# STANDARD FOR RESIDENTIAL CONSTRUCTION IN HIGH-WIND REGIONS

## ICC 600-2008

American National Standard

INTERNATIONAL CODE COUNCIL®

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## ICC 600-2008

American National Standard

International Code Council
500 New Jersey Avenue, NW, 6th Floor
Washington, DC 20001

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# American National Standard

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# FOREWORD

[The information contained in this foreword is not part of this American National Standard (ANS) and has not been processed in accordance with ANSI's requirements for an ANS. This foreword may contain material that has not been subjected to public review or a consensus process. In addition, it does not contain requirements necessary for conformance to this standard.]

## Introduction

In 2002, upon direction from the International Code Council (ICC) Board of Directors, the ICC Standards Council appointed a consensus committee to write a standard for the design and construction of residential buildings in high wind regions. The scope of the standard is to specify prescriptive methods to provide wind-resistant designs and construction details for residential buildings constructed in high-wind regions.

## Development

This is the first edition of ICC-600, *Standard for Residential Construction in High-Wind Regions*. This standard was developed by the ICC Consensus Committee on Hurricane Resistant Construction (IS-HRC) that operates under ANSI Approved ICC Consensus Procedures for the Development of ICC Standards. The consensus process of ICC for promulgating standards is accredited by ANSI. The IS-HRC Committee is a balanced committee formed and operated in accordance with ICC rules and procedures.

The meetings of the IS-HRC Committee were open to the public and interested individuals and organizations from across the country participated. The technical content of currently published documents on residential construction in high wind regions, including hurricane prone regions, was reviewed and considered by the committee. The information from these documents helped form a basis for the regulations provided in ICC-600, but the exact provisions adopted by the committee were determined based upon the scope and intent of ICC-600. The requirements of ICC-600 are based on the intent to establish provisions consistent with the scope of the ICC family of codes and standards that are written to adequately protect public health, safety and welfare; provisions that do not necessarily increase construction costs; provisions that do not restrict the use of new materials, products or methods of construction; and provisions that do not give preferential treatment to particular types or classes of materials, products or methods of construction.

## Adoption

ICC-600, *Standard for Residential Construction in High-Wind Regions,* is available for adoption and use by any jurisdiction. Its use within a governmental jurisdiction is intended to be accomplished through adoption by reference in accordance with proceedings establishing the jurisdiction's laws. At the time of adoption, jurisdictions should insert the appropriate information in provisions requiring specific local information, such as the name of the jurisdiction.

## Formal Interpretations

Requests for Formal Interpretations on the provisions of ICC 600-2008 should be addressed to: ICC, Chicago District Office, 4051 West Flossmoor Road, Country Club Hills, IL 60478.

## Maintenance – Submittal of Proposals

All ICC standards are revised as required by ANSI. Proposals for revising this edition are welcome. Please visit the ICC website at www.iccsafe.org for the official "Call for Proposals" announcement. A proposal form and instructions can also be downloaded from www.iccsafe.org.

ICC, its members and those participating in the development of ICC 600-2008 do not accept any liability resulting from compliance or noncompliance with the provisions of ICC 600-2008. ICC does not have the power or authority to police or enforce compliance with the contents of this standard. Only the governmental body that enacts this standard into law has such authority.

## International Code Council Consensus Committee on Hurricane Resistant Construction (IS-HRC)

Consensus Committee Scope: The Consensus Committee (CC) on Hurricane Resistant Construction (IS-HRC) shall have primary responsibility for minimum requirements to safeguard the public health, safety and general welfare through requirements for buildings and other structures sited in high-wind regions.

This standard was processed and approved for submittal to ANSI by the ICC Consensus Committee on Hurricane Resistant Construction (IS-HRC). Committee approval of the standard does not necessarily imply that all committee members voted for its approval.

Representatives on the Consensus Committee are classified in one of three voting interest categories. The committee has been formed to achieve consensus as required by ANSI Essential Requirements. At the time it approved this standard, the IS-HRC Consensus Committee consisted of the following members:

General Interest (G) - User Interest (U) - Producer Interest (P)

**Charles Anderson** (P), Simonton Windows, Pennsboro, WV

**Shelia W. Blake, CBO,** MBA (G), City of Houston, Houston, TX

**Charles B. Clark**, Jr. (Alternate P), National Concrete Masonry Association, Reston, VA

**Kelly Cobeen** (U), Self, Lafayette, CA

**Ralph Dorio** (U), Insurance Services Office, Jersey City, NJ

**Bradford K. Douglas**, P.E. (P), American Forest & Paper Association, Washington, DC

**Nader Elhajj** (P), National Association of Home Builders, Upper Marlboro, MD

**Charles Everly** (P), PGT Industries, Sarasota, FL

**Fayez Y. Fanik,** P.E. (G), State of New Jersey, West Windsor, NJ

**Jeffrey K. Feid** (Alternate U), State Farm Insurance, Bloomington, IL

**Dennis W. Graber** (P), National Concrete Masonry Association, Herndon, VA

**Dale T. Greiner** (G), Lake County, Tavares, FL

**Eric Haefli** (U), State Farm Insurance, Bloomington, IL

**Brad R. Harrison** (Alternate U), Structural Engineers Association of Alabama, Birmingham, AL

**Marcelino Iglesias** (G), State of New Jersey, Trenton, NJ

**Medard Kopczynski,** Chair (G), City of Keene, Keene, NH

**Said Larbi-Cherif** (G), City of El Paso, El Paso, TX

**Jay Larson** (Alternate P), American Iron & Steel Institute, Bethlehem, PA

**Mo Madani** (G), Florida Department of Community Affairs, Tallahassee, FL

**Joseph J. Messersmith, Jr.** (Alternate P), Portland Cement Association, Rockville, VA

**James A. Rossberg** (P), Self, Reston, VA

**James A. Russell** (U), Structural Engineers Association of Alabama, Mobile, AL

**John A. Scott, P.E.** (U), Outside of the Box Engineering Solutions, Los Angeles, CA

**Stephen V. Skalko, P.E.** Vice-Chair (P), Portland Cement Association, Macon, GA

**T. Eric Stafford, P.E.** (U), Institute for Business and Home Safety, Birmingham, AL

**Jeffrey B. Stone, Ph.D., C.B.O.** (Alternate P), American Forest & Paper Association, St. Pete Beach, FL

**Raymond W. Stone, P.E.** (U), South Texas Engineers, Corpus Christi, TX

**Edgar Sutton, P.E.** (Alternate P), National Association of Home Builders, Washington, DC

**Peter J. Vickery** (U), Self, Raleigh, NC

**Gary W. Walker, P.E.** (P), Tile Roofing Institute, Birmingham, AL

**George J. Wiggins** (G), City of Winter Park, Winter Park, FL

**Robert J. Willis (P),** American Iron & Steel Institute, Birmingham, AL

**Frank Zuloaga, RRC** (G), Miami-Dade County, Miami, FL

Committee Secretary, **Larry Franks, P.E., C.B.O.,** Senior Staff Engineer, Codes and Standards, International Code Council, Birmingham, AL

**Voting Membership in Each Category**

| Category | Number |
|---|---|
| General (G) | 9 |
| User (U) | 8 |
| Producer (P) | 9 |
| **TOTAL** | 26 |

### Interest Categories

**General Interest:** Individuals assigned to the General Interest category are those who represent the interests of an entity, including an association of such entities, representing the general public, or entities that promulgate or enforce the provisions within the committee scope. These entities include consumers and government regulatory agencies.

