16”
Vinyl or Aluminum siding	1/2”

Concrete block, insulated concrete forms, and reinforced masonry walls are considered to comply with this requirement. Sheet steel 0.018” thick or thicker panels or covered panels are also considered to meet this criteria.4. Gable End Wall Construction

Failure of gable end walls has been quite common in hurricanes when adequate bracing is not installed when the house is built. To significantly reduce damage and potentially reduce construction costs, full height gable end walls are recommended but not required in the ***Fortified*** program.

Gable endwalls should be structurally continuous between points of lateral support (figures 3-12A and 3-12B) on next page). 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 (Section 14).

Figure 3-12A: Continuous Gable Endwall Reinforcement for single and multi-story

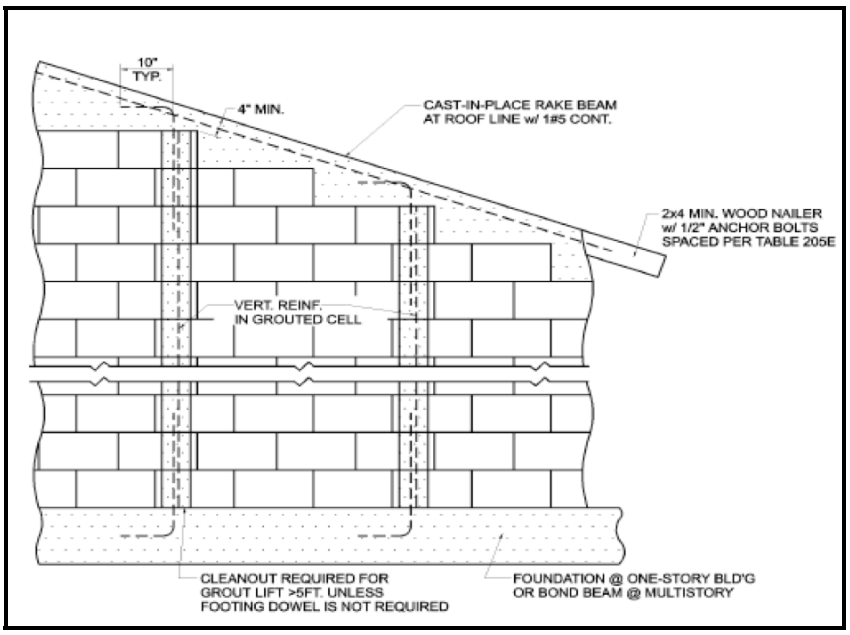
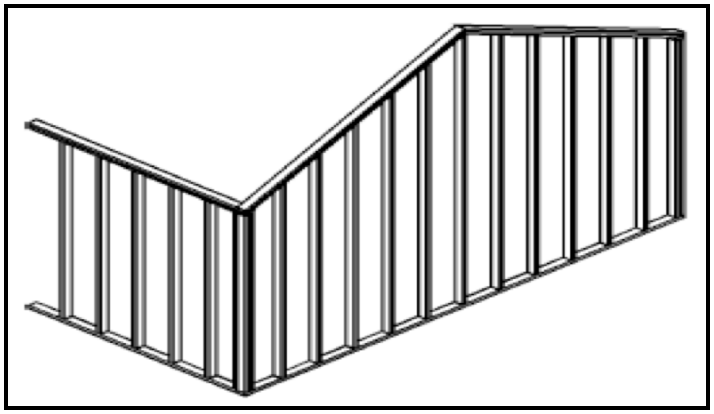


Figure 3-12B: Gable End Wall, Balloon Framing, Preferred Method of Construction



5. Corrosion-Resistant Connectors

Metal hardware and fasteners used in applications where they are either exposed to the exterior, or in contact with pressure treated wood must be either stainless steel or galvanized with a rating of G185 or greater.

In Coastal A and V flood zones (Section 4), all exposed hardware, and fasteners must be stainless steel. 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.

Cold-Formed Steel framing comes standard with G60 galvanized coating on structural members. Galvanized fasteners should be used with CFSF, and dissimilar metals (such as copper pipe) should be isolated from steel framing members. For use of steel framing with pressure treated wood, see "Pressure Treated Wood and Steel Framing," listed in the references and available from the Steel Framing Alliance.

VII. Wind Pressure and Opening Protection Requirements:

Doors and windows must be rated for the design pressure appropriate for the site and location, relative to the building geometry. The negative pressure ratings should be consistent with the ***Fortified*** Design Wind Speed and Exposure C conditions, as outlined in Table C-1 (Appendix C). This will provide the basic strength required for the windows and doors. However, positive pressure ratings are based on the pressure at which windows or doors leak water using a criteria of 15% or less of the design pressure. Consequently, the positive pressure ratings are generally set by dividing the pressure at which the leakage occurs by 0.15, and the result is normally a lower positive rating than a negative pressure rating. Positive design pressures also vary with elevation above grade and do not depend on the building geometry and distance from a corner. Positive pressure ratings should be consistent with those listed in Table C-2. At the higher wind speeds, some values have been capped based on availability of products. However, the values listed at high wind speeds in Table C-1 and C-2 at least meet the local design wind speed related values for Exposure C conditions.

Opening protection that meets at least one of the test standards listed below, or higher test and performance criteria, shall be required for all building openings in all geographic areas with ***Fortified*** Design Wind Speeds of 120 MPH or higher. In other coastal states when the ***Fortified*** Design Wind Speed is between 110 and 120 MPH, wind-borne debris protection is required within 1 mile of the coast. "Opening Protection" can be a large missile impact rated door or window or a large missile impact rated covering system. The large missile is a 9-lb 2x4 impacting end on at 34 MPH.

In other words, all entry doors, windows, skylights, and patio doors must be tested and certified to meet impact resistance and pressure standards. If the units themselves are pressure rated but have not been

tested for impact, they must be covered by a system that meets one of the following impact resistance standards.

- ✓ ASTM E1996
- ✓ SSTD-12
- ✓ Miami-Dade TAS/PA 201 (Must also pass TAS 202 and 203)

Openings required to be protected, as defined above, that are located more than 10' above grade without access from a porch or balcony, shall be impact rated or have a permanently installed system that is operable from inside the house.

Impact rated garage doors are required for structures located in areas where the ***Fortified*** Design Wind Speed exceeds 160 MPH and are recommended in other areas where debris impact protection is required. To be considered impact rated, garage doors must be tested using the large missile and pass one of the following standards:

- ✓ ASTM E1996, ANSI/DASMA 115
- ✓ Miami-Dade TAS/PA 201, TAS/PA 202 and TAS/PA203.

VIII. Soffits and Fascias:

Soffits 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. All soffits and fascias shall have a minimum design pressure rating (as determined by the AAMA 1402-86 test standard) equal to that of the adjacent walls. Unsupported soffit lengths shall not exceed the maximum dimensions of the tested configuration, as reported by the manufacturer. Soffits shall be installed according to the manufacturers' recommendations for high wind regions.

IX. Water intrusion management:

Water intrusion into houses often occurs due to wind driven rain during high wind events such as hurricanes or even severe thunderstorms. While keeping water out of the structure is a primary goal, all too often water leaks into the house through openings that are not adequately sealed during construction. Exterior wall penetrations such as electrical outlets, electrical panels, dryer vents and plumbing lines can provide a "water super highway" when not adequately sealed at the time of installation. Additionally, water intrusion through soffit vents, ridge vents, off ridge vents, gable end vents, and doors and windows can be a major source of unwanted moisture in the house.

Installation of windows and doors must be completed in accordance with the manufacturer's installation instructions and product approval documents. Investigations into water intrusion issues after recent hurricanes identified improper installation (lack of adequate sealant being used) as a primary cause of water leaks. The use of a water resistant house wrap is necessary in frame construction to keep water intrusion to a minimum. Again, proper installation is critical and manufacturer's installation instructions must be strictly adhered to. Window and Door flashing for frame construction must be installed per ASTM E2112 as detailed in Appendix D. For masonry construction, a full bed of sealant must be installed prior to setting the window or door to assure a water resistant installation.

While design and construction can prevent most water leaks, the building must be designed with appropriate consideration given to managing potential water penetration due to high winds and rain. Water management is often accomplished through the use of house wraps, flashing tape, special window, and door bucks that are designed to keep water out (or direct the moisture back out of the house if a leak does occur). The exterior finish systems, vinyl, aluminum, wood, or paint must keep water from leaking into the building. However, additional barriers and drainage planes are needed for most systems.

4. FLOOD CRITERIA

The ***Fortified … for safer living®*** (***Fortified***) flood requirements are, in general, no different than the minimum requirements of the National Flood Insurance Program (NFIP), except as follows:

1. The building must be at least 3 feet higher than the BFE

2. The foundations in Coastal A zones must adhere to the same requirements as those in V zones. That is, only open elevated foundations are allowed in the Coastal A zone in the ***Fortified*** program.

With the above in mind, the following requirements are **mandatory**:

Mandatory Requirements:

I. The building shall comply with all of the provisions of the NFIP or FEMA Coastal Construction Manual (FEMA 55/May 2005) or FEMA Recommended Residential Construction for the Gulf Coast (FEMA 550/July 2006), as appropriate.

II. Foundations shall be designed for flood forces as required by ASCE 24-05 for the ***Fortified*** Design Flood Elevation (FDFE) and the lowest adjacent existing natural grade.

III. Foundations in the Coastal A Zone shall be designed as required for the Coastal V Zone.

IV. In the Coastal V or Coastal A Zones, the bottom of the lowest horizontal structural member of the lowest habitable floor shall be above the FDFE.

V. In Non-Coastal A Zones, the finished floor elevation of the lowest habitable floor shall be above the FDFE.

VI. The FDFE shall be the minimum of:

   a. 3 feet above the maximum of the Base Flood Elevation (BFE) or FEMA Amended BFE (ABFE)

   b. For all cases the preferred elevation of the finished floor is at least the 500 year flood elevation – if known.

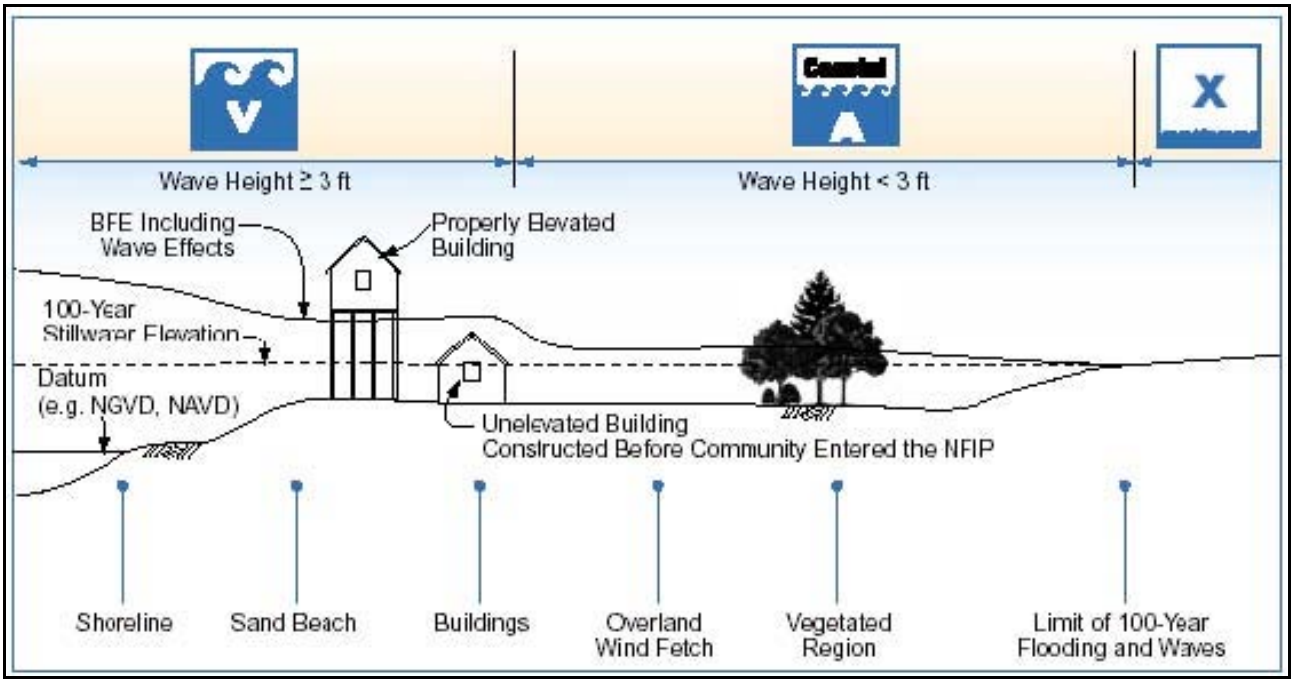
Flood Zones

V Zone – Areas along coasts subject to inundation by one percent annual chance flood events with the additional hazards associated with storm induced waves. Mandatory flood insurance purchase requirements apply.

Coastal A zone – A zone landward of a V zone, or landward of an open coast without mapped V zones (e.g., the shorelines of the Great Lakes), in which the principal sources of flooding are astronomical tides, storm surges, seiches, or tsunamis - not riverine sources. An example an elevation showing V and Coastal A zones is given in Figure 4-1.

A Zone – other areas subject to inundation by one percent annual chance flood event (e.g., along inland rivers, lakes and lowlands).

Figure 4-1: Typical shoreline elevation showing flood zones V, Coastal A and X (Coastal Construction Manual, 3rd edition, FEMA 55).



Utilities

Electrical, heating, ventilation, plumbing, air conditioning equipment and other service facilities must be elevated above the FDFE in Special Flood Areas.

5. WILDFIRE CRITERIA

Fortified … for safer living® (***Fortified***) criteria and requirements have been developed for mitigation of damage caused by wildfire, specifically in the Wildland/Urban interface. The Wildland/Urban Interface is an area where structures and other improved property meets or intermingles with wild land or vegetative fuels.

Site Evaluation

The ***Fortified*** Inspector will identify the wildfire hazard level for the site by examining the following items:

- ✓ Ingress and egress into subdivision
- ✓ Road widths
- ✓ Road condition
- ✓ Road terminus
- ✓ Surrounding vegetation (fuel)
- ✓ Topography/slope of surrounding area
- ✓ History of fire occurrence due to lightning, railroads, burning debris, arson, etc.
- ✓ Building setback
- ✓ Fire protection systems (fire hydrants)
- ✓ Utilities: gas and electric

Each factor is assigned a point value and the cumulative value of the points determines whether the site is in a low, moderate, high, or extreme wildfire hazard setting. Note that if the hazard level is determined to be Low, then none of the wildfire criteria are applicable. For a risk assessment checklist, visit www.ibhs.org.

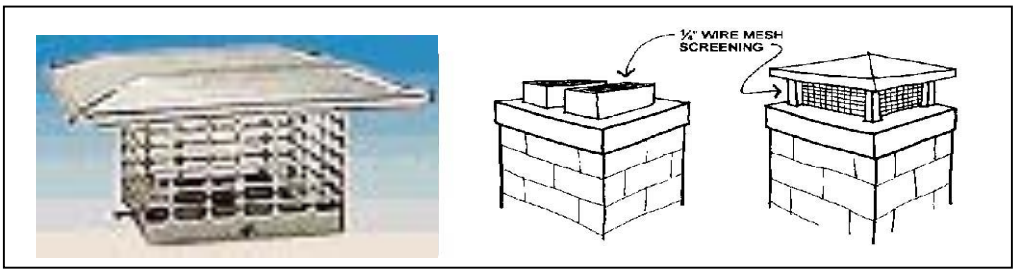
Wildfire Protection Requirements Common to Extreme, High and Moderate Wildfire Hazard Levels

The following ***Fortified*** items are applicable to all extreme, high, and moderate Wildfire Hazard Areas. These requirements must be augmented by the hazard-specific requirements detailed in this section.

Mandatory requirements:

I. A non-combustible street number at least 4” high, reflectorized, on a contrasting background, at each driveway entrance, visible from both directions of travel.
II. Firewood storage and LP gas containers must be at least 50’ away from any part of the home structure, and have at least 15’ of survivable space around them.
III. Non-combustible, corrosion-resistant screening with a mesh size no greater than ¼” covering the attic and sub-floor vents. Vent openings must not exceed 144 square inches at each vent.
IV. Gutters and downspouts of noncombustible materials. Typical aluminum gutters and downspouts are considered to be acceptable.
V. Driveways must be at least 12’ wide with at least 13.5’ of vertical clearance.
VI. If gated, the gate must open inward, have an entrance at least 2’ wider than the driveway, and be at least 30’ from the road. If secured, the gate must have a key box of a type approved by the local fire department.
VII. Individual Fire Extinguishers.
VIII. Spark arrestors in all chimneys (Figure 5-1).

Figure 5-1: Spark Arrestor for chimney



Combustible and noncombustible eave materials are defined in Table 5-1. For materials not listed in Table 5-1, any material that has passed when tested in accordance with Section 8 of ASTM E 136 "Standard Test Method for Behavior of Materials in a Vertical Tube Furnace at 750°C (1382°F)" are generally considered to be non-combustible.