**User Interest:** Individuals assigned to the User Interest category are those who represent the interests of an entity, including an association of such entities, which is subject to the provisions or voluntarily uses provisions within the committee scope. These entities include academia, applied research laboratory, building owner, design professional, government nonregulatory agency, insurance company, private inspection agency and product certification/evaluation agency.

**Producer Interest:** Individuals assigned to the Producer Interest category are those who represent the interests of an entity, including an association of such entities, which produces, installs or maintains a product, assembly or system subject to the provisions within the committee scope. These entities include builder, contractor, distributor, labor, manufacturer, material association, standards promulgator, testing laboratory and utility.

**NOTE — Multiple Interests:** Individuals representing entities in more than one of the above interest categories, one of which is a Producer Interest, are assigned to Producer Interest. Individuals representing entities in the General Interest and User Interest categories are assigned to the User Interest.

# PREFACE

Most regions in the United States face windstorm threats. Hurricanes strike the Gulf and Atlantic coastal states one or more times per year, with a single storm capable of causing billions of dollars in damage. The 2005 Atlantic hurricane season produced a record-breaking 27 named tropical storms including a record 15 hurricanes. Of these, a record four reached Category 5 strength, the highest categorization for hurricanes on the Saffir-Simpon Hurricane Scale. Five of the fifteen were major landfall hurricanes causing damages in Cuba, Mexico and the US States of Florida, Alabama, Mississippi, Louisiana and Texas. Currently, the average wind damage to constructed facilities exceeds $3 billion yearly and is rising with accelerated coastal development and the migration of people to the hurricane prone coastlines. In 2004 and 2005 wind related damage exceeded $20 billion each year. Much of this damage can be attributed to the inadequate resistance of nonengineered buildings to high winds.

In 1983, two of the world's prominent wind researchers, G. R. Walker (Australia) and K.J. Eaton (United Kingdom) expressed their frustration concerning the inadequate performance of residential construction on a global scale:

> "Basically, society has considered that housing does not warrant engineering analysis and design."

If property damage is to be mitigated in the high wind regions of this country, increased engineering attention must be given to residential construction. During the 1990s and first half of the 2000s, material associations including wood, masonry and steel, together with academics, product producers, engineers and code officials, were engaged in developing guidelines and standards that applied engineering knowledge and analysis to housing.

The International Code Council legacy standard SSTD 10-99 and its predecessors were the first US standards for high wind construction of residential structures. The ICC SSTD 10 document was based on the *Standard Building Code* wind loads and used fastest-mile wind speeds. The SSTD 10 standard was well received by builders and building officials in many parts of the country.

In 2001, both wood and steel associations published construction manuals and standards, respectively, that deal with high wind design with their materials. These are based on the ASCE 7 Wind Loads that are now the basis for defining wind loads in the *International Building Code* (IBC) and *International Residential Code* (IRC).

This standard provides a set of specifications that is consistent with the *International Building Code* and ASCE 7 wind loads, wind speed maps and conventions. See Appendix A for design load assumptions.

The primary focus of the update effort has been to provide a contemporary set of prescriptive requirements that supplement the *International Residential Code* provisions. The prescriptive requirements contained herein are based on the latest engineering knowledge and are intended to provide minimum requirements to improve structural integrity and improve building envelope performance within the limitations in building geometry, materials and wind climate specified.

Currently recognized within the IBC and IRC family of codes, the AF&PA Wood Frame Construction Manual (WFCM) and the AISI Standard for Cold-Formed Steel Framing – Prescriptive Method for One- and Two-Family Dwellings (ANSI/AISI S230) are consensus documents that provide design guidance for wood frame and cold-formed steel-framed buildings, respectively. These documents are adopted by reference in Chapter 3 for design of light-framed construction of wood or cold-formed steel.

The committee responsible for developing this standard recognized that a large number of alternatives are available to a designer or builder for providing wind resistance. The provisions given are not intended to prevent the use of alternate materials or methods permitted by Section 104.11of the 2006 *International Building Code* and *International Residential Code*. Neither the ICC nor any of the reviewers make any representation or warranty of any kind, whether expressed or implied, concerning the accuracy, completeness and utility of any information provided in this publication and assumes no liability for use of the information. This information should not be used without obtaining competent advice concerning its suitability for the application under consideration. Anyone using this information assumes all liability arising from its use.

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# CHAPTER 1
# GENERAL REQUIREMENTS

## SECTION 101
## GENERAL

**101.1 Scope.** The prescriptive methods presented in this standard provide wind resistant designs and construction details for residential buildings of concrete, masonry, wood-framed and cold-formed steel-framed construction sited in high-wind regions.

**101.2 Limitations.**

**101.2.1** The provisions of this standard are directed toward ensuring structural integrity for resisting wind loads. For design and construction requirements outside the scope of this standard, applicable requirements of the *International Residential Code®* or the *International Building Code®* shall prevail.

**101.2.2** Provisions contained in this standard are based on an enclosed building.

**101.2.3** Buildings outside the range of design parameters, design load criteria, and materials and methods of construction set forth in this standard are beyond the scope of this standard.

**101.3 Intergrity of building envelope.** Individual elements of a building not in strict compliance with or addressed by this standard may be engineered without requiring engineering for the entire building. Elements which maintain the structural integrity of the building envelope shall comply with Chapter 6. Windows and doors that are not addressed in Chapter 6 shall be designed and installed to comply with the components and cladding loads of Section 1609 of the *International Building Code*.

**101.4 Alternate materials and methods.** A large number of alternatives are available to a designer for providing wind resistance. The provisions given are not intended to prevent the use of such alternate materials or methods permitted by Section 104.11 of the *International Building Code*.

**101.5 Items not addressed.** Elements and assemblies not specifically addressed by this standard shall be designed and constructed in accordance with the *International Building Code* or *International Residential Code*.

**101.6 Inspections.**

**101.6.1 High wind inspections.** For construction in high wind regions as established by Figure 104, inspection of framing and masonry construction shall be made after the roof, masonry, all framing, sheathing fasteners, clips, straps and bracing are in place, but prior to placement of insulation, moisture barrier, roof covering or wall covering material.

## SECTION 102
## DESIGN PARAMETERS

**102.1 Generic building geometry.** The provisions of this standard apply to enclosed wood or steel framed, concrete, masonry and insulated concrete form (ICF) walled residential buildings formed by rectangular shaped elements in plan view and having the geometry shown in Table 102.

**102.1.1 Enclosed exterior walls.** The requirements are based on all exterior walls having solid elements (walls, windows and doors) for the full perimeter of the building. Open porches not exceeding 20 feet (6096 mm) in width and constructed in accordance with Sections 208 and 308 shall be permitted.