Table 5-1: Combustible and Non-combustible Soffit Materials

Combustible	**Noncombustible**
➢ Vinyl ➢ PVC ➢ Wood boards or panels less than or equal to ½" thick (including plywood and OSB)	➢ Aluminum ➢ Wood boards or panels greater than ½" in thickness (including plywood and OSB) ➢ Cementious soffit board

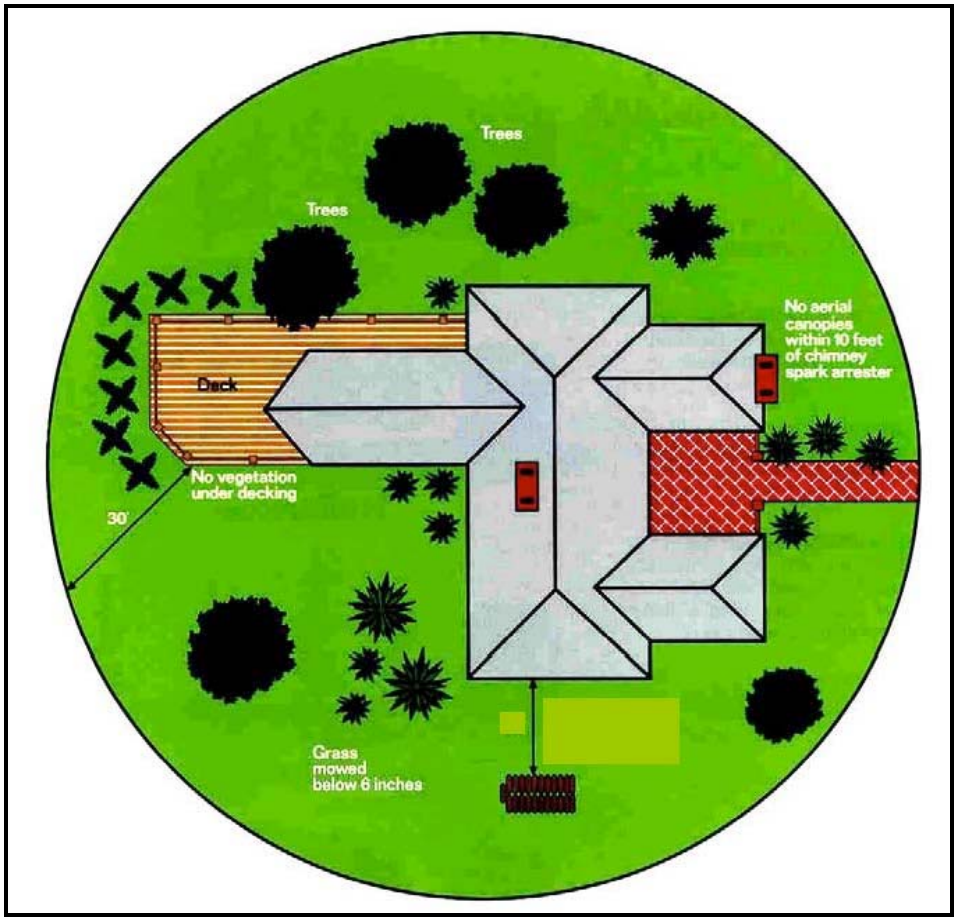
Wildfire Protection Criteria that Varies by Wildfire Hazard Level

Survivable Space Characteristics

The following characteristics must be applied in the survivable space whose extent is defined by the wildfire hazard level below:

I. Grass mowed below 6"
II. Provide regular irrigation
III. For trees taller than 18', prune lower branches within 6' of ground
IV. Trees are 10' apart from each other
V. No tree limbs within 10' of home
VI. All plants or plant groups are more than 20' apart
VII. No vegetation under decks
VIII. Remove all dead/dying vegetation

Figure 5-2: Survivable Space features (Western Fire Chiefs Association, 1996).



Extreme Hazard Areas

If the home is in a wild land/urban interface area and has an "Extreme" hazard rating, it must have the following additional items:

I. A survivable space of 100'.
II. A roof covering assembly with a Class A fire rating according to UL 790. Other standards that are also accepted include ASTM E 108 Class A, or UBC 15-2 ratings. Consult the product packaging or other manufacturer literature to determine if the product meets this standard. There are also publications available from the National Roofing Contractors Association that list fire ratings (and other information) by manufacturer and product name [NRCA 1999a, 1999b]. Wood shakes and wood shingles do not qualify regardless of rating.
III. Non-combustible material enclosing the undersides of aboveground decks and balconies.
IV. No fire wood within 50' of structure.
V. Exterior windows are double-paned glass with a tempered outside lite and non-combustible, corrosion resistant screens OR have non-combustible shutters.
VI. Exterior glass doors and skylights are double paned, tempered glass.
VII. Exterior wall assemblies must have one-hour fire resistive rating with non-combustible exterior surfaces. The following materials are considered to be Non-combustible exterior surfaces: brick veneer, concrete block, concrete, and stone.
VIII. Monitored smoke alarms.
IX. In-home sprinkler system that complies with NFPA 13-D-1999: Installation of sprinklers in 1 and 2 family dwellings.

High Hazard Area

If the home is in a wild land/urban interface area and has a “High” hazard rating, it must have the following additional items:

I. A survivable space of 50’.
II. A roof assembly with a Class A fire rating. Wood shakes and wood shingles do not qualify regardless of rating.
III. Non-combustible material enclosing the undersides of aboveground decks and balconies.
IV. Exterior windows are double-paned glass and non-combustible, corrosion resistant screens OR has non-combustible shutters.
V. Exterior glass doors and skylights are double-paned glass.
VI. Exterior wall assemblies must have one-hour fire resistive rating with fire resistant exterior surfaces. The following materials are considered to be fire-resistive: wood boards or panels greater than ½” in thickness (including plywood and OSB), stucco, plaster, and brick or stone veneer.
VII. Non-monitored smoke alarms.

Moderate Hazard Area

If the home is in a wild land/urban interface area and has a “Moderate” hazard rating, it must have the following additional items:

I. A survivable space of 30’.
II. A roof assembly with a class B fire rating.
III. Fire-resistive material enclosing the undersides of aboveground decks and balconies. .
IV. Exterior windows and skylights are double-paned glass.
V. Exterior walls are fire resistant materials. The following materials are considered to be fire-resistive: wood boards or panels greater than ½” in thickness (including plywood and OSB), stucco, plaster, and brick or stone veneer.
VI. Non-monitored smoke alarms.

6. HAIL CRITERIA

Fortified … for safer living® (***Fortified***) criteria and requirements have been developed for mitigation of damage caused by hail. With this in mind, the following requirement is **mandatory**:

Mandatory Requirement:

I. Install an impact resistant roof covering – UL 2218 Class 4 or FM 4473 Class 4. (Note that UL test is designed for flexible roof covering products, and the FM test is designed for rigid roof covering products). This is the only criterion for Hail regions.

   UL 2218 is a test that is administered by Underwriters Laboratories and involves dropping steel balls of varying sizes from heights designed to simulate the energy of falling hailstones. Class 4 indicates that the product was still functional after being struck twice in the same spot by 2" steel balls. Examine the package of the roof cover product, or consult manufacturer documentation to determine if the product has met the Class 4 designation of UL 2218. If difficultly is encountered locating products that meet UL 2218 Class 4, contact the ***Fortified*** staff at IBHS for a list of approved roof covering products. Note that this standard is appropriate for flexible roofing products like asphalt shingles, and metal panels or shingles.

   FM 4473 is administered by Factory Mutual Research and is a test that is similar to UL 2218, but instead of using steel balls, frozen ice balls are used. The FM 4473 test standard is used on rigid roof covering materials (like cement tiles) and involves firing the ice balls from a sling or air cannon at the roof-covering product. Class 4 indicates that the product was still functional after being struck twice in the same spot by a 2" ice ball.

7. SEVERE WINTER WEATHER CRITERIA

Fortified … for safer living® (***Fortified***) criteria and requirements have been developed for mitigation of damage caused by severe winter weather. Severe Winter Weather criteria specifically addresses the potential for damage from ice dams in areas prone to snowfall accumulations greater than 12". Areas where the ***Fortified*** criteria for Freezing Weather are required are shown in Figure 7-1. The boundary of the so-called Severe Winter Weather Region outlined on this map follows state and county boundaries, and is roughly based on a combination of 1) the 20 degree isotherm of the 97½ % winter design temperature map in the IRC, and 2) a 20-lb/sq. ft. ground snow load from the 2000 International Residential Code. The northern boundaries of NC, TN, AK, OK, NM, and AZ 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.

With the above in mind, the following requirements are **mandatory**:

Mandatory Requirements:

I. Unless already included because of other risks, an additional moisture barrier must be applied to the roof deck along the eaves of the roof to prevent intrusion caused by ice dams.

II. All drains on flat roofs must have heating strips (heat trace) installed around them in such a way that it prevents blockage of the drains by ice or ice dams.

III. No heat source must be installed in un-conditioned attic space.

IV. No un-insulated recessed lights must be installed.

V. All attic doors between conditioned and un-conditioned space must be treated as exterior doors, properly insulated, sealed and weather-stripped or gasketed.

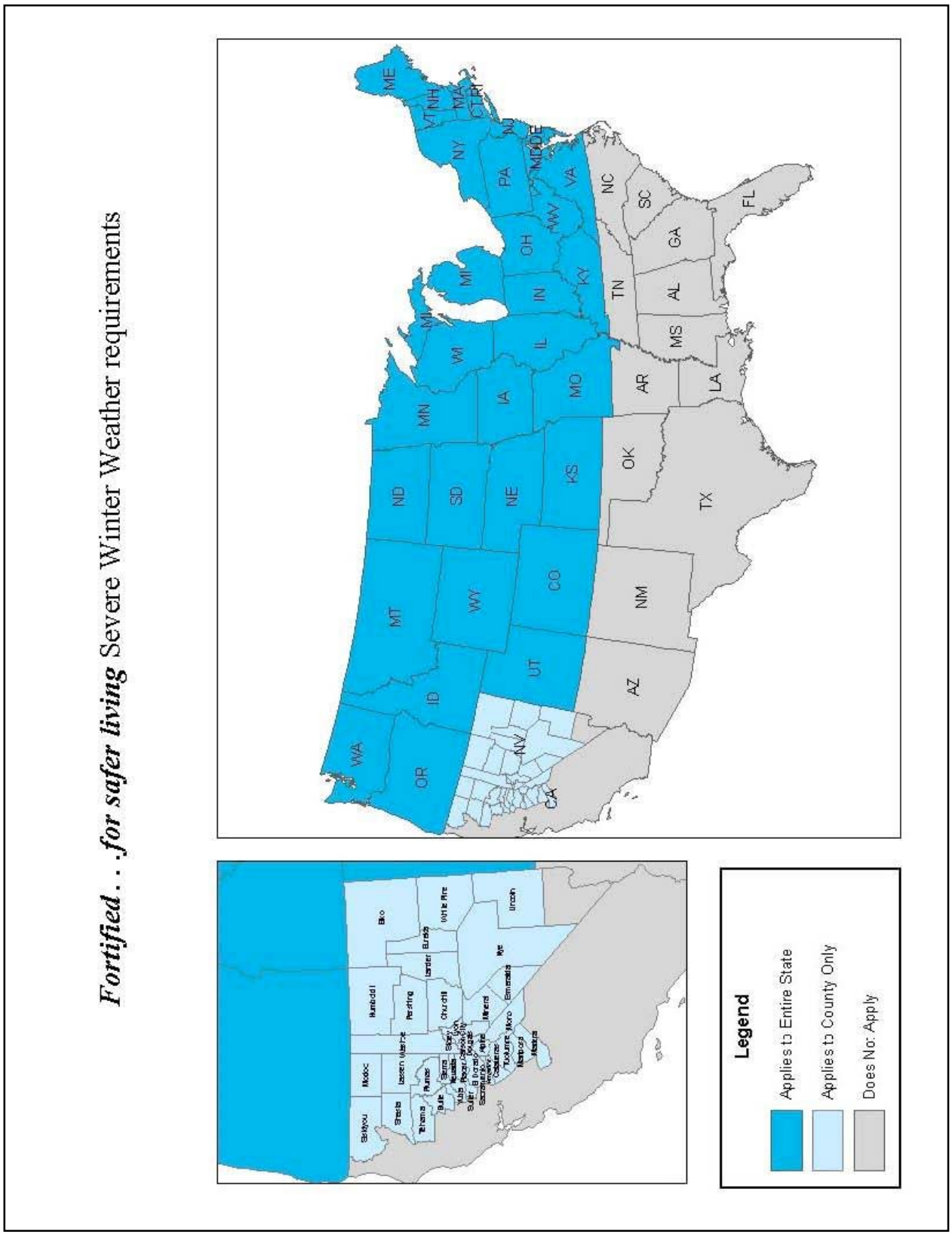
VI. All hidden attic penetrations (stack vents, partition walls, electrical chases, etc.) must be properly sealed and insulated.

VII. Frozen Pipes: Require sufficient insulation on all exterior piping and on all piping in exterior walls, crawl spaces, attics, and basement ceilings.

OR

Prohibit pipes in external walls and unheated spaces.

Figure 7-1: Regions where Severe Winter Weather requirements apply under the ***Fortified*** program.



8. SEISMIC CRITERIA

Fortified … for safer living® (***Fortified***) criteria and requirements have been developed for mitigation of damage caused by earthquakes in seismically active regions of the US. Structures built within these regions will likely experience their most severe loadings during seismic events. Thus, for areas with a maximum considered earthquake ground motion greater than or equal to 0.5g shown in Figure R301.2(2) of the IRC-2006 or Figure 22-1 of ASCE 7-05, the seismic criteria of the ***Fortified*** program must be applied. Structures designated as ***Fortified*** that are located in these seismic designated areas must be designed for ground motions that are approximately 20% higher than those used for design in the IRC-2006 or ASCE 7-05. From a practical standpoint, this can be accomplished by designing and building the home so that it meets the requirements of the next higher seismic design category in the IRC-2006. However, once "engineered design" is reached, (seismic design category E), the designer must increase the code specified ground motions by 20% and design the home accordingly. Table 8-1 summarizes the determination of the seismic design category for use in the ***Fortified*** program.

Seismic Design Category Determination		
IRC-2006 Calculated S_{DS}	IRC-2006 Seismic Design Category	Fortified … for safer living® Seismic Design Category
$0.5g \le S_{DS} \le 0.67g$	D_0	D_1
$0.67g < S_{DS} \le 0.83g$	D_1	D_2
$0.83g < S_{DS} \le 1.17g$	D_2	E*
$1.17g < S_{DS}$	E	E*
*Increase calculated S_{DS} by 20%		

Table 8-1: Determination of seismic design category

With the above in mind, the following requirements are either **mandatory or strongly recommended:**

Mandatory Requirements:

I. The Seismic Ground Motion used to design the building must be 1.2 times the 0.2 sec. Spectral Response Acceleration (5% of critical damping) as shown in the ASCE 7-05 earthquake ground motion acceleration maps.

II. ***Fortified*** designated structures are not permitted to be built where fault zones have been established and mapped (such as in California).

III. Where Seismic Hazard Zone maps have been developed (such as in California), the foundations of structures built in areas designated as being at risk of either liquefaction or ground failure must be designed by a licensed structural engineer.

IV. Structures not built to the prescriptive criteria and meeting the building limitations outlined in this Guide must be designed by a licensed professional engineer (structural specialty) to resist the ground motions outlined in 1 above.

V. Water heaters must be securely attached to structural members such as wall studs within a load bearing wall.

VI. Mechanical equipment and associated pipes and conduit must be restrained with appropriate anchors to prevent damage under the design basis reduced loads.

VII. All glazing must be tempered glass or have a safety film applied on the interior surface.

VIII. All natural gas and propane lines must have flexible connections and an automatic shut off valve.
IX. Masonry chimneys must be connected to structural members of exterior walls and provided with adequate restraint for the expected loads on the chimneys. Chimneys must not extend more than 24” above the rooftop.

Strongly recommended:

I. Install L-brackets or Z-brackets to attach bookcases, file cabinets, entertainment centers, and other furniture to the wall.

II. Secure picture frames and bulletin boards to the wall by using closed screw-eyes instead of traditional picture hangers.

III. Secure ceiling lights to supports using safety cables.

IV. Anchor large appliances such as refrigerators to the wall using safety cables or straps.

Install locking mechanisms on cabinet and cupboard doors to prevent them from opening and letting the contents fall out during an earthquake.

9. INTERNAL FIRE CRITERIA

Fortified … for safer living® (***Fortified***) criteria and requirements have been developed for mitigation of damage caused by fire inside the home. With this in mind, the following requirements are either **mandatory or strongly recommended**:

Mandatory requirements:

I. Install wired smoke alarms integrated and located according to the IRC, plus within 15' of the main electrical panel.

II. Install heat sensors in the kitchen and laundry rooms.

III. Install smooth sheet metal dryer vent pipe assembled with pop-rivets (no screws) and in a length no greater than 15' to the exterior. Not allowed to discharge into the attic space or garage.

IV. Install arc fault circuit interrupters on all electrical circuits for bedrooms.

Strongly recommended:

I. Install a monitored smoke/carbon monoxide alarm system.

II. Install a sprinkler system that meets NFPA 13D for residential applications.

III. Install a full fire separation wall between an attached garage and living spaces. Provide an X-hour rated ceiling in any attached garage.

IV. Install permanent fire rescue ladders, in each upper floor bedroom, providing a means of emergency egress.

V. Install only screw-wired connection electrical outlets. Back-wired connection electrical outlets are not allowed.

VI. Install solid or X-hour fire-rated door between attached garage and house.

10. WATER LOSS CRITERIA

Fortified … for safer living® (***Fortified***) criteria and requirements have been developed for mitigation of damage caused by water loss inside the home. With this in mind, the following requirements are either **mandatory or strongly recommended**:

Mandatory requirements:

I. Water heaters are not permitted in attic spaces unless they are installed with a 4" deep pan that is fitted with an elevated drain (1" above bottom of pan), and a float shut-off switch that will automatically shut off water supply to the tank if water builds in the bottom 1" of the pan.

II. Water heaters installed in habitable living areas must have a drain pan piped to a floor drain or containment area with a floor drain.

III. Drain pans for condenser units above living spaces must be equipped with two drain lines (one to be 1" diameter) or a single 1.5" diameter drain line. They must be fitted with an automatic overflow sensor and shutoff switch.

IV. Option 1: Master cutoff ball-valves for washing machine or automatic shutoff of water when equipment is not in use or other means of limiting water flow in the event of a broken hose or pipe must be installed. Option 2: The building must be connected to a monitored alarm system that provides detection of water leaks with automatic shutoff capability.

V. All service piping must be installed not less than 12" deep or less than 6" below the frost line (Per IRC).

VI. Plumbing under slabs: corrosion-sensitive materials must be sealed with a protective coating.

VII. Exterior framed walls must include a drainage plane system under the exterior cladding product that controls liquid moisture that gets in behind the cladding material and drains it to the outside of the building.

VIII. Laundry rooms and utility rooms on upper floors must be fitted with floor drains.

Strongly recommended:

I. Dish washers located on a waterproof surface with rear and side edging to prevent damage to surrounding cabinetry/walls/flooring.

II. Clothes washers located on a waterproof surface with rear and side edging to prevent damage to surrounding walls/flooring.

III. Water hammer arrestors at all bathrooms, kitchens, and laundry areas. Air chambers not allowed.

IV. Drain tile and sump pump systems (at least 24" diameter or 20 square inches) with approved backwater valves must be installed with battery backup in basement areas, regardless of soil classification (IRC does not require this when the soil classification is "well drained").

11. BURGLARY CRITERIA

Fortified … for safer living® (***Fortified***) criteria and requirements have been developed for mitigation of damage and/or loss caused by burglary. With this in mind, the following requirements are **strongly recommended**:

Strongly recommended:

I. Install solid core doors at exterior locations and from an attached garage into the living space. Doors must be a minimum 1 ¾" thick. Steel doors must be a minimum 24 gauge. 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.

II. Install ANSI/BHMA Grade 1 deadbolt locks with a minimum 1" long throw at all doors at exterior locations and from an attached garage into the living space. 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 must be a high security strike plate attached with a minimum (4) 3" long screws to the reinforcing plate. The reinforcing plate must extend at least 12" on either side of the deadbolt lock location and be attached with a minimum (8) 3" long screws to the house wall framing.