**102.1.2 Nonrectangular buildings.** Nonrectangular shaped buildings in plan view shall be permitted in accordance with the provisions of Section 105.

**102.2 Foundations.**

**102.2.1** The requirements of this standard apply to buildings supported on the types of foundations shown in Figures 102(1), 102(2) and 102(3):

1. Monolithic slab-on-grade,
2. Foundation walls supported on cast-in-place concrete footings, and
3. Piles.

**102.2.2** Stemwall foundation height shall not exceed 3 feet-0 inches (914 mm) from finished grade to top of concrete or masonry.

**Exception:** For slab-on-grade floors, foundation wall height may exceed 3 feet-0 inches (914 mm), provided:

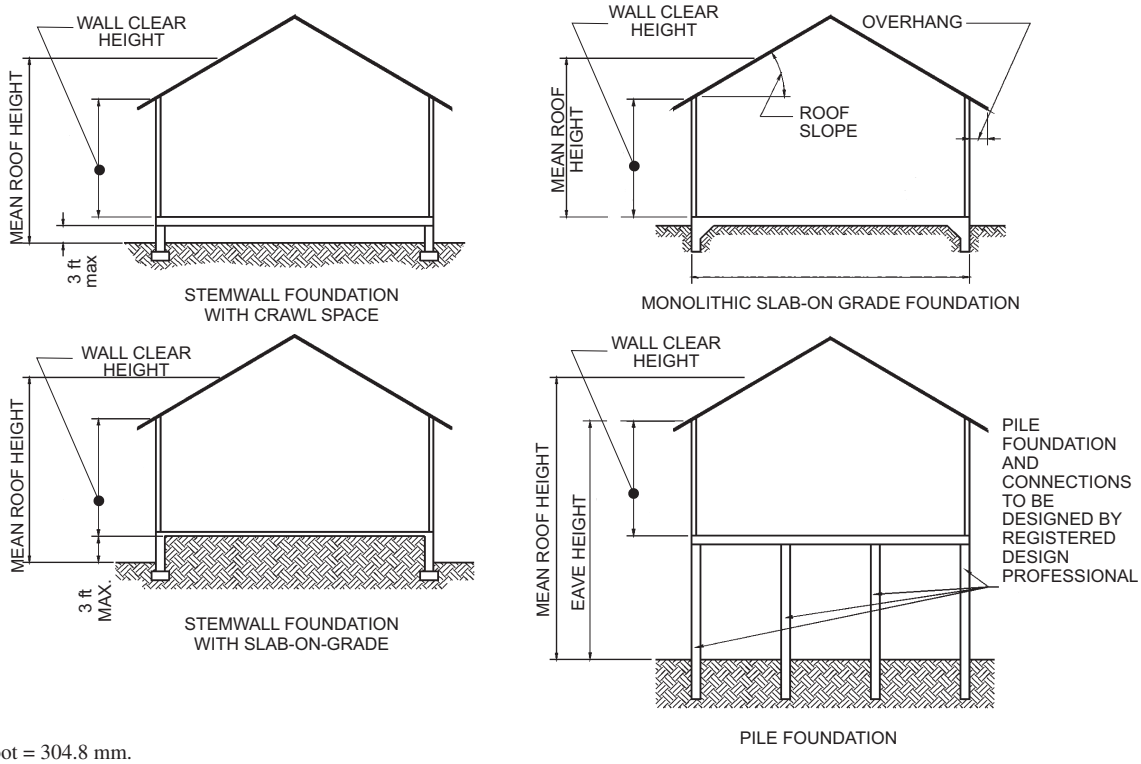
1. The foundation wall or walls do not exceed 8 feet-0 inches (2438 mm) in height (see Section 102.2.2 and *International Residential Code*, Section R404); and
2. A bond beam complying with Section 205.2 is provided; and
3. The foundation wall or walls comply with Section R404 of the *International Residential Code*; and
4. Vertical reinforcement terminates in the bond beam in accordance with Section 205.7.2 of this standard; and
5. The top of the wall is keyed to the slab by:
   a. Providing 6 × 6 W1.4 × W1.4 welded wire fabric extending 10 feet-0 inches (3048 mm) into the slab and 6 inches (152 mm) into the bond beam; or,
   b. Providing No. 3 minimum reinforcing steel at 4 feet-0 inches (1219 mm) o.c. hooked into the bond beam, and extending 10 feet-0 (3048 mm) inches into the slab.

**102.3** In flood hazard areas, flood-resistant construction shall be in accordance with the *International Residential Code*. Appendix B of this standard and FEMA 550, Recommended Residential Construction for the Gulf Coast, provide guidance for flood-resistant foundations and prescriptive designs for flood- and wind-resistant foundations for buildings with wood or light steel-framed exterior walls.