III. Install windows that meet ASTM F 588-97.

IV. Install a fire-resistant safe in concrete or in masonry (floor or wall).

V. Install at least two motion sensing exterior lights on each side of the house or no greater than 30' apart around the house in locations that are not easily accessible from the ground without a 6' step ladder.

VI. At exterior doors and doors from attached garage to living spaces, install hardwood shims at all hinge locations and install hinges with 3" long screws.

VII. At all exterior doors and doors from an attached garage to a living space, 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.

VIII. Option 1: Pre-wire home for security system that will provide contacts at all windows and doors plus motion and glass break detectors. Option 2: Install a security alarm system with contacts at all windows, exterior doors, doors between garage and living space, and on the garage door. Install glass break detectors for all windows. Install a strobe/audible alarm on the exterior of the house facing the street or more visible location and in a place that cannot be easily accessed from the ground. Where allowed by law, install security cameras that can be accessed remotely to visibly verify the alarm.

12. ELECTRICAL SURGE CRITERIA

Fortified … for safer living® (***Fortified***) criteria and requirements have been developed for mitigation of damage caused by electrical surges. With this in mind, the following requirements are **strongly recommended**:

Strongly recommended:

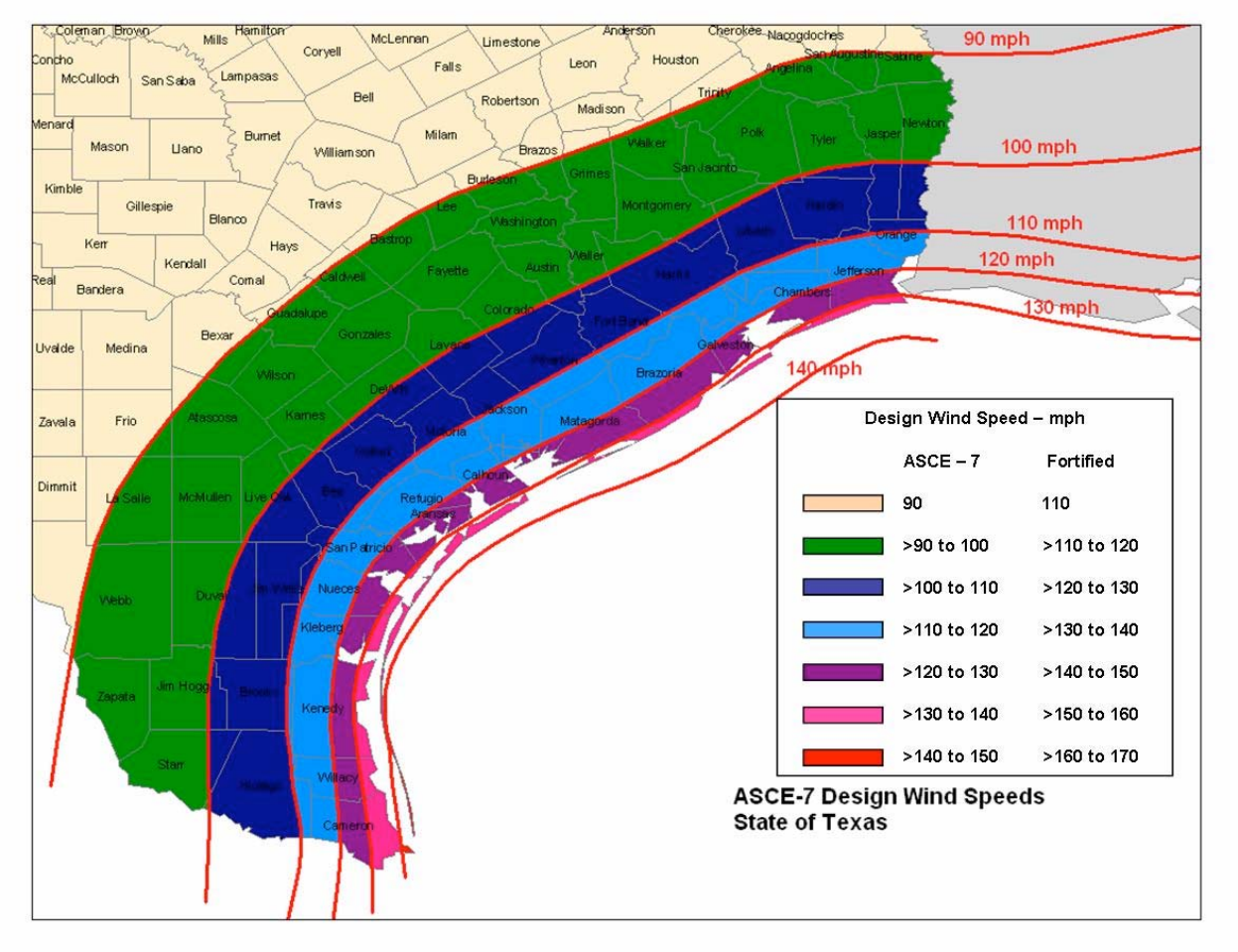
I. All structures must be equipped with a service-entrance (whole-house) surge protector with protection for electrical, telephone, and cable or satellite TV lines entering the house. The service-entrance surge protector for the electrical panel must be a Surge Protective Device (SPD) or Transient Voltage Surge Suppressor (TVSS) that has been listed to UL 1449, 2nd Edition Revision. The protector is to be installed in accordance with Article 285 of the National Electrical Code (as is applicable). The service entrance surge protector must have a working indicator light.

II. The home's electrical system must be properly grounded in accordance with Article 250 of the National Electrical Code. It is important that all utilities (telephone, electrical, and cable or satellite TV) be bonded to the same grounding point, for proper operation of the surge protection system and to prevent ground potentials developing on the electrical system. All utilities (telephone, electrical, and cable or satellite TV lines) must enter the house within 10' of electrical service entrance ground wire.

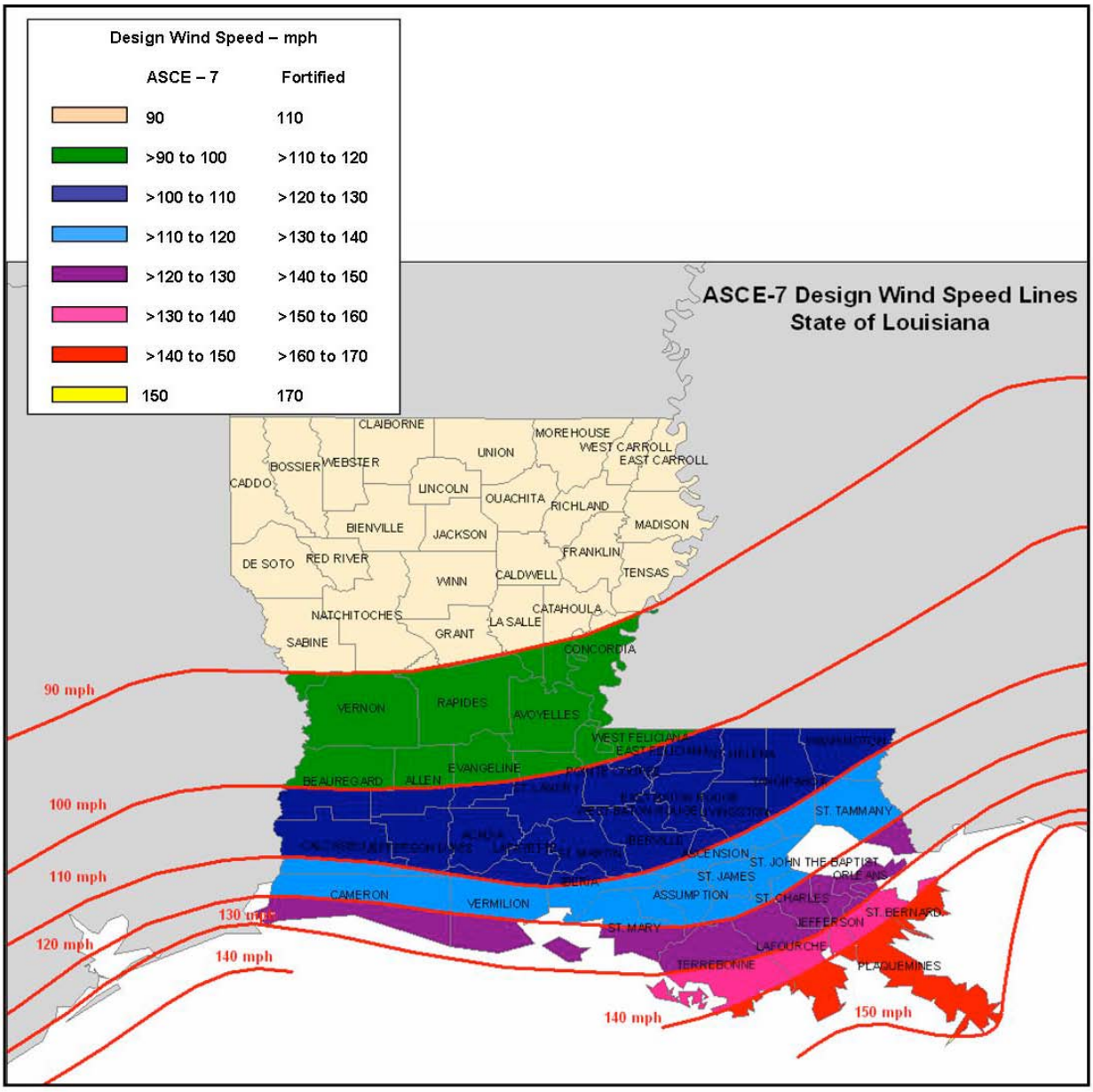
APPENDIX A

Fortified … for safer living*®** (Fortified***) ASCE-based Wind Speed Maps

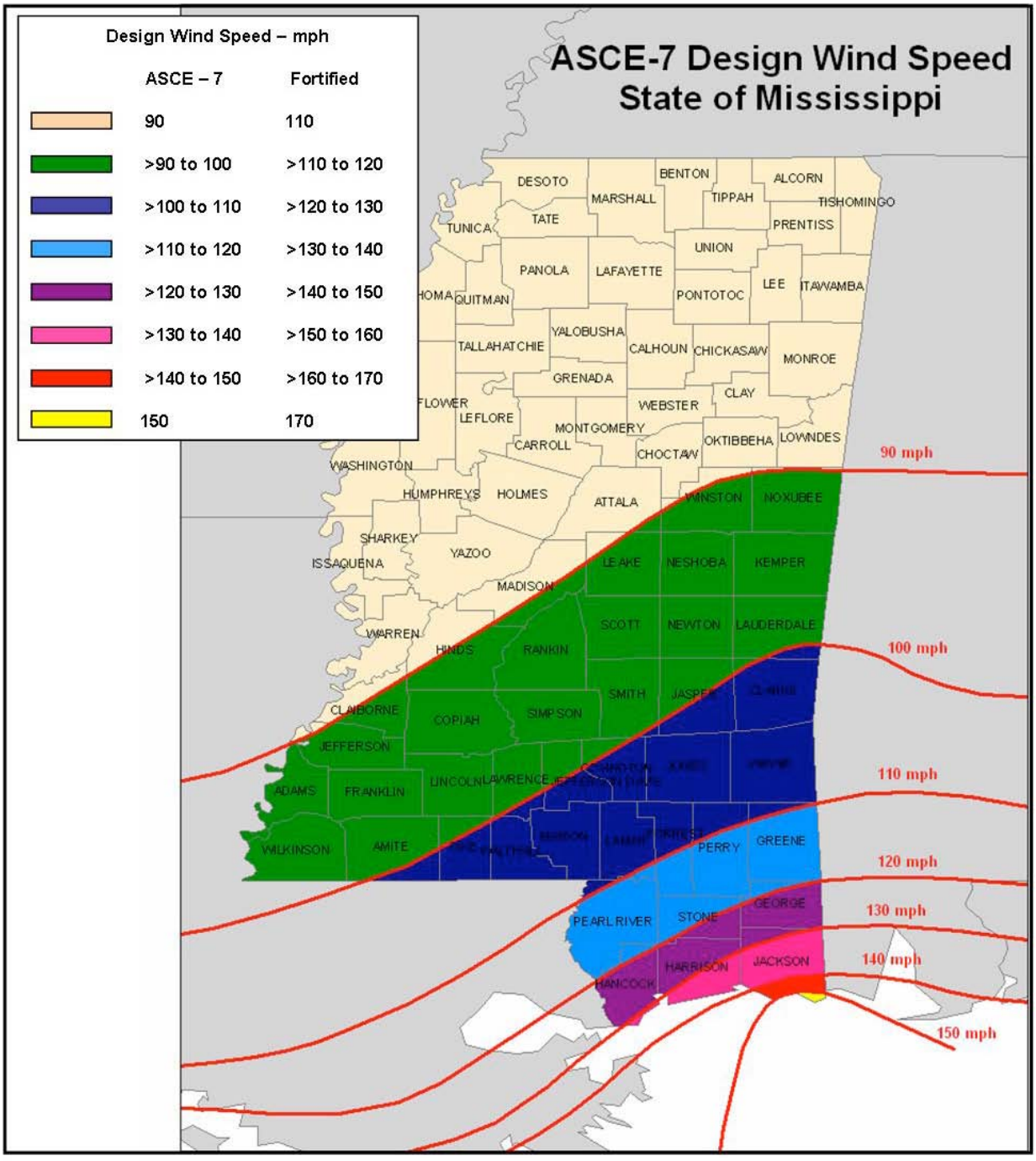
Note: all areas within the dark blue >100-110 MPH zone and higher must comply with the ***Fortified*** hurricane criteria.



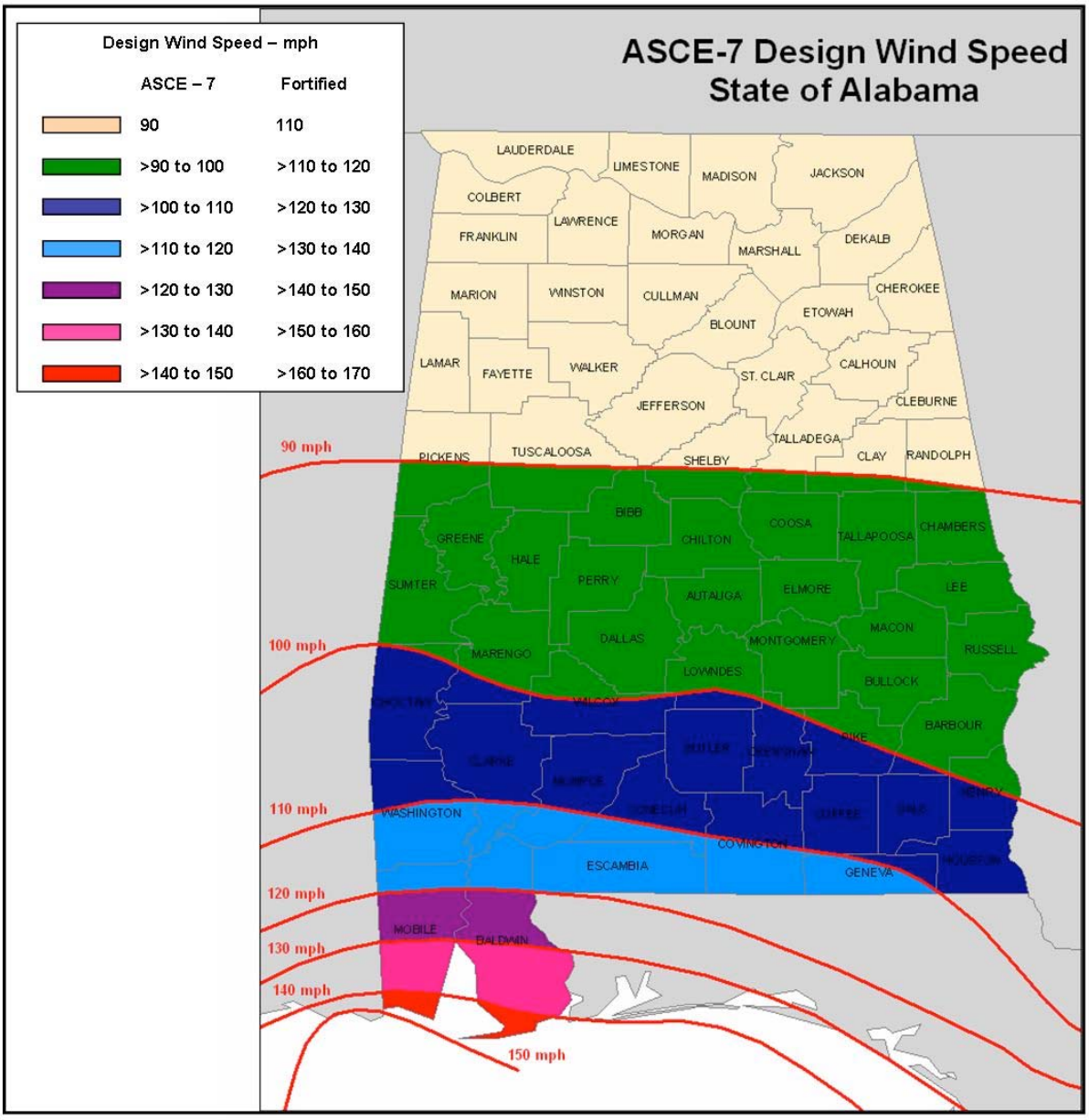
Note: all areas within the dark blue >100-110 MPH zone and higher must comply with the ***Fortified*** hurricane criteria.