**TABLE 102**
**BUILDING GEOMETRY LIMITATIONS**

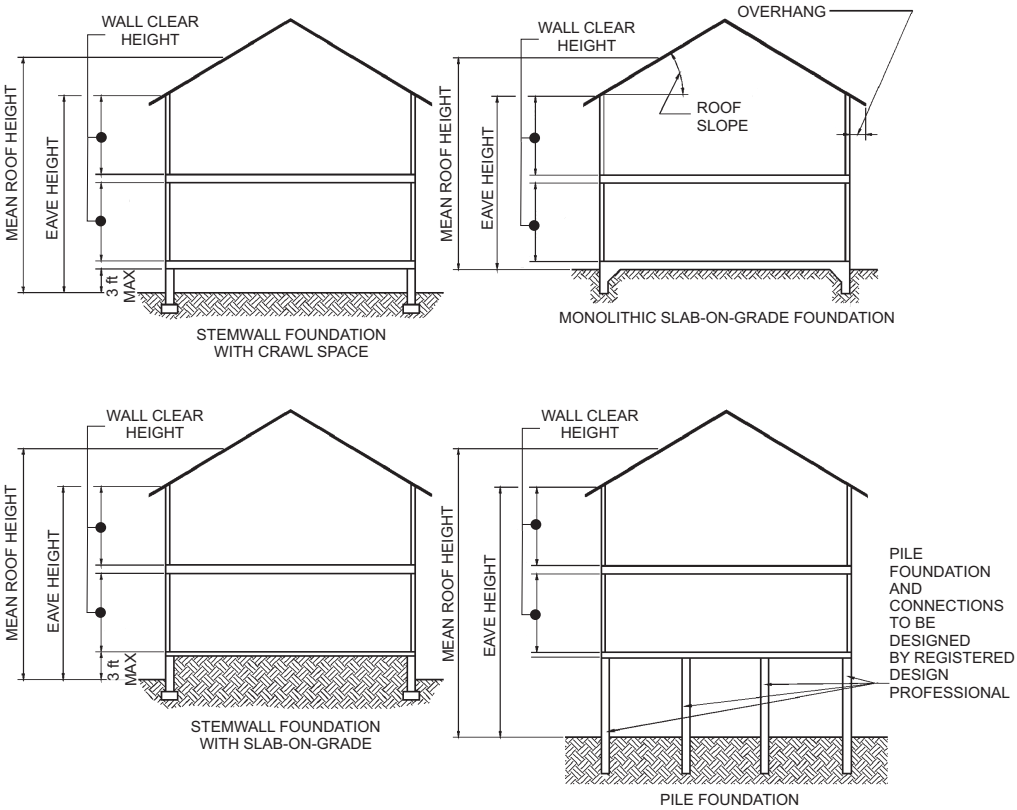
| WALL CONSTRUCTION | MASONRY | CONCRETE | WOOD LIGHT-FRAME[a] | STEEL LIGHT-FRAME[b] |
|---|---|---|---|---|
| Maximum number of stories | 3 | 2 | 3 | 3 |
| Enclosure classification | Enclosed except as provided for open insets by Section 208 | Enclosed except as provided for open insets by Section 308 | Enclosed except as provided for open insets by Section 308 | Enclosed except as provided for open insets by Section 308 |
| Building endwall width (parallel to roof framing direction)[3] | 12 ft to 40 ft 1 story<br>18 ft to 40 ft 2 and 3 story | 40 ft maximum | 80 ft maximum | 40 ft maximum |
| Minimum building sidewall length (perpendicular to roof framing direction)[c] | 0.5 times building width perpendicular | 0.5 times building width perpendicular | 12 ft | AISI S230 Section E13.2 |
| Maximum building sidewall length (perpendicular to roof framing direction)[c] | 2 times building width perpendicular | 2 times building width perpendicular | 80 ft maximum | 60 ft |
| Maximum bearing wall clear height | 10 ft | 10 ft | 10 ft | 10 ft |
| Maximum nonbearing wall clear height | 22 ft | 10 ft | 20 ft | 22 ft exterior AISI S230 Tables E3-17a and E3-17b 22 ft 10 in interior ASTM C754 |
| Maximum eave height above grade | 30 ft | not applicable | not applicable | not applicable |
| Maximum mean roof height above average grade | not applicable | 35 ft | 33 ft | 33 ft |
| Roof type | gable or hip | gable or hip | gable or hip | gable or hip |
| Roof slope, 1 and 2 story | 0° to 45° (0:12 - 12:12) | 0° to 45° (0:12 - 12:12) | 0° to 45° (0:12 - 12:12) | 14° to 45° (3:12 - 12:12) |
| Roof slope, 3 story | 0° to 45° (9:12 - 12:12) | not applicable | 0° to 26.5° (0:12 - 6:12) | 14° to 30° (3:12 - 7:12 |
| Maximum roof overhang at sidewall and hip roofs all around | 4 ft | 4 ft | 2 ft | 2 ft |
| Maximum roof overhang at endwall with outlooker framing | 2 ft | 2 ft | 2 ft | 1 ft |
| Maximum roof overhang at endwall with other framing | 1 ft | 2 ft | 1 ft | 1 ft |

For SI: 1 foot = 304.8 mm, 1 degree = 0.0175 rad.
a. WFCM is AF&PA Wood Frame Construction Manual. See Section 303.
b. S230 is AISI Prescriptive Method. See Section 303.
c. Where building plan is nonrectangular; apply to each rectangle as per Section 105.



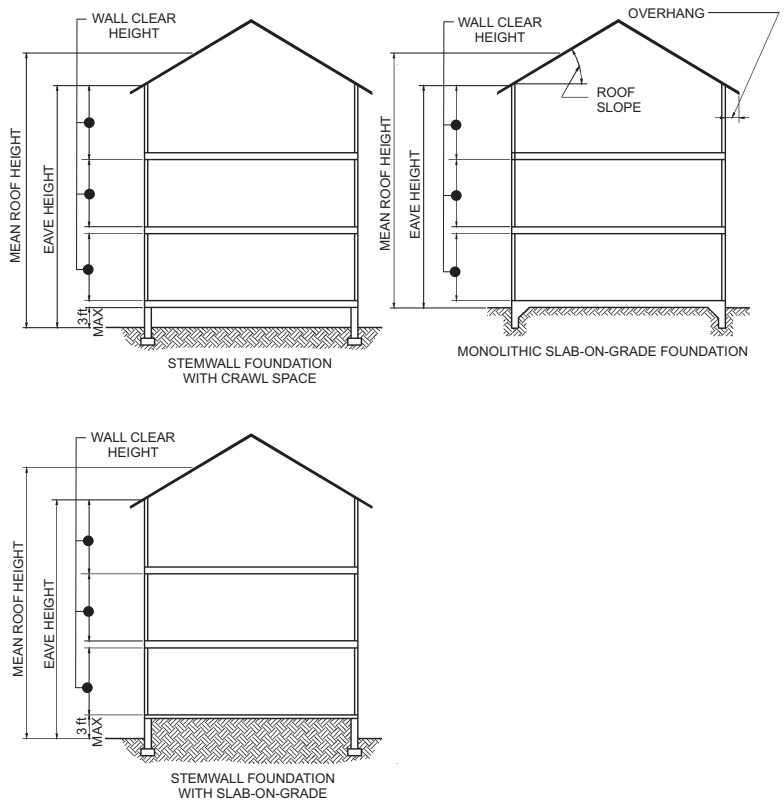

For SI: 1 foot = 304.8 mm.

**FIGURE 102(1)**
**ONE-STORY BUILDING GEOMETRY**




For SI: 1 foot = 304.8 mm.

**FIGURE 102(2)**
**TWO-STORY BUILDING GEOMETRY**




For SI: 1 foot = 304.8 mm.

**FIGURE 102(3)**
**THREE-STORY BUILDING GEOMETRY**

## SECTION 103
## DEFINITIONS

**103.1** The following words and terms used in this standard shall have the meaning set forth herein:

**APPROVED.** Approved by the building official or other authority having jurisdiction.

**AVERAGE GRADE.** A reference plane representing the average of finished ground level adjoining the building at all exterior walls. When the finished ground level slopes away from the exterior walls, the reference plane shall be established by the lowest points within the area between the building and the lot line or between the building and a point 6 feet (1829 mm) from the building, whichever is closer to the building.

**BALLOON-FRAME CONSTRUCTION.** Construction in which the exterior wall studs extend the full height of the building from foundation plate to rafter plate.

**BLOCKED DIAPHRAGM.** A diaphragm in which all adjoining panel edges occur over framing or lightweight nailers (usually 2 × 4) or other primary structural supports for the specific purpose of connecting the edges of the panels. This "blocking" is provided to allow connections of panels at all edges for better shear transfer.

**BOND BEAM.** One or more courses of masonry units grouted solid; cast-in-place concrete; or composite precast/cast-in-place concrete, reinforced with longitudinal reinforcement.

**BUILDING LENGTH (L).** The dimension of exterior walls perpendicular to the span of roof rafters or trusses [see Figure 103(1)].

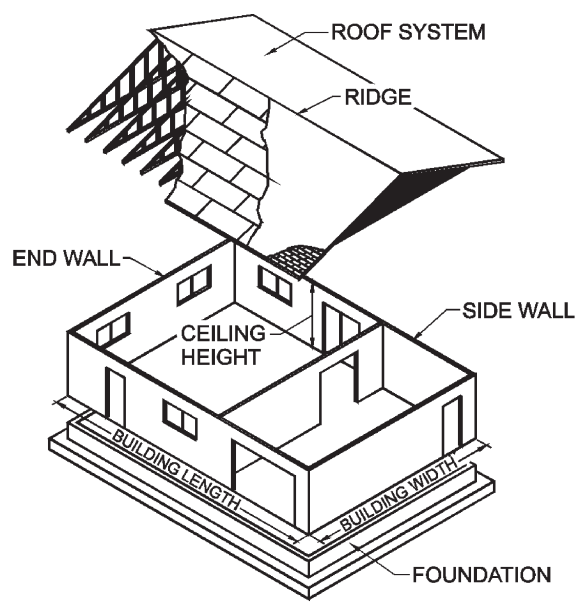



**FIGURE 103(1)**
**BUILDING NOMENCLATURE**

**BUILDING WIDTH (W).** The dimension of exterior walls parallel to the span of roof rafters or trusses [see Figure 103(1)].

**CEILING HEIGHT.** Nominal distance measured at the sidewall between top of floor and bottom surface of ceiling above that is directly attached to roof/floor framing system [see Figure 103(1)].

**CONCRETE COVER.** Protective covering of concrete over reinforcing steel.

**CONTINUOUS (REINFORCING STEEL).** Refers to lengths of reinforcing steel spliced together to act as a single unit, providing an uninterrupted connection capable of developing the full strength of the bar.

**DESIGN WIND SPEED.** Design wind speed in miles per hour (3 sec. gust) given in Figure 104 or as specified by the building official or other authority having jurisdiction.

**DIAPHRAGM.** A flat structural unit acting like a deep thin beam.

**DRAG STRUT.** A structural member that transfers axial loads between adjacent shear-resisting elements. Bond beams, top plates, joists, girders and truss chords may be used as drag struts provided connections at each end of the drag strut are capable of transferring loads (see Section 105).

**ENDWALL.** An exterior wall parallel to the primary floor and roof framing direction. [see Figure 103(1)].

**FACE SHELL.** Side wall of a hollow masonry unit.

**GROUP II, III, and IV WOOD SPECIES.** Classifications of wood species by specific gravity for the purpose of fastening design. Specific gravities of various species are provided in the American Forest and Paper Association's (AF&PA) National Design Specification (NDS) for Wood Construction.

**Group II Species.** Species with a specific gravity of 0.49 or greater (Douglas Fir, Southern Pine, etc.).

**Group III Species.** Species with a specific gravity of 0.42 or greater and less than 0.49 (Hem Fir, Spruce Pine Fir, etc.).

**Group IV Species.** Species with a specific gravity less than 0.42 (California Redwood, Western Cedar, etc.).

**GROUT.** A mixture of cementitious material and aggregate to which water is added to provide desired slump.

**COARSE GROUT.** A mixture of portland cement, sand, pea gravel and water.

**FINE GROUT.** A mixture of portland cement, sand and water.

**HEADER.** See LINTEL.

**HIGH-WIND REGION.** Areas where the design wind speed equals or exceeds 100 miles per hour (44.7 m/s) or greater.

**INSULATED CONCRETE FORM (ICF).** A concrete forming system using stay-in-place forms of rigid foam plastic insulation, a hybrid of cement and foam insulation, a hybrid of cement and wood chips, or other insulating material for constructing cast-in-place concrete walls.

**INTERIOR SHEARWALL.** A shearwall located in the interior of the building; i.e., not an endwall or sidewall.

**LINTEL.** A beam placed over an opening in a wall.

**MASONRY.** A form of construction composed of concrete masonry units or clay masonry units laid up unit by unit and set in mortar.

**MASONRY COVER.** Protective covering for reinforcement consisting of masonry units, grout, or mortar or a combination thereof.

**MEAN ROOF HEIGHT.** The distance from average grade to the average roof elevation [see Figures 102(1), 102(2) and 102(3)].

**OVERHANG.** Projection of a roof beyond the wall below.

**EAVE OVERHANG.** Projection of a roof beyond the sidewall.

**RAKE OVERHANG.** Projection of a roof beyond the gable endwall.

**RUNNING BOND.** The placement of masonry units such that head joints in successive courses are horizontally offset at least one quarter of the unit length.

**STACK BOND.** The placement of masonry units in a bond pattern such that head joints in successive courses are vertically aligned. For the purpose of this standard, requirements for stack bond shall apply to all masonry laid in other than running bond.

**SHEARWALL.** A wall or portion of a wall used to resist horizontal forces parallel to the wall (in-plane shear) [see Figure 205(8)].

**SHEARWALL PIER.** Portion of a shearwall segment adjacent to and equal in height to the opening with the shortest height on either side of the shearwall segment [see Figure 205(8)].

**SHEARWALL SEGMENT.** Portion of a shearwall between openings extending between horizontal diaphragms and/or floor designed to resist in-plane shear (shear parallel to the wall) [see Figure 205(8)].

**SIDEWALL.** An exterior wall perpendicular to the primary floor and roof framing direction [see Figure 103(1)].

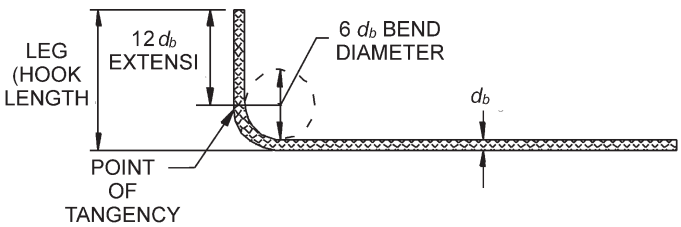
**STANDARD 90 DEGREE HOOK.** Reinforcing steel which ends in a 90 degree bend plus extension of at least 12-bar diameters beyond the bend. Leg (hook length) = 6 inches (152 mm) for No. 3 bars, 8 inches (203 mm) for No. 4, 10 inches (254 mm) for No. 5, 12 inches (304.8 mm) for No. 6, and 14 inches (356 mm) for No. 7 bars] [see Figure 103(2)].

**STANDARD 180 DEGREE HOOK.** Reinforcing steel which ends in a 180-degree bend plus a minimum extension of 4-bar diameters or $2^1/_2$ inches (64 mm), whichever is greater [see Figure 103(3)].

**STORY.** The portion of a building included between the upper surface of a floor and upper surface of the roof or floor above.

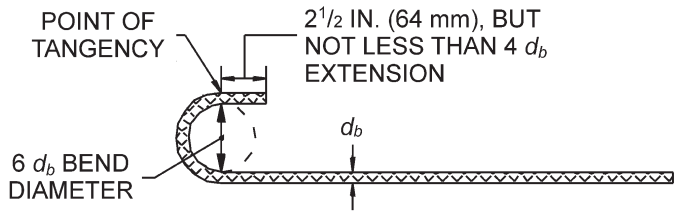
**WOOD STRUCTURAL PANEL.** A structural panel manufactured in accordance with DOC PS 1 or DOC PS 2 from veneers, wood strands or wafers or a combination of veneer and wood strands or wafers bonded together with waterproof synthetic resins or other suitable bonding systems. Examples of wood structural panels are: composite panels, oriented strand board (OSB) and plywood.