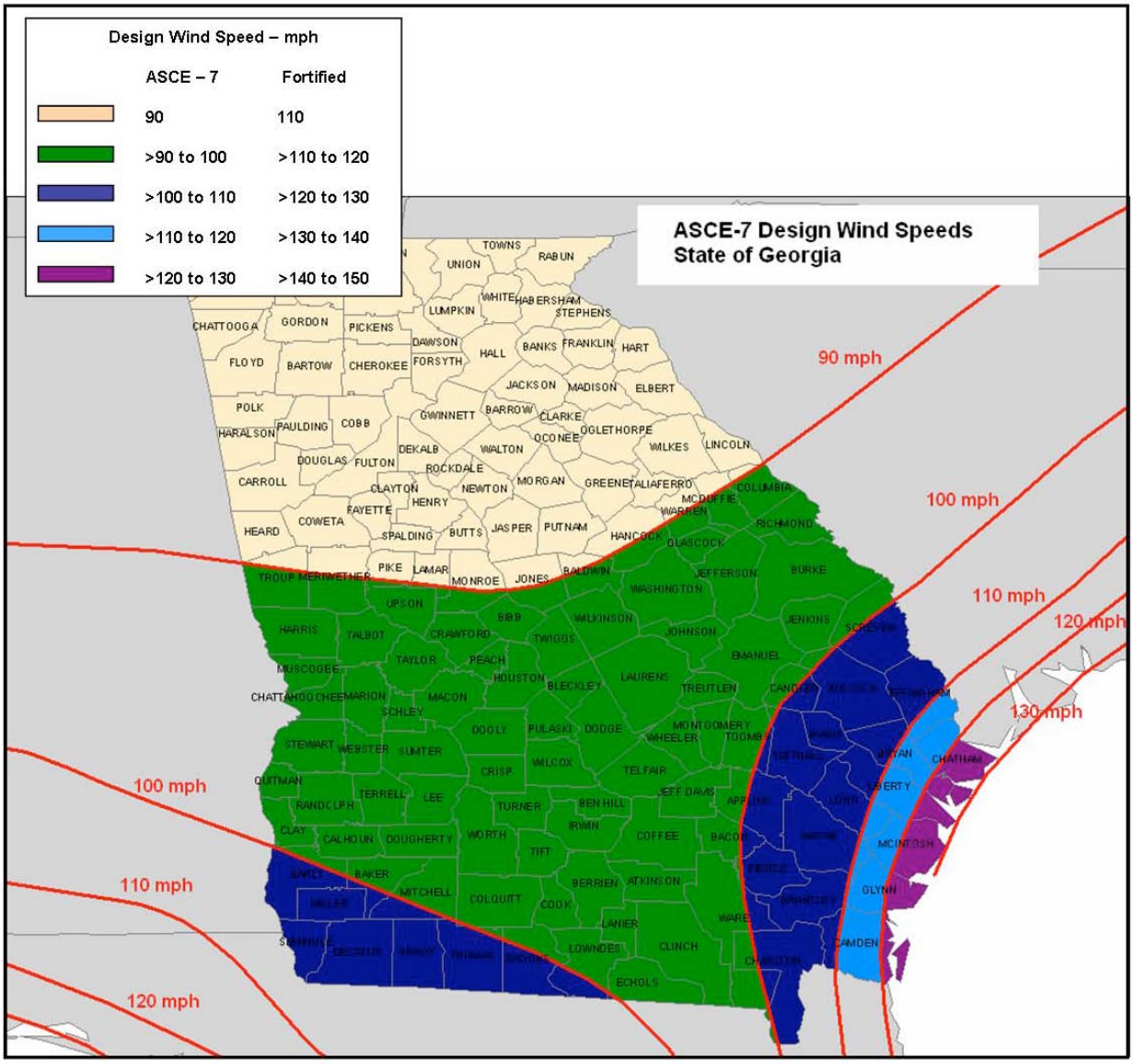
Note: all areas within the dark blue >100-110 MPH zone and higher must comply with the ***Fortified*** hurricane criteria.



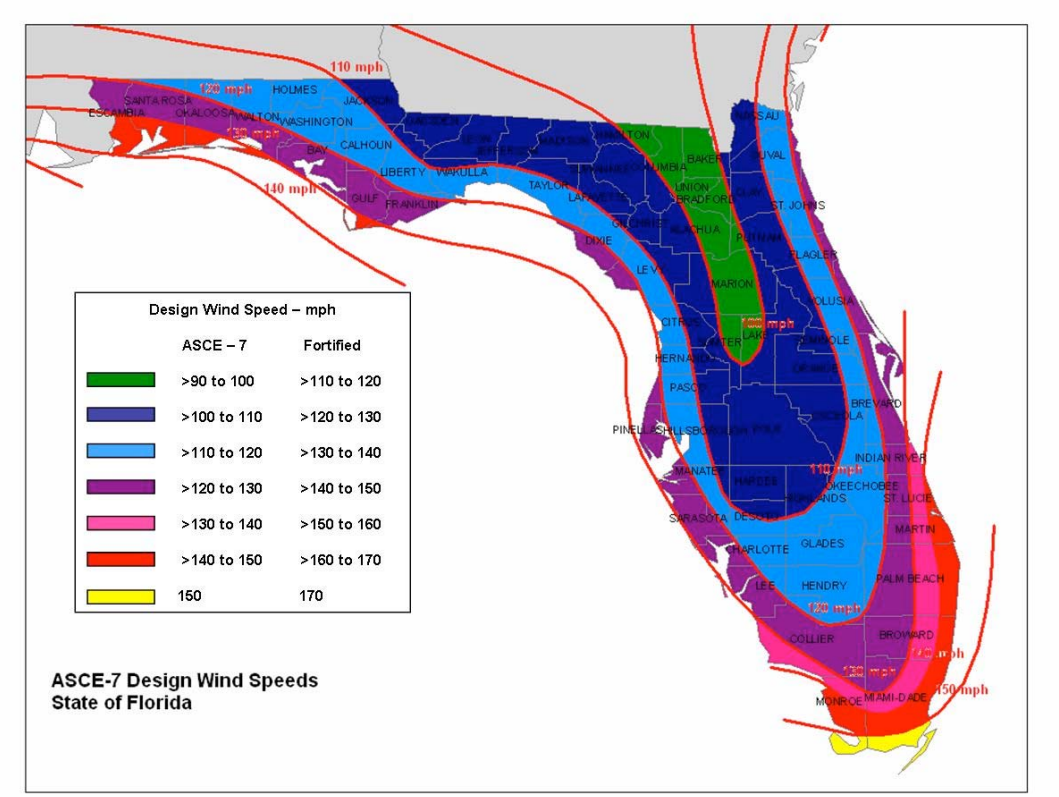
Note: all areas within the dark blue >100-110 MPH zone and higher must comply with the ***Fortified*** hurricane criteria.



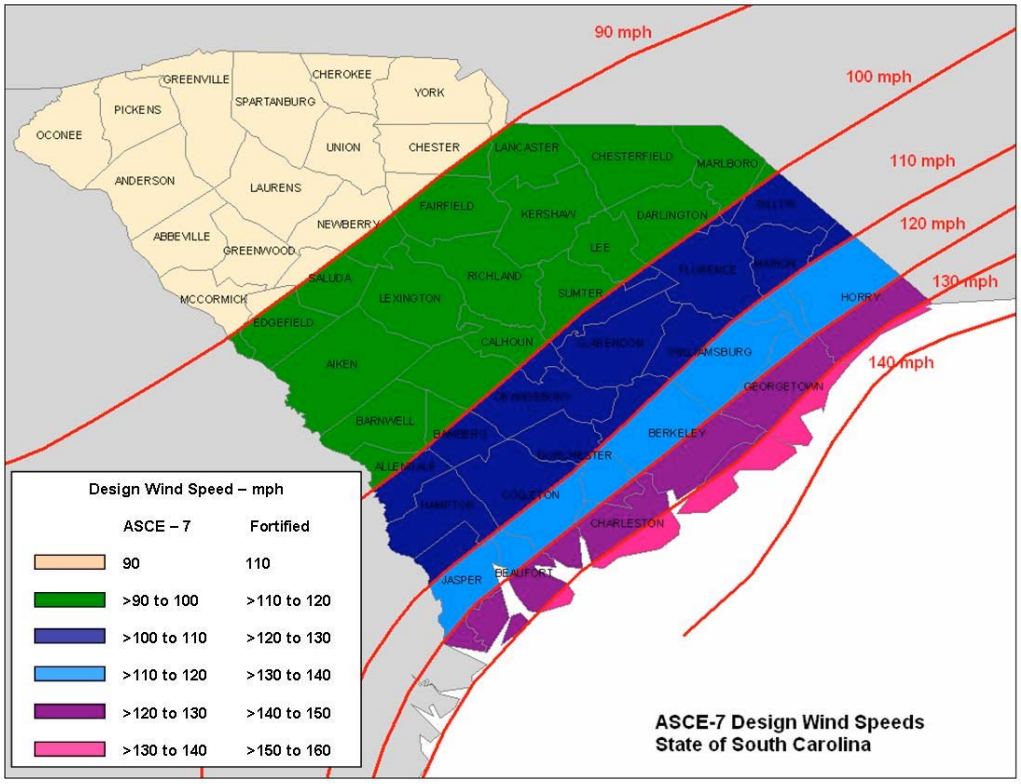
Note: all areas within the dark blue >100-110 MPH zone and higher must comply with the ***Fortified*** hurricane criteria.



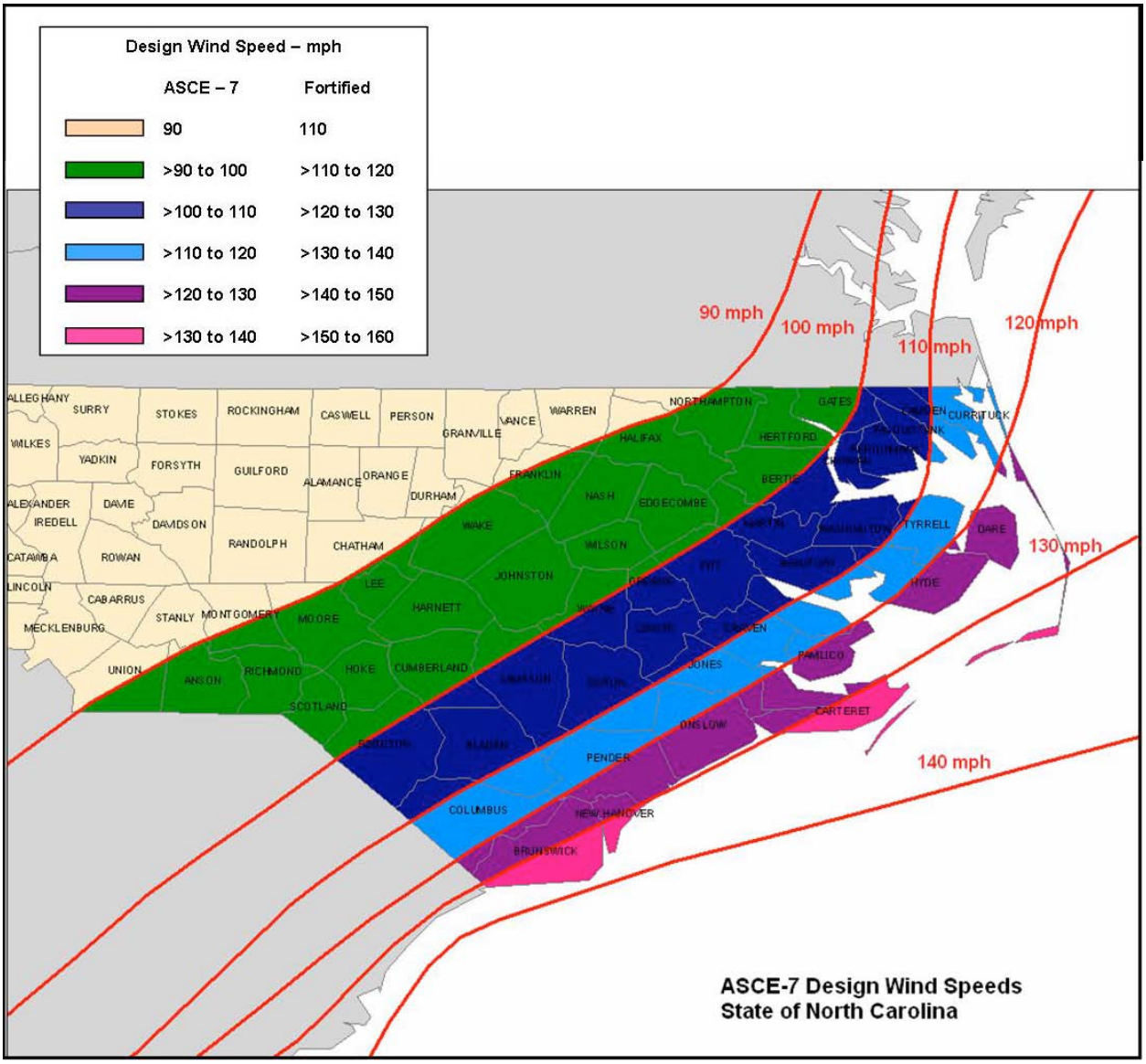
Note: <u>All</u> counties within Florida <u>must</u> comply with ***Fortified*** hurricane criteria, including opening impact protection requirements.



Note: all areas within the dark blue >100-110 MPH zone and higher must comply with the ***Fortified*** hurricane criteria.


90 mph
100 mph
110 mph
120 mph
130 mph
140 mph
GREENVILLE
CHEROKEE
YORK
SPARTANBURG
PICKENS
OCONEE
UNION
CHESTER
LANCASTER
CHESTERFIELD
MARLBORO
ANDERSON
LAURENS
FAIRFIELD
KERSHAW
DARLINGTON
NEWBERRY
ABBEVILLE
GREENWOOD
LEE
SALUDA
RICHLAND
FLORENCE
MCCORMICK
LEXINGTON
SUMTER
HORRY
EDGEFIELD
CALHOUN
WILLIAMSBURG
AIKEN
GEORGETOWN
BARNWELL
BERKELEY
COLLETON
CHARLESTON
JASPER
BEAUFORT
Design Wind Speed – mph
ASCE – 7
Fortified
90
110
>90 to 100
>110 to 120
>100 to 110
>120 to 130
>110 to 120
>130 to 140
>120 to 130
>140 to 150
>130 to 140
>150 to 160
ASCE-7 Design Wind Speeds
State of South Carolina

Note: all areas within the dark blue >100-110 MPH zone and higher must comply with the ***Fortified*** hurricane criteria.



APPENDIX B

Fortified … for safer living*®** (Fortified***) Example Plan Review Checklist

***Fortified* Site Information**			
What is the actual Exposure Category for site?		[ ] B	[ ] C
What is the design wind speed at site from ASCE 7 or from IRC/IBC 2006?		_____ MPH	
What is the ***Fortified*** Program design wind speed at the site?		_____ MPH	
Is the site in one of the special flood hazard zones listed here?	V	[ ] Yes	[ ] No
	Coastal A	[ ] Yes	[ ] No
	A	[ ] Yes	[ ] No
If the answer to any elements in question 4 is yes, then:			
What is the maximum of the Base Flood Elevation (BFE) or FEMA Advisory BFE (ABFE).		_____ ft.	
What is the lowest existing natural grade at the site?		_____ ft.	
What is the ***Fortified*** Design Flood Elevation (FDFE)? - see Builder's Guide.		_____ ft.	
Is the site potentially in a wildfire hazard area as indicated by a yes answer to one of the questions listed below?			
Is there a large undeveloped area within 1 mile of site?		[ ] Yes	[ ] No
Is the site within an undeveloped area?		[ ] Yes	[ ] No
Is the site next to or in a Forest?		[ ] Yes	[ ] No
If the answer to any of questions 5.a through 5.c is Yes, a site specific wildfire risk evaluation of the site is required to determine whether wildfire must be considered in the design (see Builder's Guide for information on how to conduct a site specific evaluation).			
Fortified natural hazards for the site:			
Hurricane		[ ] Yes	[ ] No
High Wind		[ ] Yes	[ ] No
Tornado / Hail		[ ] Yes	[ ] No
Flood		[ ] Yes	[ ] No
Earthquake		[ ] Yes	[ ] No
Severe Winter Weather		[ ] Yes	[ ] No
Wildfire		[ ] Yes	[ ] No

***Fortified* General Review of Plans / Specifications / Notes**		
What is the Design Wind Speed and Exposure used to determine Components and Cladding (C&C) design loads?	_____ MPH	[ ] B ; [ ] C
Are C&C Design Loads consistent with ***Fortified*** Program requirements?	[ ] Yes	[ ] No
What is the Design Wind Speed and Exposure used to determine Main Wind Force Resisting System (MWFRS) design loads	_____ MPH	[ ] B ; [ ] C
Are MWFRS Design Loads consistent with ***Fortified*** Program requirements? (Note: If home is sited in Exposure B and MWFRS is designed for ASCE / IRC design wind speed and Exposure C, it meets the ***Fortified*** Program criteria)	[ ] Yes	[ ] No
If the earthquake hazard was checked:	[ ] N/A	
What is the Seismic Design Category at the site from the IRC-2006?	[ ] Yes	[ ] No
What is the ***Fortified*** Seismic Design Category?	[ ] Yes	[ ] No
Has the building been designed using prescriptive methods allowed in the IRC-2006 (Only allowed if the Seismic Design Category is D1 or D2)?	[ ] Yes	[ ] No
Has the building been designed by an engineer using the prescribed 20% increase in code specified ground motion (required if the ***Fortified*** Seismic Design Category is E)?	[ ] Yes	[ ] No
Wall Construction Type (check all that apply):	[ ] Insulating Concrete Forms [ ] Reinforced masonry [ ] Solid Concrete [ ] Steel Frame [ ] Structural Insulated Panels [ ] Wood Frame	
Roof Slope for Primary Roof	____ on 12	
Number of Stories	_____	
Eave height for roof on highest story	_____ ft.	
Ridge height for roof on highest story	_____ ft.	
Mean Roof Height	_____ ft.	
What is the elevation of lowest habitable space?	_____ ft.	
Is the elevation of the lowest floor or floor structural member higher than the FDFE?	[ ] Yes	[ ] No
Are Design Pressure ratings for windows and doors listed on the drawings or in specifications or notes?	[ ] Yes	[ ] No
Are Design Pressure ratings required for windows and doors compatible with ***Fortified*** Program design pressures listed in Table C-1 for negative pressures and C-2 for positive pressures?	[ ] Yes	[ ] No
Are Design Pressure ratings for garage doors listed on the drawings or in specifications or notes?	[ ] Yes	[ ] No
Are Design Pressure ratings required for garage doors compatible with ***Fortified*** Program design pressures listed in Table C-3?	[ ] Yes	[ ] No
Are shear wall segments clearly identified on the drawings and are details for their construction provided?	[ ] Yes	[ ] No
Is the anchorage for the ends of the shear walls or shear wall segments specified and locations for anchors identified on the drawings?	[ ] Yes	[ ] No

Are the types of roof structure and decking clearly specified for all parts of the house?	[ ] Yes	[ ] No
Are the types of wall structures and finishes clearly specified for each part of the house?	[ ] Yes	[ ] No
Are there detailed plans for the foundation?	[ ] Yes	[ ] No
Have the foundation plans been prepared by an engineer or do they follow one of the acceptable prescriptive methods for the ***Fortified*** Program design wind speed and the appropriate flood / coastal construction requirements?	[ ] Yes	[ ] No
Is the floor system clearly specified for all floors?	[ ] Yes	[ ] No
Is information provided that clearly identifies elements of the continuous load path from the roof to the foundation?	[ ] Yes	[ ] No

If you have checked "No" in answer to any of the above questions, the drawings should be returned to the designer. However, you may want to go through the more detailed checklists that follow to help point out specific deficiencies.