**WYTHE.** Each continuous vertical section of a masonry wall one masonry unit in thickness.




For SI: 1 inch = 25.4 mm, 1 degree = 0.0175 rad.

**FIGURE 103(2)**
**STANDARD 90 DEGREE HOOK**




For SI: 1 inch = 25.4 mm, 1 degree = 0.0175 rad.

**FIGURE 103(3)**
**STANDARD 180 DEGREE HOOK**

## SECTION 104
## DESIGN CRITERIA

**104.1 Wind loads.** The loads used in the design of the various structural systems and elements of the buildings are separated into:

1. The overall (or global) forces used in the design of the MAIN WIND FORCE RESISTING SYSTEMS (MWFRS), and
2. Those loads appropriate for the design of fasteners, cladding and elements of the building that must resist the much higher loadings induced over relatively small areas. The latter loads are designated COMPONENT AND CLADDING Loads (C&C).

**104.2 Other design loads and assumptions.** See Appendix A.

**104.3 Design wind speeds and use factors.** This standard provides prescriptive requirements and other details of construction for buildings sited in wind climates of 100 to 150 miles per hour (44.7 to 67 m/s) in 10 mile per hour (4.5 m/s) increments. The appropriate minimum design wind speed to be selected for a particular geographical location shall be based on the WIND SPEED MAP given in Figure 104. In developing the provisions of the standard, a USE FACTOR of 1.0 was used throughout.

**104.4 Exposure Categories.** The prescriptive details provided in this standard are based on the building being located in Exposure Category B or C as defined in Sections 104.4.1 or 104.4.2. Buildings constructed using ICF and flat panel concrete walls in Section 209 shall be permitted in Exposure Category D as defined in Section 104.4.3. All other buildings located in areas that qualify as Exposure Category D shall be designed in accordance with the *International Building Code*.

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

**104.4.2 Exposure C.** Open terrain with scattered obstructions, including surface undulations or other irregularities, having heights generally less than 30 feet (9144 mm) extending more than 1500 feet (457.2 m) from the building site in any quadrant. This exposure shall also apply to any building located within Exposure B-type terrain where the building is directly adjacent to open areas of Exposure C-type terrain in any quadrant for a distance of more than 600 feet (182.9 m). This category includes flat open country, grasslands and shorelines in hurricane-prone regions.

**104.4.3 Exposure D.** Flat, unobstructed areas exposed to wind flowing over open water (excluding shorelines in hurricane prone regions) for a distance of at least 1 mile (1.61 km). Shorelines in Exposure D include inland waterways, the Great Lakes and coastal areas of California, Oregon, Washington and Alaska. This exposure shall apply only to those buildings and other structures exposed to the wind coming from over the water. Exposure D extends inland from the shore line a distance of 1500 feet (457.2 m) or 10 times the height of the building structure, whichever is greater.

**104.5 Applicability.** The provisions of this standard shall not apply to buildings sited where all of the following conditions exist:

1. The hill, ridge or escarpment is 60 feet (18 288 mm) or higher if located in Exposure B or 30 feet (9144 mm) or higher if located in Exposure C;
2. The maximum average slope of the hill exceeds 10 percent; and
3. The hill, ridge or escarpment is unobstructed upwind by other such topographic features for a distance from the high point of 50 times the height of the hill or 1 mile (1.61 km), whichever is greater.