***Fortified* Detailed Checklists for Specific Components and Criteria**		
Roof deck; Fastening schedule; Secondary water protection; Roof covering		
If wood structural panels, is thickness at least 19/32"?	[ ] Yes	[ ] No
If wood structural panels does fastening schedule meet or exceed ***Fortified*** criteria?	[ ] Yes	[ ] No
If roof deck is some other system, does it meet the deflection, anchorage, and impact resistance requirements of the ***Fortified*** criteria?	[ ] Yes	[ ] No
Is a secondary water protection system specified that meets the ***Fortified*** Criteria?	[ ] Yes	[ ] No
If the severe winter weather hazard is checked, is there an ice and water shield membrane specified that extends from the eaves 2-ft. beyond the exterior insulated wall?	[ ] Yes	[ ] No
If the severe winter weather hazard is checked, does a roof surface with a smooth roof cover slope towards an entrance pathway?	[ ] Yes	[ ] No
Do the roof cover and its anchorage meet the requirements listed in the Builder's Guide for the ***Fortified*** design wind speed?	[ ] Yes	[ ] No
If the Tornado / Hail hazard is checked, does the roof cover specified provide UL 2218 or FM 4473 Class 4 impact resistance?	[ ] Yes	[ ] No
If the wildfire hazard is checked, does the roof cover specified have a Class A fire rating if the home is located in a high hazard area or a class B fire rating if located in a moderate hazard area?	[ ] Yes	[ ] No
Roof structure and anchorage to walls		
Engineered Truss Systems:	[ ] Yes	[ ] N/A
Has a truss layout drawing been prepared by truss company or engineer?	[ ] Yes	[ ] No
Are straps, clips, or truss anchors specified for each end of each truss?	[ ] Yes	[ ] No
Do straps, clips, or truss anchors provide sufficient uplift capacity? (See Table C-4 for a rough check)	[ ] Yes	[ ] No
If anchored to a wood or steel frame wall, are straps, clips, or truss anchors to be located on the inside or outside surface of the wall?	[ ] Yes	[ ] No
Is a truss bracing plan provided at the gable ends and/or at any other locations throughout the roofing system?	[ ] Yes	[ ] No
Are the gable end walls and walls below tied together and braced using an acceptable method of anchorage to the ceiling diaphragm?	[ ] Yes	[ ] No
Are anchorage and strapping requirements provided for any interior bearing walls?	[ ] Yes [ ] N/A	[ ] No
When roofs with different ridges frame together, are the terminating members properly anchored?	[ ] Yes	[ ] No
Rafter Systems:	[ ] Yes	[ ] N/A
Are lumber sizes and species or steel sizes and thickness appropriate for the specified spans?	[ ] Yes	[ ] No
For wood rafter systems, are straps that wrap over the top of the rafter specified at each rafter to wall connection?	[ ] Yes	[ ] No

Do the straps have sufficient uplift capacity? (See Table C-4 for a rough check)	[ ] Yes	[ ] No
If anchored to a wood or steel frame wall, are straps to be located on the inside or outside surface of the wall?	[ ] Yes	[ ] No
Are straps specified over the ridge to connect rafters from both planes of the roof?	[ ] Yes	[ ] No
Are collar ties specified at the required frequency?	[ ] Yes	[ ] No
If knee braces are specified, are they supported by walls below and are straps specified for providing uplift resistance in addition to gravity load bracing?	[ ] Yes	[ ] No
If rafters are allowed to be spliced, are appropriate specifications provided for the splices?	[ ] Yes	[ ] No
If braces terminate on a beam or girder, are straps specified to connect the braces to the beam or girder as well as to anchor the beam or girder to the structure below and all the way to the foundations?	[ ] Yes	[ ] No
If coffered ceilings, knee walls or other elements are used that disrupt the plane of the ceiling joists, are strapping and framing specified that will provide appropriate ceiling diaphragm action?	[ ] Yes	[ ] No

Wall System Structural—Wood	[ ] Yes	[ ] N/A
If uplift and shear are to be transmitted primarily through the wall sheathing:	[ ] Yes	[ ] N/A
Does the sheathing extend from the bottom of the sole plate to the top of the top plate with all horizontal joints blocked?	[ ] Yes	[ ] No
Are there sufficient nails in the top and bottom plates to meet the prescriptive requirements for combined uplift and shear?	[ ] Yes	[ ] No
Are 5/8” anchor bolts specified within 12” of the end of each load bearing wall segment and at a spacing of no more than 2-feet along the walls?	[ ] Yes	[ ] No
Are 3” x 3” by ¼” thick washers specified for all anchor bolts?	[ ] Yes	[ ] No
Are truss or rafter straps, clips or anchors required to be on the same side of the wall as the sheathing?	[ ] Yes	[ ] No
If truss or rafter straps, clips or anchors are not required to be on the same side of the wall as the sheathing, are metal straps specified for anchor the top plate to the studs (on the same side of the wall as the roof structure connectors) or are the wall studs and roof structural members aligned and connected with straps that transfer loads directly to the wall studs?	[ ] Yes	[ ] No
Are metal straps specified as appropriate around all openings to anchor the header to the wall studs and these wall studs to the bottom plate?	[ ] Yes	[ ] No
Are there appropriately sized hold-down anchors	[ ] Yes	[ ] No
If uplift is to be transmitted primarily through metal connectors (including threaded rod systems) and shear is to be transmitted through sheathing panels:	[ ] Yes	[ ] N/A
Do the plans specify installation location and appropriate sizes for the metal connectors and straps (including threaded rod systems) that provide a continuous load path for uplift from the roof to the foundation?	[ ] Yes	[ ] No

Are appropriate strapping details specified around every wall opening, connecting the header to studs and studs to bottom plate?	[ ] Yes	[ ] No
Are appropriate hold-downs specified at the ends of shear walls or shear-wall segments to provide the required shear wall anchorage?	[ ] Yes	[ ] No
For multi-story structures are continuous paths provided using multiple hold-downs or threaded rods to pass the upper floor shear wall anchor forces down to the foundation?	[ ] Yes	[ ] No
For slab on grade construction, are anchor bolts, mud sill anchors, or screw type masonry anchor bolts specified within 12” of the end of each load bearing wall segment sole plate and at the appropriate spacing along the wall?	[ ] Yes	[ ] No
For wood floor systems, are sole plates anchored to the foundation wall using appropriate anchors, anchor spacing and washers?	[ ] Yes	[ ] No
For wood floor systems, are walls attached to the rim joists and the rim joists attached to the sill plate with appropriate strapping, nailing of sheathing or clips?	[ ] Yes	[ ] No
If a single hold-down is specified at a corner of the house, is the nailing of the intersecting walls specified properly to transfer the loads from the adjacent wall?	[ ] Yes	[ ] No
If a threaded rod system is specified for a multi-story building, are washers and nuts that adjust for shrinkage specified at each intermediate floor level?	[ ] Yes	[ ] No
Is the sheathing material specified as required in the ***Fortified*** Builders Guide?	[ ] Yes	[ ] No
Wall System Structural—Masonry (Reinforced Block and Solid)	[ ] Yes	[ ] N/A
Do the plans specify horizontal re-bar in the tie/bond beam?	[ ] Yes	[ ] No
Do the plans specify the location and size of vertical re-bar in accordance with the applicable design standard?	[ ] Yes	[ ] No
Wall System Structural—Cold-Formed Steel Framing	[ ] Yes	[ ] N/A
Do the plans meet the requirements of the Standard for Cold-Formed Steel Framing – Prescriptive Method for the ***Fortified*** Design Wind Speed?	[ ] Yes	[ ] No
Is appropriate anchorage (uplift, shear and shear wall anchorage) provided between the walls and the foundation?	[ ] Yes	[ ] No

Wall Systems Structural – SIPS	[ ] Yes	[ ] N/A
Do the plans meet the requirements of the IRC-2006 for SIP construction at the ***Fortified*** Design Wind Speed?	[ ] Yes	[ ] No
Is appropriate anchorage (uplift, shear and shear wall anchorage) provided between the walls and the foundation?	[ ] Yes	[ ] No
Wall System Exterior Finishes		
Are appropriate wind resistant products and manufacturer's recommended high-wind / water intrusion prevention attachment details specified for the wall finish?	[ ] Yes	[ ] No
If in a wildfire hazard region, does the wall have a one-hour fire resistive rating with non-combustible exterior surface?	[ ] Yes	[ ] No
If in a wildfire hazard region, are non-combustible surfaces specified for enclosing the undersides of aboveground decks and balconies?	[ ] Yes	[ ] No
Windows, Doors, Skylights - Debris Impact Protection		
For locations where the ***Fortified*** Design Wind Speed is equal to 120 MPH or greater, are the doors and windows specified to be impact rated or is a rated protective system provided as defined in the Builders Guide?	[ ] Yes	[ ] No
For locations where the ***Fortified*** Design Wind Speed is equal to 120 MPH or greater, are the skylights impact and pressure rated?	[ ] Yes	[ ] No
For locations where the ***Fortified*** Design Wind Speed is equal to 160 MPH or greater, are the garage doors impact rated in addition to being pressure rated?	[ ] Yes	[ ] No
Windows, Doors, Skylights, Chimneys – Wildfire Protection		
If in moderate wildfire hazard region, are windows and skylights double-paned glass?	[ ] Yes	[ ] No
If in a high wildfire hazard region, do specified windows have double-paned glass with a tempered outside lite and non-combustible corrosion resistant screens or are window openings provided with non-combustible shutters?	[ ] Yes	[ ] No
If in a high wildfire hazard region, do specified glass doors and skylights have double paned tempered glass?	[ ] Yes	[ ] No
If in a wildfire hazard region, are spark arrestors specified for all chimneys?	[ ] Yes	[ ] No
Soffits and Fascias		
Are details provided for installation of soffits to assure that the installation meets the manufacturer's recommendations for high-wind installations?	[ ] Yes	[ ] No
If in a wildfire hazard region, are soffits covered with non-combustible materials as defined in the Builder's Guide?	[ ] Yes	[ ] No
If in a wildfire hazard region, are soffits or sub-floor vents less than 144 sq. in. and covered with non-combustible corrosion resistant screening with a mesh size no greater than ¼"?	[ ] Yes	[ ] No
If in a wildfire hazard region, are non-combustible gutters and downspouts specified?	[ ] Yes	[ ] No

Foundations, pier and/or pilings		
If the home is located in a special flood zone (Coastal V, Coastal A or A Zone), are the foundations designed in accordance with ASCE 24-05 and the FEMA Coastal Construction Manual and Guide as appropriate?	[ ] Yes [ ] N/A	[ ] No
If the home is located in a special flood zone, are all electrical / mechanical / utility connections, lines, equipment located above the ***Fortified*** Design Flood Elevation (see Builder's Guide)?	[ ] Yes [ ] N/A	[ ] No
Do the drawings and specifications call out appropriate reinforcing for the foundations, basement walls, or stem walls as appropriate?	[ ] Yes	[ ] No
Are any cast-in-place anchors such as hold-downs, anchor bolts or mud-sill anchors called out and their location and spacing clearly identified?	[ ] Yes	[ ] No
Are any special reinforcing requirements and locations for specific hold-downs called out and specified?	[ ] Yes	[ ] No
Is the foundation type expected to develop the design lateral and uplift capacities with no more than ¼" of deflection in any direction?	[ ] Yes	[ ] No
If in a seismic hazard zone, is the foundation designed for the ***Fortified*** Seismic Design Category or ground motion?	[ ] Yes	[ ] No

Fortified **Water intrusion management**		
For frame construction, are window and door flashing details called out in accordance with AAMA InstallationMasters™ Guide or ASTM E2112-01?	[ ] Yes	[ ] No
For non-frame construction, do the plans specify application of a full bead of caulk around the rough opening before the window is set in place?	[ ] Yes	[ ] No
For non-masonry construction, are the appropriate vapor barriers, water intrusion protection membranes and drainage planes provided that will keep moisture out or at a minimum direct it to the outside of the home?	[ ] Yes	[ ] No
Fortified Water Loss Risks		
Is there a water heater shown in the attic?	[ ] Yes	[ ] No
If a water heater is shown in the attic, is a 4-inch deep drain pan shown with an elevated drain and a float shutoff valve wired to shut off water supply to tank?	[ ] Yes	[ ] No
If a laundry room or utility room is on an upper floor, is a floor drain shown on drawings for the room?	[ ] Yes	[ ] No

APPENDIX C

Fortified … for safer living® (***Fortified***) Tables to Assist in Plan Review Checking (windspeed = 3-sec. gust)

Table C-1: ***Fortified*** Negative Design Pressures for Windows and Doors
For Checking Purposes - Terrain Exposure C

Small Windows at Corners							
Mean Roof Height	**Design Wind Speed**						
(ft)	110	120	130	140	150	160	170
15	*35 psf*	*40 psf*	*50 psf*	*60 psf*	*65 psf*	*75 psf*	*85 psf*
30	*40 psf*	*50 psf*	*60 psf*	*65 psf*	*75 psf*	*85 psf*	*90 psf*
45	*45 psf*	*55 psf*	*65 psf*	*75 psf*	*85 psf*	*90 psf*	*90 psf*
Small Windows in Middle of Wall							
Mean Roof Height	**Design Wind Speed**						
(ft)	110	120	130	140	150	160	170
15	*30 psf*	*35 psf*	*40 psf*	*45 psf*	*55 psf*	*60 psf*	*70 psf*
30	*35 psf*	*40 psf*	*45 psf*	*55 psf*	*60 psf*	*70 psf*	*75 psf*
45	*35 psf*	*45 psf*	*50 psf*	*60 psf*	*70 psf*	*75 psf*	*75 psf*
Large Windows in Middle of Wall							
Mean Roof Height	**Design Wind Speed**						
(ft)	110	120	130	140	150	160	170
15	*30 psf*	*35 psf*	*40 psf*	*45 psf*	*50 psf*	*60 psf*	*65 psf*
30	*35 psf*	*40 psf*	*45 psf*	*50 psf*	*60 psf*	*70 psf*	*70 psf*
45	*35 psf*	*40 psf*	*50 psf*	*55 psf*	*65 psf*	*70 psf*	*70 psf*
Sliding Glass Doors							
Mean Roof Height	**Design Wind Speed**						
(ft)	110	120	130	140	150	160	170
15	*25 psf*	*30 psf*	*35 psf*	*45 psf*	*50 psf*	*55 psf*	*65 psf*
30	*30 psf*	*35 psf*	*40 psf*	*50 psf*	*55 psf*	*65 psf*	*65 psf*
45	*35 psf*	*40 psf*	*45 psf*	*55 psf*	*60 psf*	*65 psf*	*65 psf*

Table C-2: ***Fortified*** Positive Design Pressures for Windows and Doors
For Checking Purposes - Terrain Exposure C

Small Windows at Corners							
Elevation of Center of Window (ft)	**Design Wind Speed**						
	110	120	130	140	150	160	170
15	*26 psf*	*32 psf*	*37 psf*	*43 psf*	*45 psf*	*45 psf*	*50 psf*
30	*31 psf*	*37 psf*	*43 psf*	*50 psf*	*50 psf*	*55 psf*	*60 psf*
45	*34 psf*	*40 psf*	*47 psf*	*54 psf*	*54 psf*	*56 psf*	*62 psf*
Small Windows in Middle of Wall							
Elevation of Center of Window (ft)	**Design Wind Speed**						
	110	120	130	140	150	160	170
15	*26 psf*	*32 psf*	*37 psf*	*43 psf*	*45 psf*	*45 psf*	*50 psf*
30	*31 psf*	*37 psf*	*43 psf*	*50 psf*	*50 psf*	*55 psf*	*60 psf*
45	*34 psf*	*40 psf*	*47 psf*	*54 psf*	*54 psf*	*56 psf*	*62 psf*
Large Windows in Middle of Wall							
Elevation of Center of Window (ft)	**Design Wind Speed**						
	110	120	130	140	150	160	170
15	*25 psf*	*30 psf*	*35 psf*	*41 psf*	*45 psf*	*45 psf*	*47 psf*
30	*29 psf*	*35 psf*	*41 psf*	*47 psf*	*50 psf*	*50 psf*	*54 psf*
45	*32 psf*	*38 psf*	*44 psf*	*52 psf*	*54 psf*	*54 psf*	*59 psf*
Sliding Glass Doors							
Elevation of Center of Door (ft)	**Design Wind Speed**						
	110	120	130	140	150	160	170
15	*24 psf*	*28 psf*	*33 psf*	*38 psf*	*44 psf*	*45 psf*	*45 psf*
30	*27 psf*	*33 psf*	*38 psf*	*44 psf*	*50 psf*	*50 psf*	*51 psf*
45	*30 psf*	*36 psf*	*42 psf*	*49 psf*	*52 psf*	*52 psf*	*56 psf*

Table C-3: ***Fortified*** Reference Negative Design Pressures for Garage Doors
For Checking Purposes – Terrain Exposure C

One Car Garage Doors							
Building Height (ft)	**Fortified Design Wind Speed (mph)**						
	110	120	130	140	150	160	170
15	*25 psf*	*30 psf*	*35 psf*	*45 psf*	*50 psf*	*55 psf*	*65 psf*
30	*30 psf*	*35 psf*	*40 psf*	*50 psf*	*55 psf*	*65 psf*	*75 psf*
45	*30 psf*	*40 psf*	*45 psf*	*55 psf*	*60 psf*	*70 psf*	*80 psf*
Two Car Garage Doors							
Building Height (ft)	**Fortified Design Wind Speed (mph)**						
	110	120	130	140	150	160	170
15	*25 psf*	*30 psf*	*35 psf*	*40 psf*	*45 psf*	*55 psf*	*60 psf*
30	*30 psf*	*35 psf*	*40 psf*	*45 psf*	*55 psf*	*60 psf*	*70 psf*
45	*30 psf*	*40 psf*	*45 psf*	*50 psf*	*60 psf*	*65 psf*	*75 psf*

Table C-4: ***Fortified*** Reference Design Uplift Forces for Roof-to-Wall Connections
For Checking Purposes – Terrain B and 30' Mean Roof Height

Low Slope Roof - 2:12 to 5:12 (less than 25 degrees) 24" Truss/Rafter Spacing; Mean Roof Height = 30'; Exposure = B; 2' Max. Overhang						
Fortified 3-Sec. Gust Wind Speed (mph)	Uplift Forces at Roof-to-Wall Connection (lbs)					
	Building Width (feet)					
	20	24	28	32	36	40
110	398	448	497	546	595	644
120	508	574	639	704	770	835
130	628	711	794	877	960	1042
140	757	859	961	1063	1165	1266
150	895	1018	1140	1262	1385	1507
160	1044	1188	1332	1476	1620	1764
170	1201	1369	1536	1703	1871	2038

Steep Slope Roof - 6:12 on up (greater than 25 degrees) 24" Truss/Rafter Spacing; Mean Roof Height = 30'; Exposure = B; 2' Max. Overhang						
Fortified 3-Sec. Gust Wind Speed (mph)	Uplift Forces at Roof-to-Wall Connection (lbs)					
	Building Width (feet)					
	20	24	28	32	36	40
110	284	322	354	400	438	475
120	373	425	469	530	583	633
130	468	536	595	672	741	806
140	572	656	730	826	911	992
150	683	785	875	991	1094	1192
160	802	923	1030	1167	1289	1406
170	929	1070	1196	1354	1497	1633

Adjustment Factors:

Mean Roof Height (ft)	Exposure B	Exposure C
15	1	1.21
20	1	1.29
25	1	1.35
30	1	1.4
35	1.05	1.45
40	1.09	1.49
45	1.12	1.53

For 16" truss or rafter spacing, multiply by 0.667

Connection loads for connections located a distance of 20% of the least horizontal dimension of the building from the corner of the building are permitted to be reduced by multiplying the table connection value by 0.7.

APPENDIX D

Fortified … for safer living® (***Fortified***) Window Flashing and Installation

Windows and doors are installed according to manufacturers specifications. The ***Fortified*** program has specific requirements for flashing around all windows and doors in wood and steel framed walls that may exceed requirements from manufacturer. Confirm that flashing meets the following specifications. Note that there is no requirement for flashing in masonry walls. The intent of these details is to prevent moisture penetration into the wall cavities as well as the interior spaces. As a builder, you are encouraged to obtain training and certification through the AAMA (American Architectural Manufacturers Association) InstallationMasters™ Residential and Light Commercial Window and Door Installation Program. Call (540) 877-9957 for more information.

The steps presented below are consistent with Method "B" from the AAMA InstallationMasters™ guide for windows with mounting flanges and weather resistant barriers applied after installation of the windows. These recommended steps are presented in a step-by-step format as well as in Figure 5 (next page). Other types of windows or installations methods are acceptable as long as the AAMA InstallationMasters™ guide, or ASTM E 2112-01 – Standard Practice for Installation of Exterior Windows, Doors, and Skylights, recommends them.

The following five sections give instructions for installing windows with mounting flanges:

Step 1: Sill Flashing

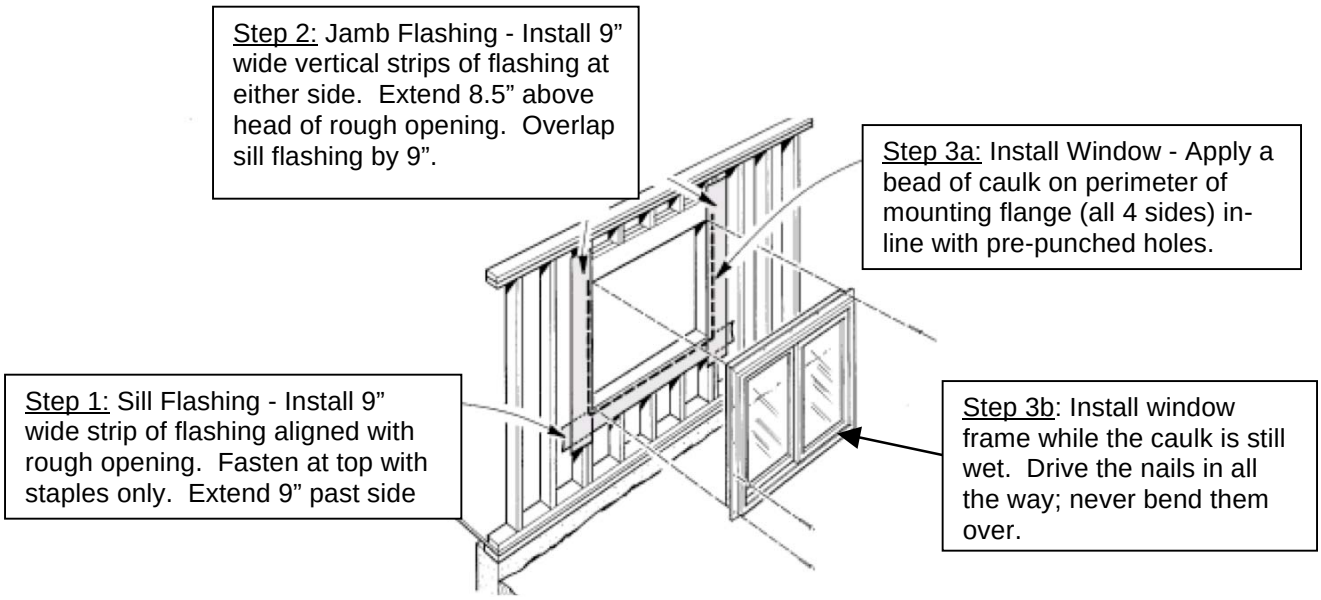
Install a 9” wide flashing flush with the rough opening of the window allowing the flashing material to overlap the sheathing below. Fasten with staples at the top edge and do not remove release paper until weather resistant barrier is installed in Step 5. Extend flashing 9” beyond the rough opening at the side jambs.

Step 2: Jamb Flashing

Install 9” wide flashing on side jambs of windows opening letting material extend above the top opening 8.5” and extending below the sill for a minimum of 9”. Jamb flashing should overlap the sill flashing. Attach entire length except for lowest 9” to allow weather resistant barrier to be installed in Step 5.

Step 3: Install the window

a. Apply a continuous bead of sealant to back of perimeter of mounting flange in line with the pre-punched holes.
b. Install window in wall according to the manufacturers recommended schedule. Cover up any pre-punched holes in nailing flange with sealant.



Step 4: Head Flashing

Apply a bead of sealant to outside of top mounting flange and then install 9" wide flashing overlapping nailing flange. Head flashing must cover top edge of jamb flashing and should extend a minimum of 9" past side jambs of window.

Step 5: Weather Resistant Barrier

Install weather resistant barrier consisting of house wrap or building paper in weather board fashion starting from base of the wall and working upward. The first course of weather resistant barrier should be tucked up under the sill and loose ends of jamb flashing. Attach sill and jamb flashing to barrier. Apply next courses of barrier to overlap the jamb flashing.

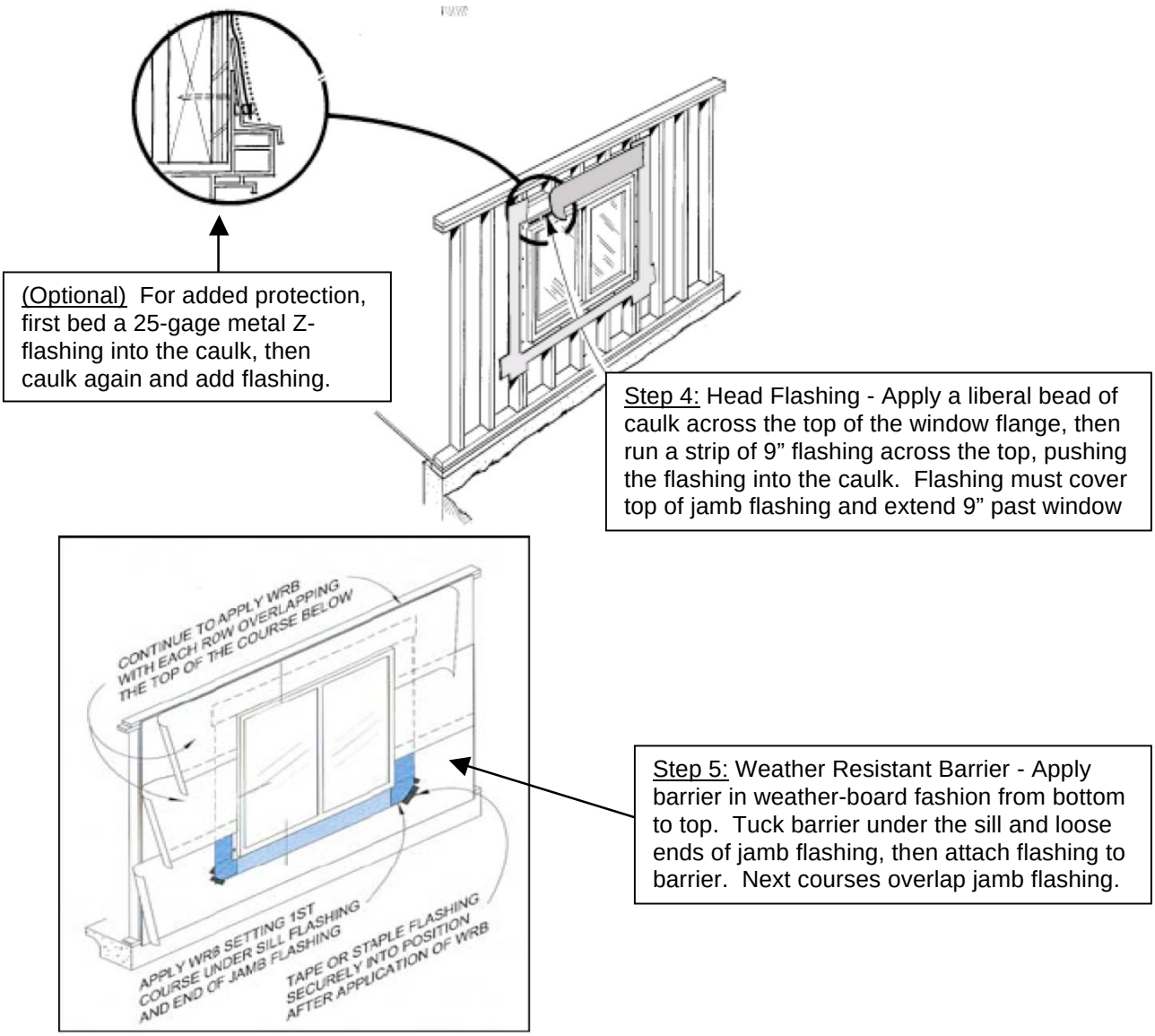


Figure 5: Water Penetration Resistant Window Flashing Details (AAMA).

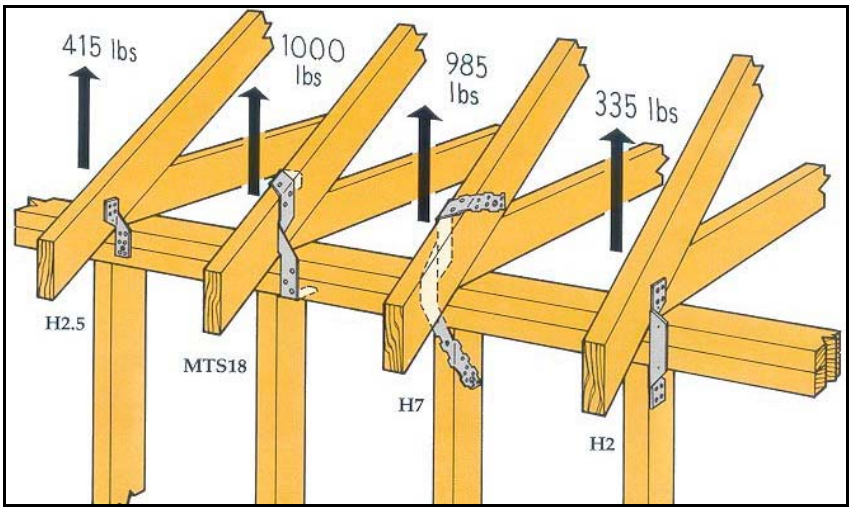
APPENDIX E

Fortified … for safer living® (***Fortified***) Continuous Load Path Requirements.

Roof-wall Connectors

Roof to wall connections must provide the necessary uplift resistance to keep the roof assembly in place during a high wind event such as a hurricane or tornado. The ***Fortified*** program requires straps that wrap over the top of rafters (Figure CLP-1). Straps are optional for truss roofs.

Figure CLP -1: Metal straps, clips, and connectors installed on the outside of the wall.



Note that the non-wrapping clip styles on the left and right are not accepted by the ***Fortified*** program for wood rafter construction. Non-wrapping connectors are accepted for wood truss and steel frame construction because there is no concern for cross-grain splitting (Simpson Strong-Tie, 1991).

While proper installation of these straps is not difficult, there are several key considerations to developing an adequate Continuous Load Path from the roof to foundation:

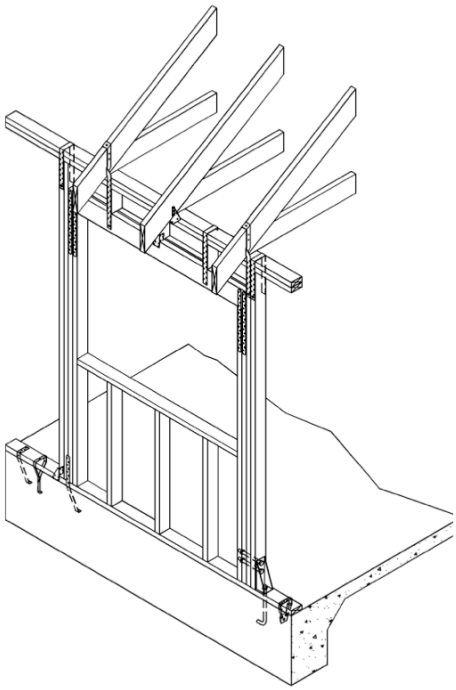
1. Connectors can be installed on the inside of the top plate (Figure CLP-2).

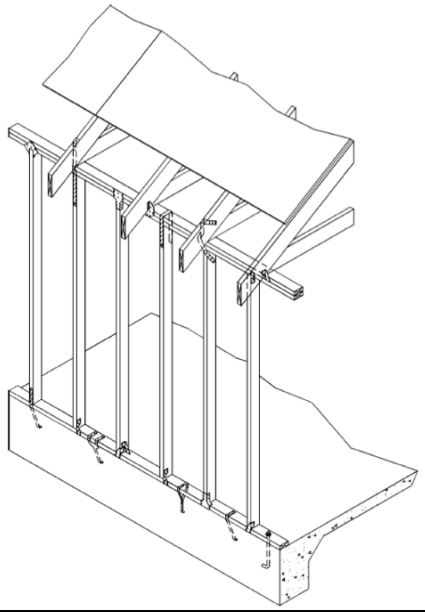
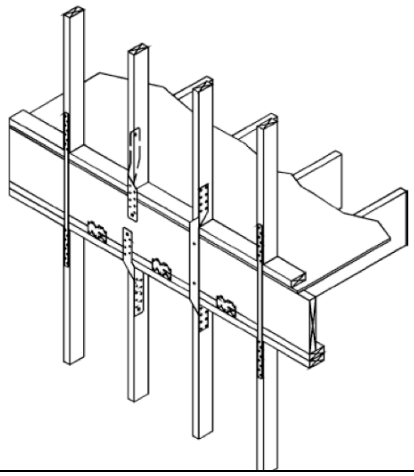
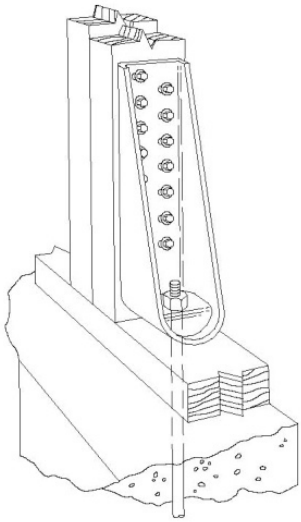
Figure CLP-2: Metal straps, clips, and connectors installed on the inside of the wall.

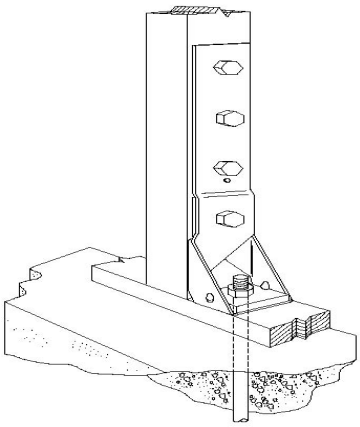
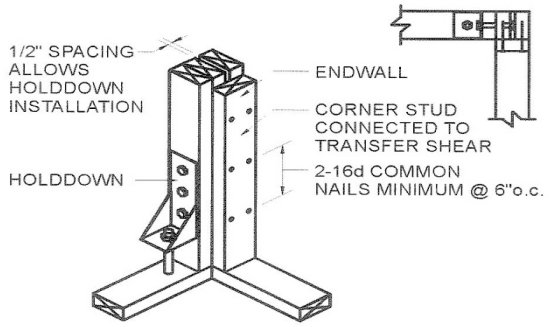
2. Once the uplift load is transferred from the roof structure to the top plate, it must be transferred into the studs for further transfer to the floor below or foundation. This can be accomplished using one of several methods:

a. The use of straps as shows in Figure CLP-2 above. Using this method transfers the load from the top plate into the studs and allows you to complete the load transfer to the structure below in a number of different ways:

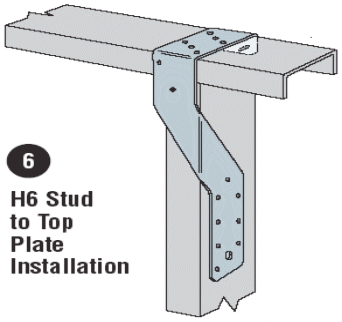
   a) Straps on the inside of the studs to the bottom plate which is bolted to the foundation or floor below.
   b) Straps on the outside of the stud to the bottom plate which is bolted to the foundation or floor below.
   c) Sheathing installed on the outside of the wall to connect the studs to the bottom plate which is bolted to the foundation of floor below.