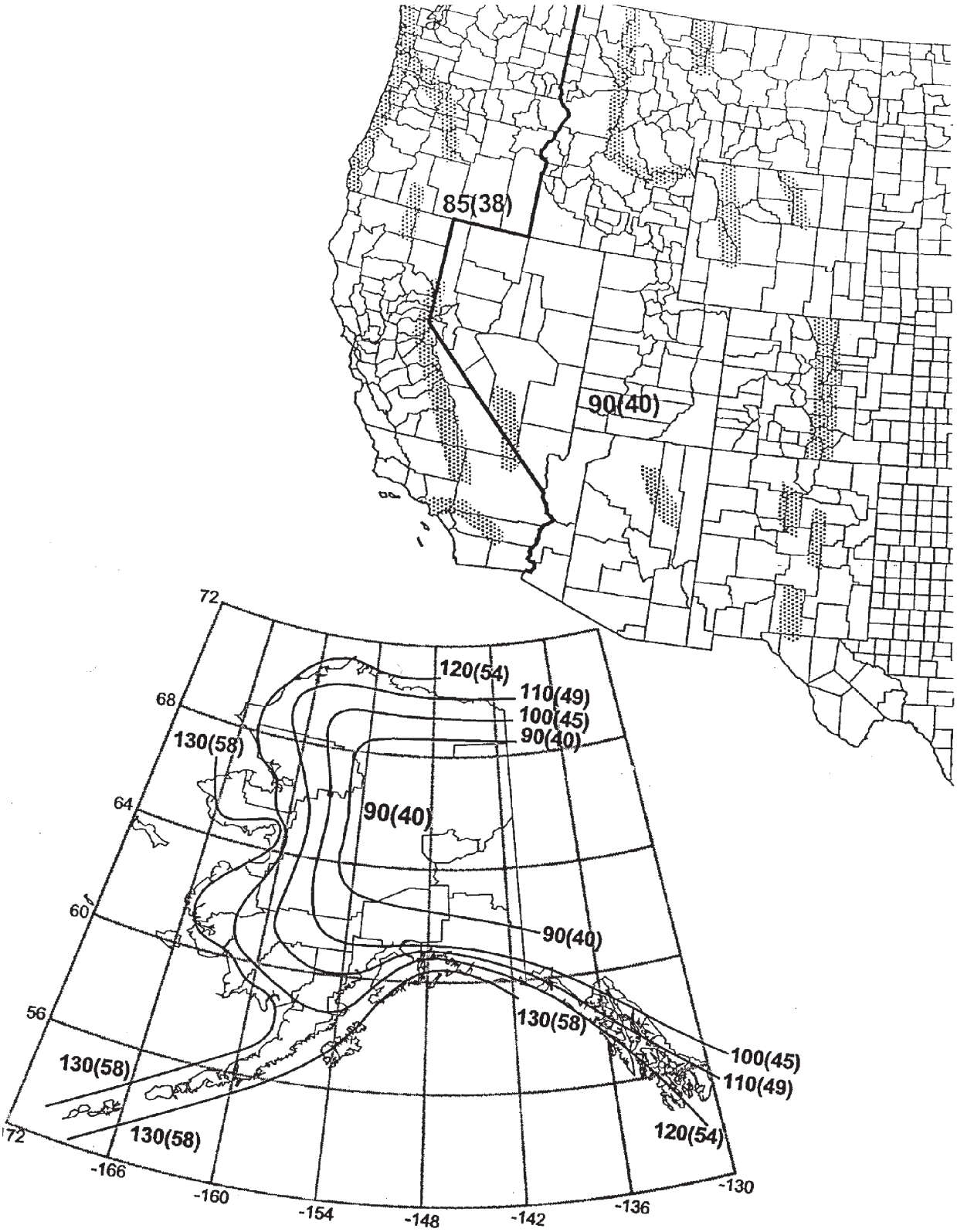
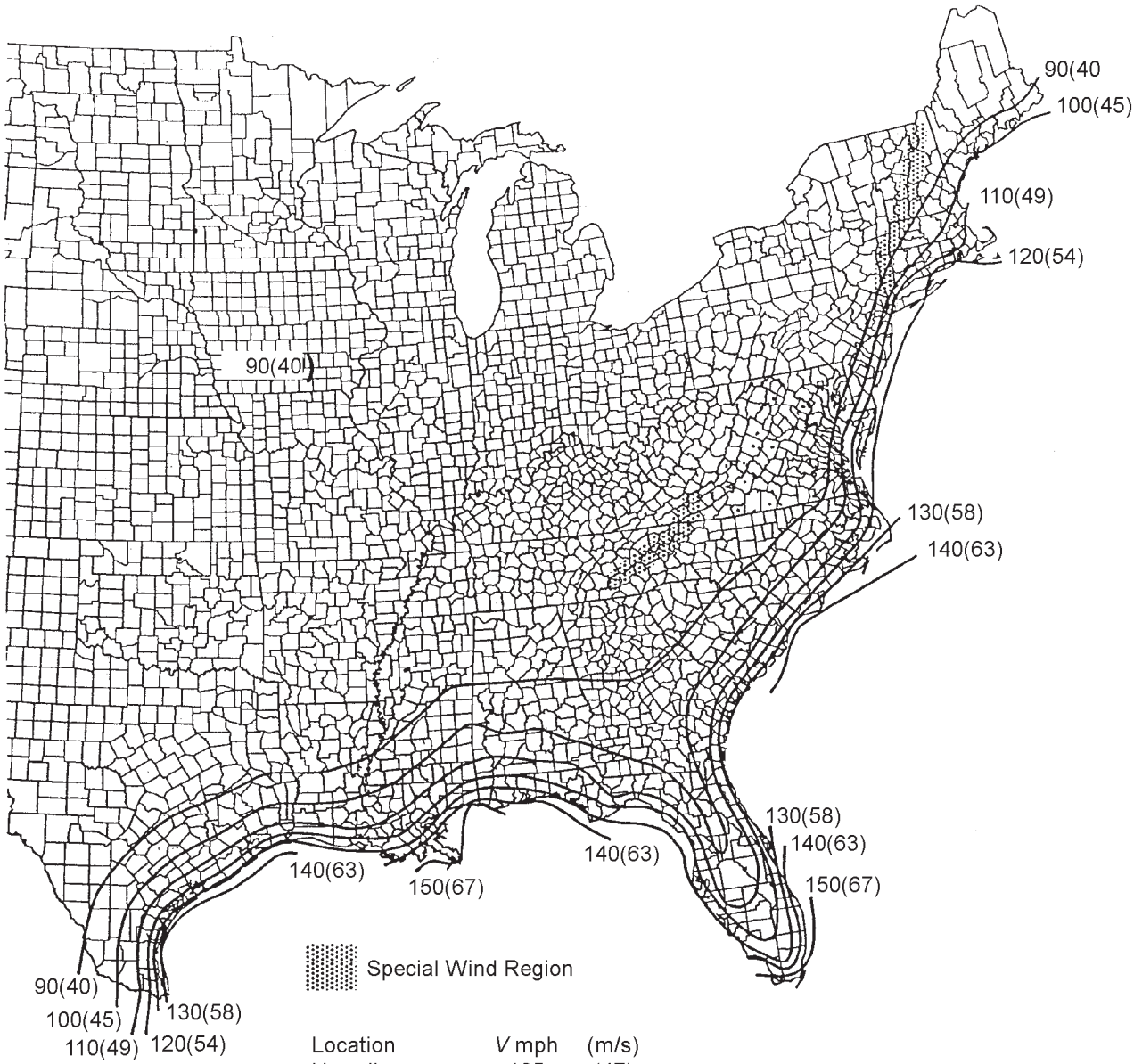