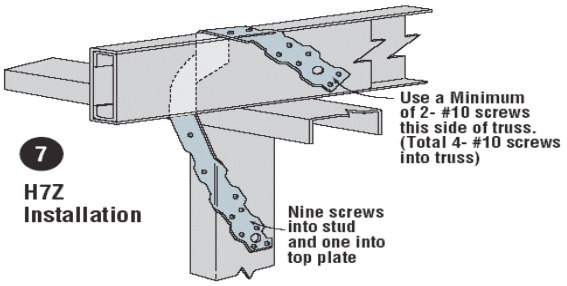
Typical wall connections with stud spacing the same as truss/rafter spacing. Figure 305G-1, IBHS Guide	

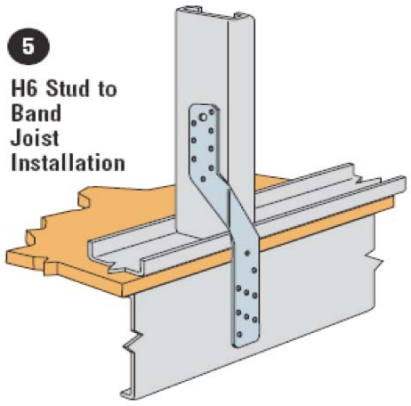
Typical wall connections with stud spacing different from truss/rafter spacing. Figure 305G2, IBHS Guide	
Connection details at second floor level. Figure 305H1, IBHS Guide	
Hold-down connected to footing/foundation	

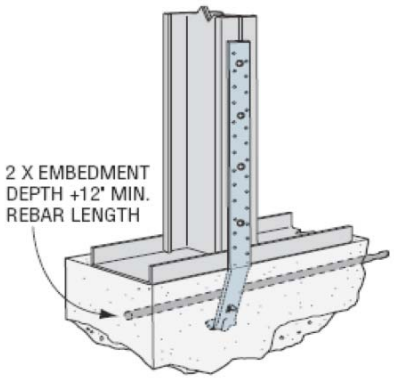
Hold-down connected to footing/foundation	
Hold-down at corner	

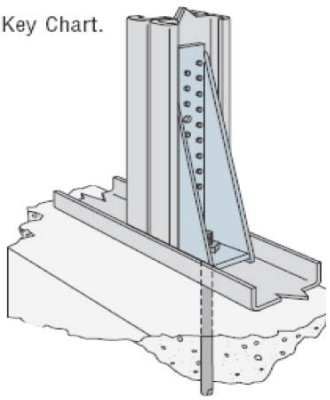
Additional detailing for Cold-Formed Steel Framing:



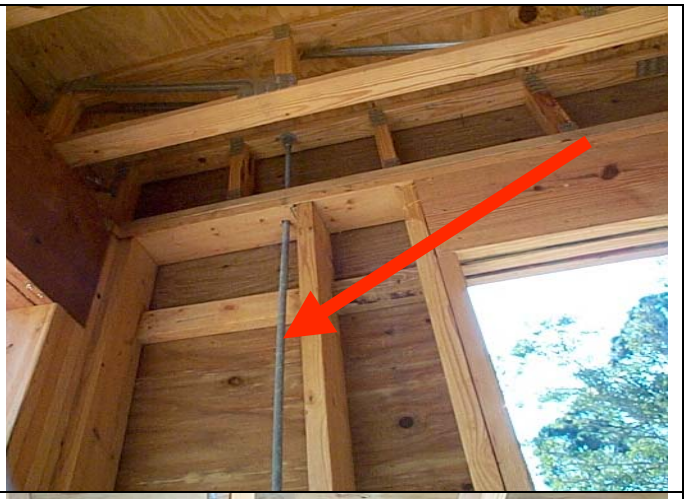


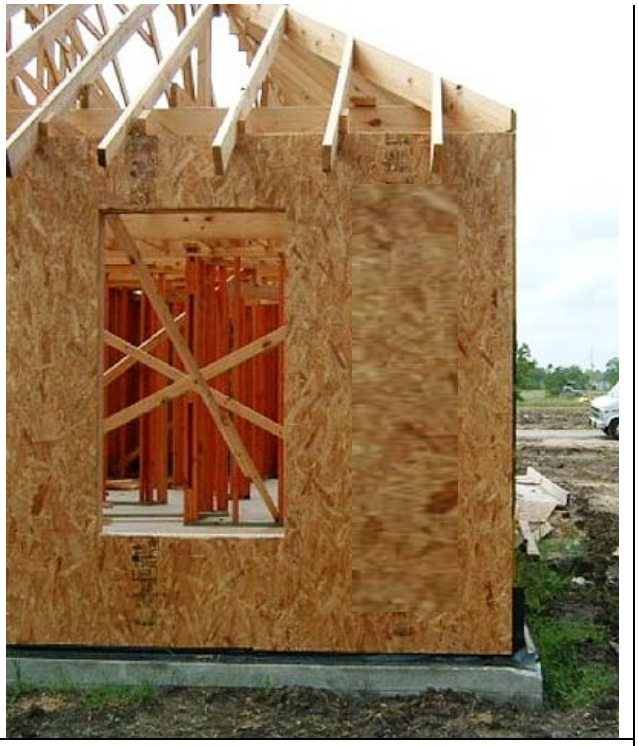

5
H6 Stud to
Band
Joist
Installation

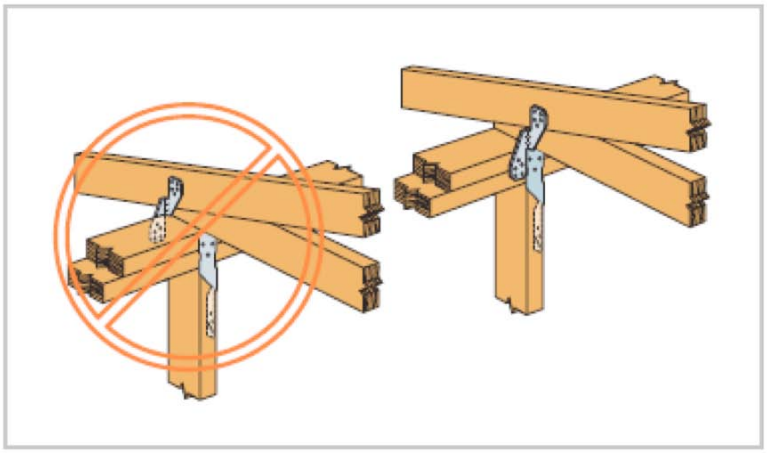

2 X EMBEDMENT
DEPTH +12" MIN.
REBAR LENGTH


Key Chart.

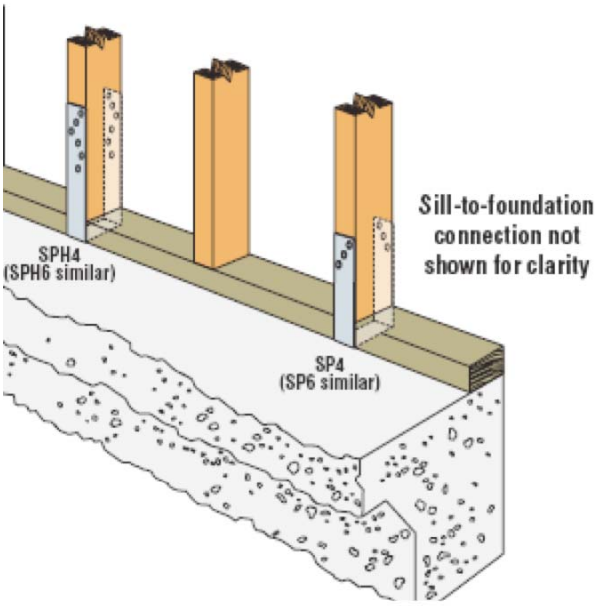
The use of threaded rod or stainless steel cable to connect the top plate to the foundation; this can be used for single or multi-story structures.

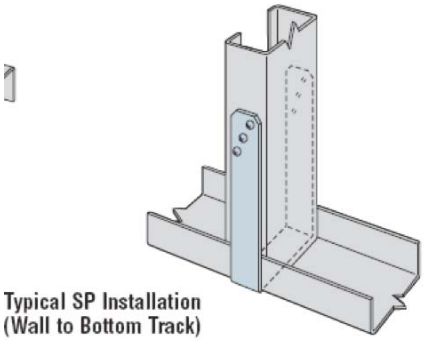
<table>
<tr>
<td>Threaded rod installed from footing though top plate in two story house.
 
  </td>
<td> 
  </td>
</tr>
<tr>
<td>Stainless Steel cable installed for up-lift resistance in single story house.</td>
<td>  </td>
</tr>
</table>

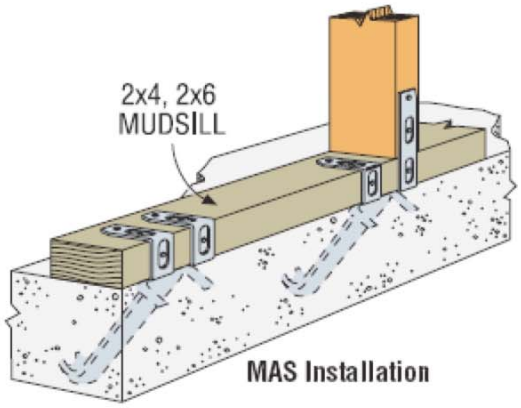
Sheathing used for uplift transfer from top plate to bottom plate. Connectors from roof structure must be used to transfer uplift load to top plate, panels can then transfer the load to the bottom plate which is anchored to the floor/foundation.	

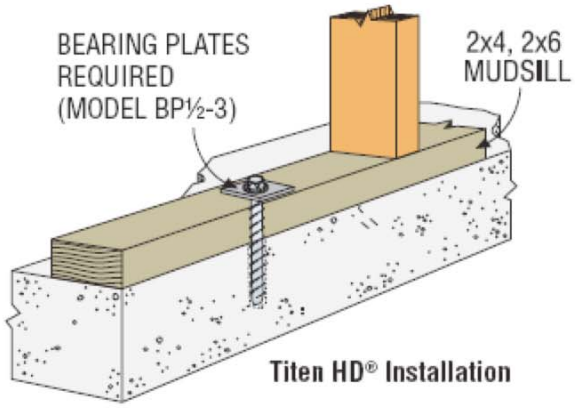


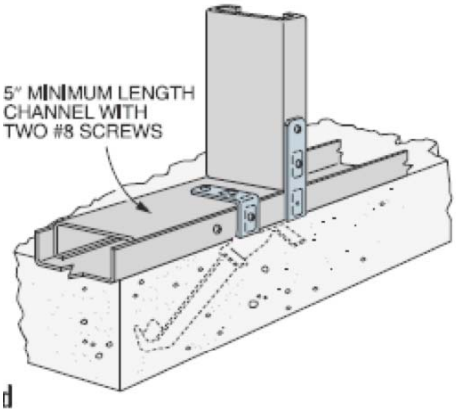
Rafter/Truss-to-top plate connectors and top plate-to-stud connectors shall be installed on same side of wall

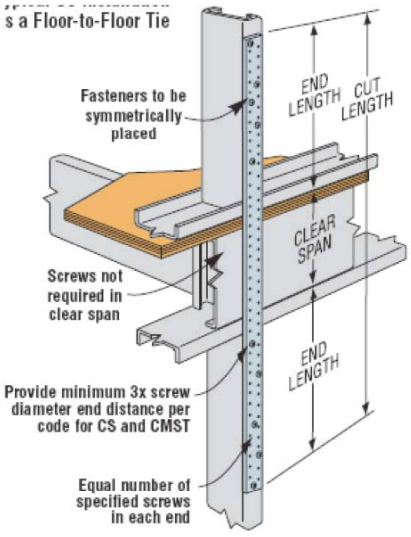

SPH4
(SPH6 similar)
SP4
(SP6 similar)
Sill-to-foundation
connection not
shown for clarity

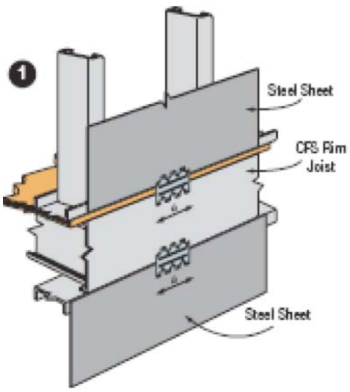

Typical SP Installation
(Wall to Bottom Track)


2x4, 2x6
MUDSILL
MAS Installation


BEARING PLATES
REQUIRED
(MODEL BP½-3)
2x4, 2x6
MUDSILL
Titen HD® Installation


5" MINIMUM LENGTH
CHANNEL WITH
TWO #8 SCREWS

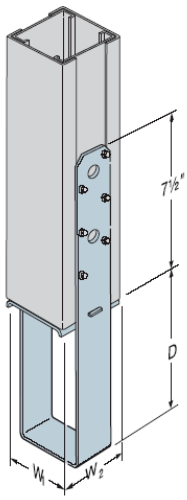

s a Floor-to-Floor Tie
Fasteners to be
symmetrically
placed
END
LENGTH
CUT
LENGTH
CLEAR
SPAN
Screws not
required in
clear span
END
LENGTH
Provide minimum 3x screw
diameter end distance per
code for CS and CMST
Equal number of
specified screws
in each end


1
Steel Sheet
CFS Rim
Joist
Steel Sheet

Attached Structures:

Securely anchor connections for exterior attached structures such as carports and porches that attach to the main structure of the house. Stainless steel or hot dipped galvanized hardware with a minimum rating of G185 shall be used for any connections that will be exposed to weathering in service. Fasteners used with such hardware shall consist of a similar metal to prevent accelerated corrosion. In Coastal A and V flood zones (Section 4), all exposed hardware, and fasteners must be stainless steel.

Strapping of top of porch column to supporting beam.



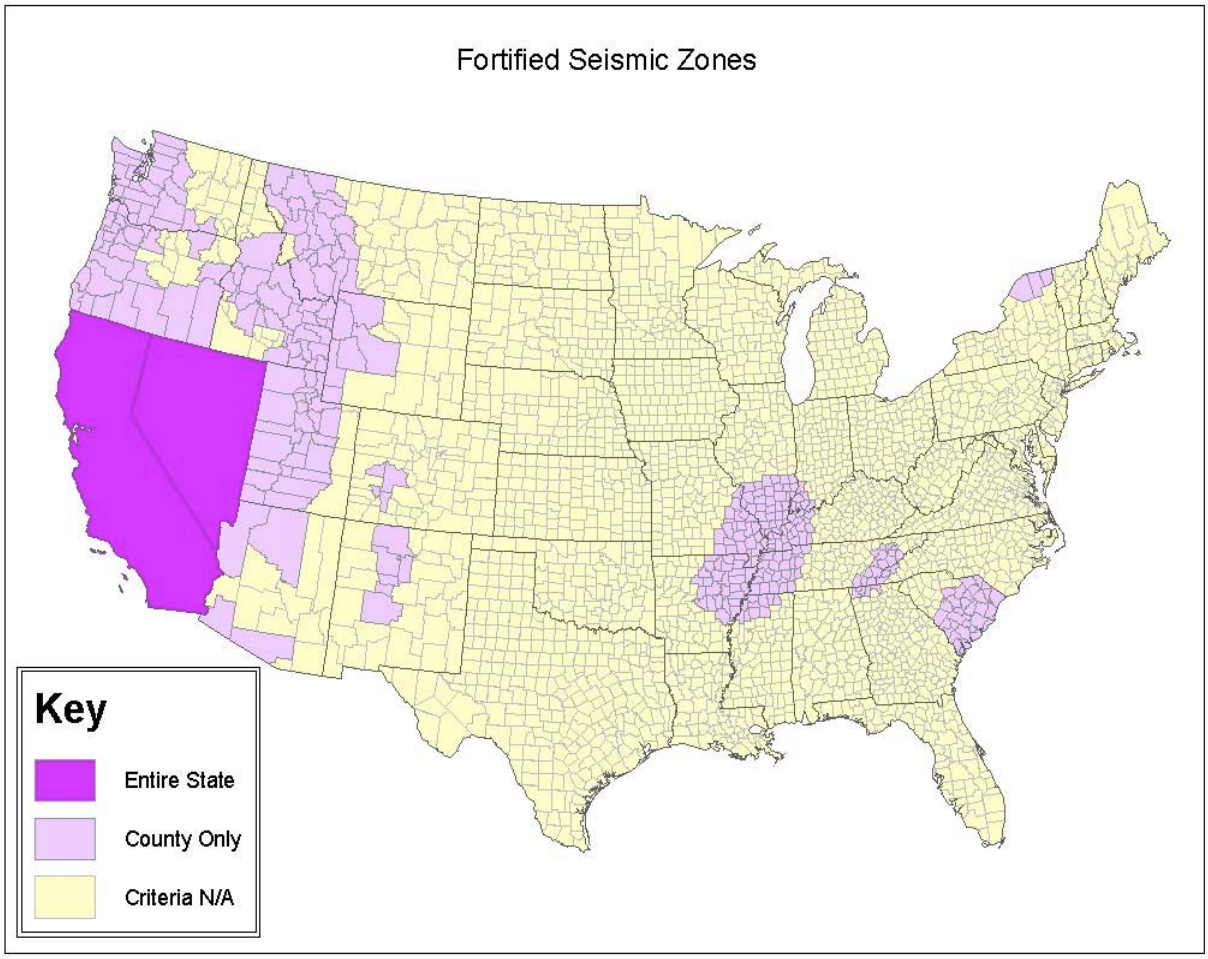
Installation for cold-formed steel built-up column. *Note: The engineer of record is responsible for design of column member.*

Connection of column on porch to foundation with post anchor.

APPENDIX F

Fortified … for safer living® (***Fortified***) Seismic Zones

Figure 1: ***Fortified*** Seismic Zones of the contiguous US (Alaska and Hawaii are also considered seismic zones)



The following four (4) states in their entirety shall meet the seismic requirements of the ***Fortified*** program:

1. **Alaska**
2. **California**
3. **Hawaii**
4. **Nevada**

In addition, the following counties within the states listed below must meet the requirements of the ***Fortified*** program:

Arizona
Coconino
Mohave
Pima
Yuma

Arkansas
Arkansas
Clay
Cleburne
Craighead
Crittenden
Cross
Faulkner
Fulton
Greene
Independence
Izard
Jackson
Lawrence
Lee
Lonoke
Mississippi
Monroe
Phillips
Poinsett
Prairie
Pulaski
Randolph
Sharp
St. Francis
Stone
White
Woodruff

Illinois
Alexander
Bond
Clay
Clinton
Crawford
Edwards
Effingham
Fayette
Franklin
Gallatin
Hamilton
Hardin
Jackson
Jasper
Jefferson
Lawrence
Madison
Marion
Massac
Monroe
Perry
Pope
Richland
Saline
St. Clair
Union
Wabash
Washington
Wayne
White
Randolph
Williamson

Indiana
Gibson
Knox
Pike
Posey
Spencer
Vanderburgh
Warrick

Kentucky
Ballard
Caldwell
Calloway
Carlisle
Christian
Crittenden
Daviess
Fulton
Graves
Henderson
Hickman
Hopkins
Livingston
Lyon
Marshall
McCracken
McLean
Muhlenberg
Todd
Trigg
Union
Webster

Mississippi
Benton
Coahoma
Desoto
Lafayette
Marshall
Panola
Quitman
Tate
Tippah
Tunica

Missouri
Bollinger
Butler
Cape
Girardeau
Carter
Madison
Dunklin
Iron
Jefferson
Madison
Mississippi
New Madrid
Ripley
Scott
Shannon
St. Francois
St. Louis
St.Genevieve
Stoddard
Washington
Wyne

Montana
Beaverhead
Broadwater
Cascade
Deer Lodge
Flathead
Gallatin
Glacier
Granite
Jefferson
Lake
Lewis and Clark
Park
Pondera
Powell
Sanders
Silver Bow
Teton

New Mexico
Bernalillo
Los Alamos
Rio Arriba
Sandoval
Santa Fe
Socorro
Valencia

New York
Clinton
Franklin
St. Madison
Lawrence
Silver Bow

North Carolina
Cherokee
Graham
Swain

Oregon
Baker
Benton
Clackamas
Clatsop
Columbia
Curry
Coos
Deschutes
Douglas
Harney
Hood River
Jackson
Josephine
Klamath
Lake
Lane
Lincoln
Linn
Malheur
Marion
Multnomah
Polk
Tillamook
Umatilla
Wasco
Washington
Yamhill

South Carolina
Aiken
Allendale
Bamberg
Barnwell
Beaufort
Berkeley
Calhoun
Charleston
Chesterfield
Clarendon
Colleton
Darlington
Dillon
Dorchester
Fairfield
Georgetown
Hampton
Horry
Jasper
Florence
Kershaw
Lee
Lexington
Orangeburg
Richland
Sumter
Williamson

Tennessee
Anderson
Benton
Blount
Bradley
Chester
Coclee
Dillon
Dorchester
Carroll
Crockett
Decatur
Dyer
Fayette
Grainger
Gibson
Hamblen
Hamilton
Hardeman
Hardin
Haywood
Henderson
Henry
Houston
Humphreys
Lake
Lauderdale
Jefferson
Knox
Loudon
Monroe
Madison
McNairy
Montgomery
Obion
Polk
Sevier
Perry
Shelby
Stewart
Tipton
Union
Weakley

Utah
Beaver
Box Elder
Cache
Carbon
Davis
Duchesne
Emery
Garfield
Iron
Juab
Kane
Millard
Morgan
Piute
Rich
Salt Lake
Sanpete
Sevier
Summit
Tooele
Utah
Wasatch
Washington
Wayne
Weber

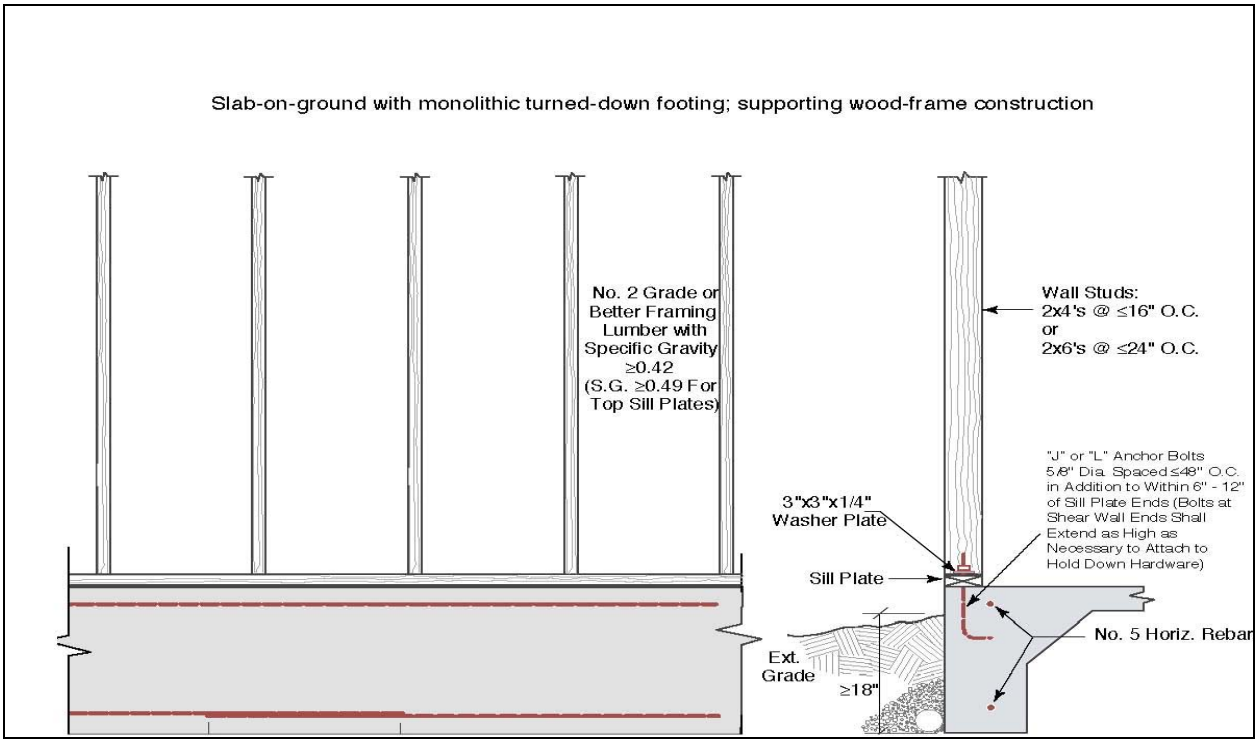
Washington
Benton
Chelan
Clallam
Clark
Cowlitz
Grays - Harbor
Island
Jefferson
King
Kitsap
Kittitas
Klickitat
Lewis
Mason
Pacific
Pierce
San Juan
Skagit
Skamania
Snohomish
Thurston
Wahkiakum
Walla Walla
Whatcom
Yakima

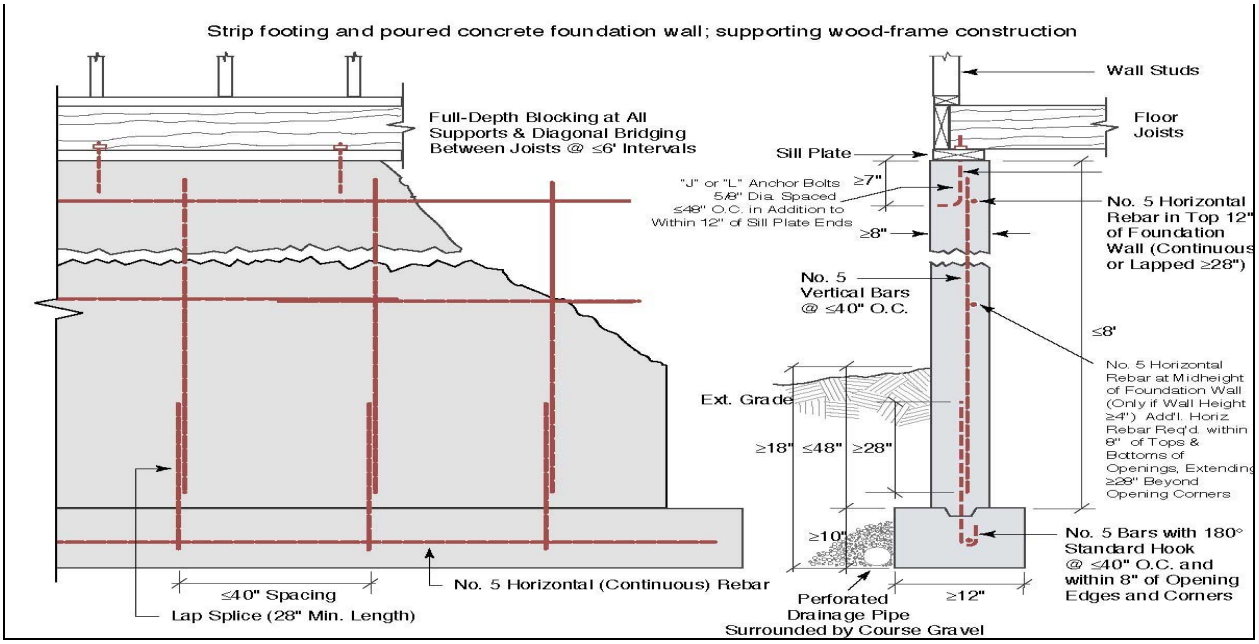
Wyoming
Freemont
Lincoln
Park
Sublette
Teton
Uinta

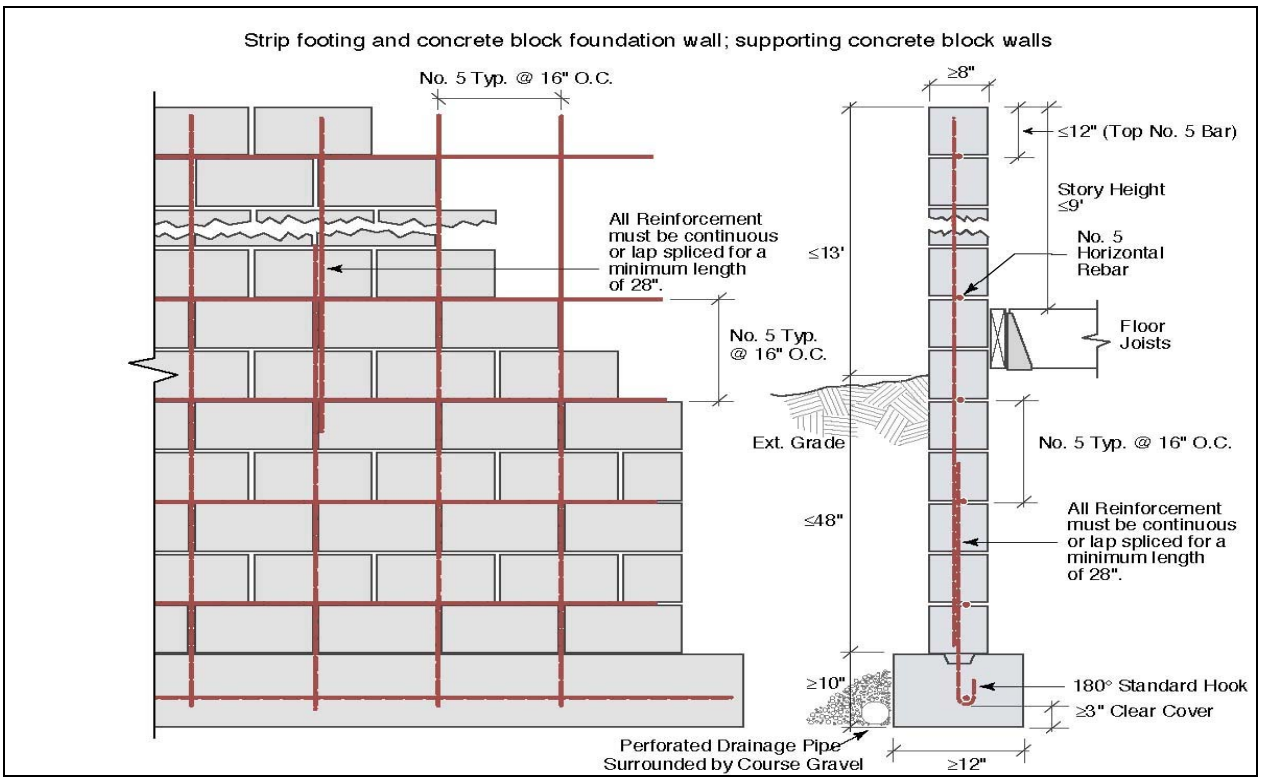
APPENDIX G

Fortified … for safer living® (***Fortified***) Example Foundation Reinforcement for Seismic Zones

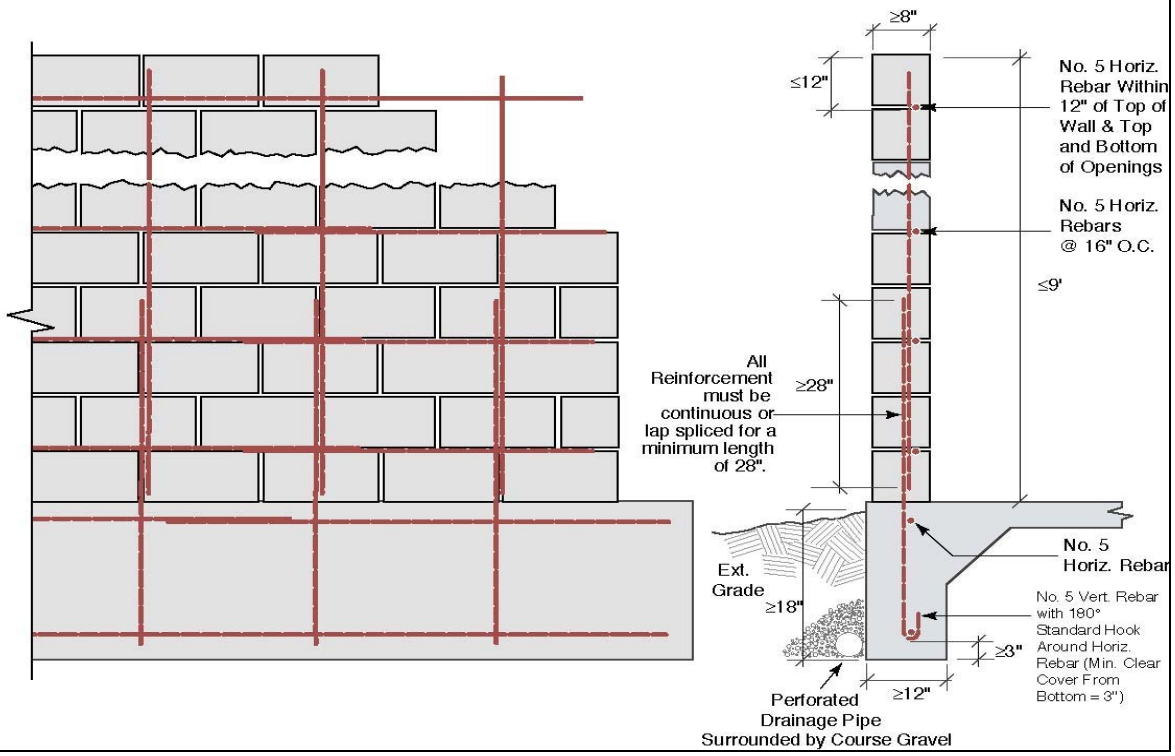
This appendix contains five illustrations, each of a different commonly used foundation system. The drawings and text show minimum reinforcement requirements for foundations of ***Fortified*** structures built in areas defined by the ***Fortified*** program as seismic risk zones. Note: each illustration contains a title that describes what type of system it is. An elevation (left) and a profile (right) are shown for each system.



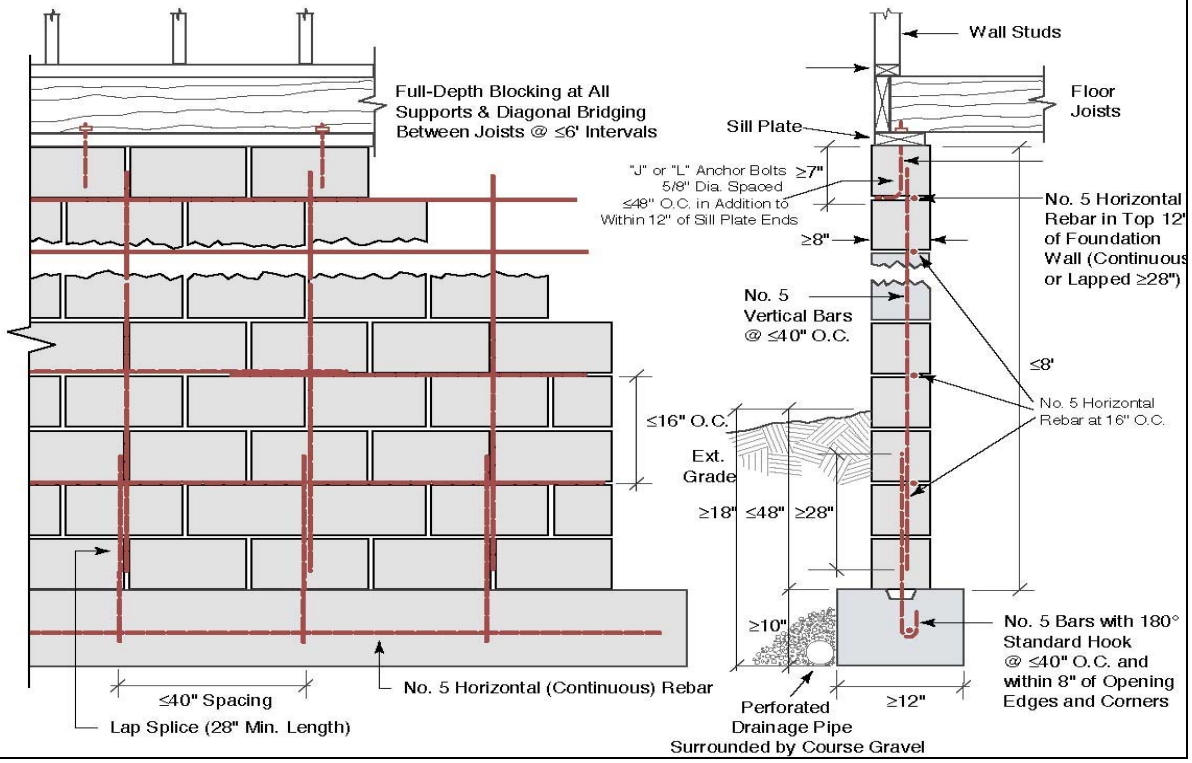

Strip footing and poured concrete foundation wall; supporting wood-frame construction
Full-Depth Blocking at All Supports & Diagonal Bridging Between Joists @ ≤6' Intervals
Wall Studs
Floor Joists
Sill Plate
"J" or "L" Anchor Bolts 5/8" Dia. Spaced ≤48" O.C. in Addition to Within 12" of Sill Plate Ends
≥7"
≥8"
No. 5 Horizontal Rebar in Top 12" of Foundation Wall (Continuous or Lapped ≥28")
No. 5 Vertical Bars @ ≤40" O.C.
≤8'
No. 5 Horizontal Rebar at Midheight of Foundation Wall (Only if Wall Height ≥4') Add'l. Horiz. Rebar Req'd. within 8" of Tops & Bottoms of Openings, Extending ≥28" Beyond Opening Corners
Ext. Grade
≥18"
≤48"
≥28"
≥10"
No. 5 Bars with 180° Standard Hook @ ≤40" O.C. and within 8" of Opening Edges and Corners
≤40" Spacing
Lap Splice (28" Min. Length)
No. 5 Horizontal (Continuous) Rebar
Perforated Drainage Pipe Surrounded by Course Gravel
≥12"


Strip footing and concrete block foundation wall; supporting concrete block walls
No. 5 Typ. @ 16" O.C.
≥8"
≤12" (Top No. 5 Bar)
Story Height ≤9'
All Reinforcement must be continuous or lap spliced for a minimum length of 28".
≤13'
No. 5 Horizontal Rebar
Floor Joists
No. 5 Typ. @ 16" O.C.
Ext. Grade
No. 5 Typ. @ 16" O.C.
≤48"
All Reinforcement must be continuous or lap spliced for a minimum length of 28".
≥10"
180° Standard Hook
≥3" Clear Cover
Perforated Drainage Pipe Surrounded by Course Gravel
≥12"

Slab-on-ground with monolithic turned-down footing; supporting concrete block walls



Strip footing and concrete block foundation wall; supporting wood-frame construction



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