**FIGURE 104**
**DESIGN WIND SPEED (3-SECOND GUST)**

*(continued)*

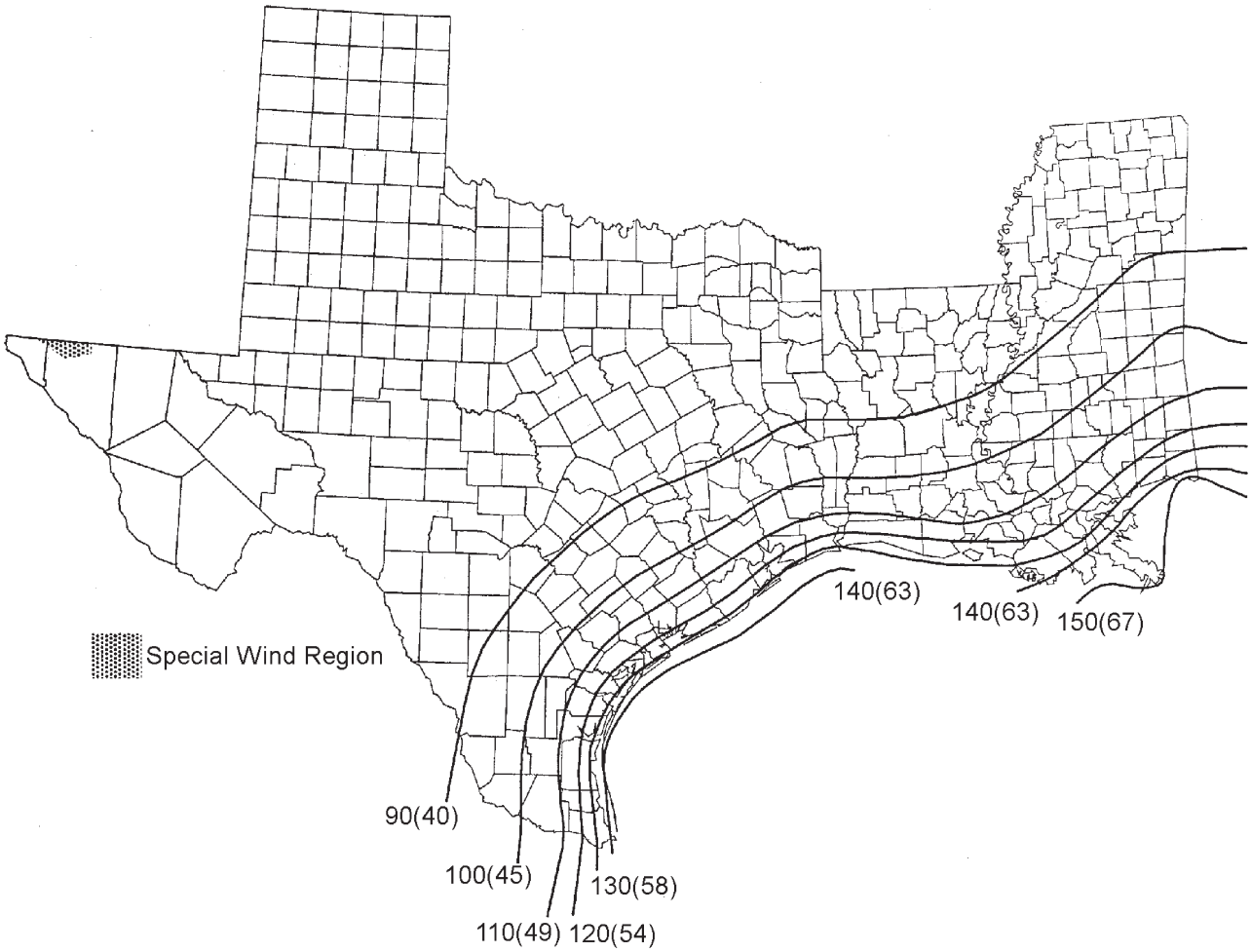



| Location | *V* mph | (m/s) |
|---|---|---|
| Hawaii | 105 | (47) |
| Puerto Rico | 145 | (65) |
| Guam | 170 | (76) |
| Virgin Islands | 145 | (65) |
| American Samoa | 125 | (56) |

Notes:
1. Values are nominal design 3-second gust wind speeds in miles per hour (m/s) at 33 ft (10 m) above ground for Exposure C category.
2. Linear interpolation between wind contours is permitted.
3. Islands and coastal areas outside the last contour shall use the last wind speed contour of the coastal area.
4. Mountainous terrain, gorges, ocean promontories, and special wind regions shall be examined for unusual wind conditions.

**FIGURE 104—continued**
**DESIGN WIND SPEED (3-SECOND GUST)**

*(continued)*




Notes:
1. Values are nominal design 3-second gust wind speeds in miles per hour (m/s) at 33 ft (10 m) above ground for Exposure C category.
2. Linear interpolation between wind contours is permitted.
3. Islands and coastal areas outside the last contour shall use the last wind speed contour of the coastal area.
4. Mountainous terrain, gorges, ocean promontories, and special wind regions shall be examined for unusual wind conditions.

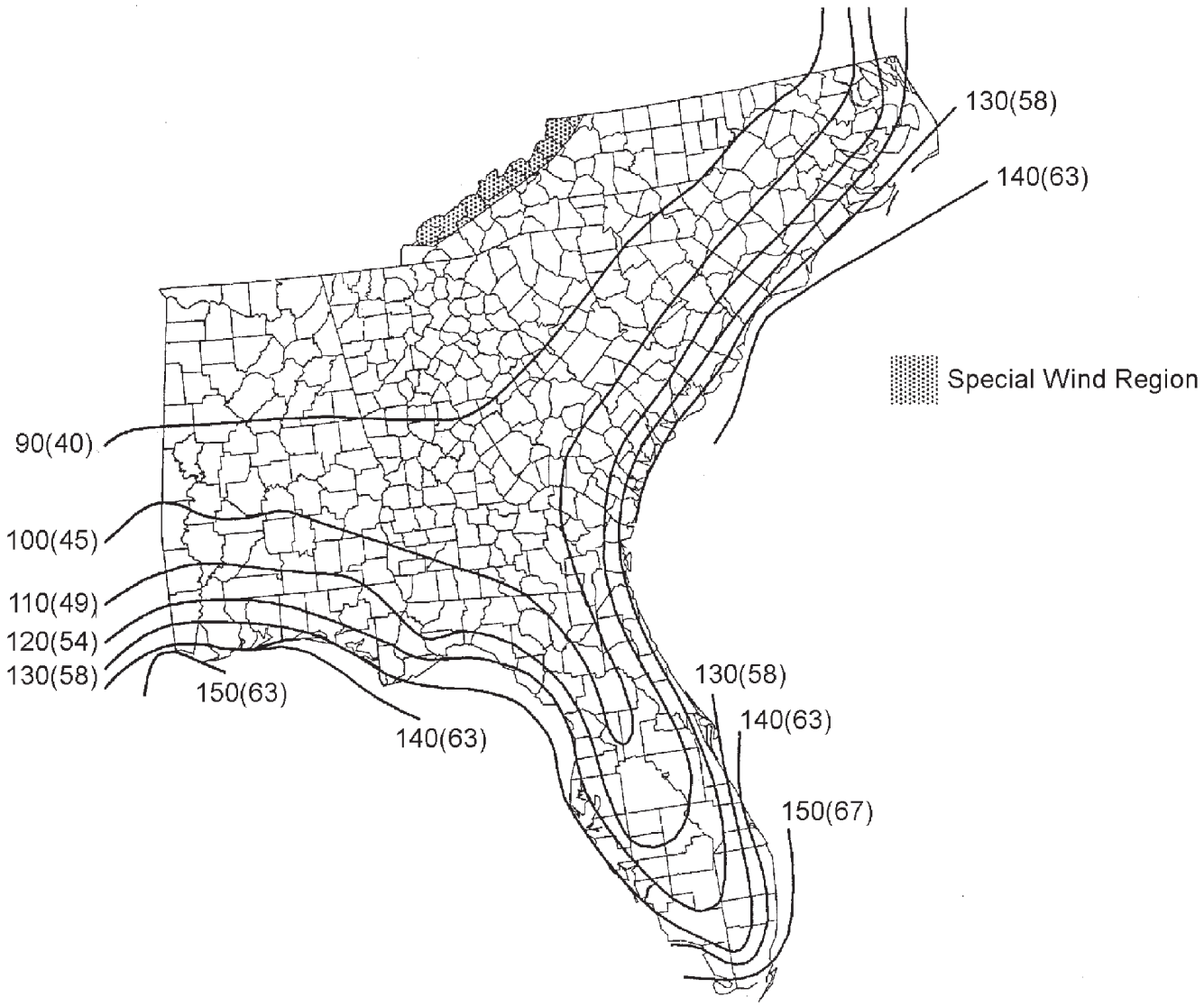
**FIGURE 104—continued**
**DESIGN WIND SPEED (3-SECOND GUST)**
**WESTERN GULF OF MEXICO HURRICANE COASTLINE**

*(continued)*


Notes:
1. Values are nominal design 3-second gust wind speeds in miles per hour (m/s) at 33 ft (10 m) above ground for Exposure C category.
2. Linear interpolation between wind contours is permitted.
3. Islands and coastal areas outside the last contour shall use the last wind speed contour of the coastal area.
4. Mountainous terrain, gorges, ocean promontories, and special wind regions shall be examined for unusual wind conditions.

**FIGURE 104—continued**
**DESIGN WIND SPEED (3-SECOND GUST)**
**MID AND NORTHERN ATLANTIC HURRICANE COASTLINE**

*(continued)*




Notes:
1. Values are nominal design 3-second gust wind speeds in miles per hour (m/s) at 33 ft (10 m) above ground for Exposure C category.
2. Linear interpolation between wind contours is permitted.
3. Islands and coastal areas outside the last contour shall use the last wind speed contour of the coastal area.
4. Mountainous terrain, gorges, ocean promontories, and special wind regions shall be examined for unusual wind conditions.

**FIGURE 104—continued**
**DESIGN WIND SPEED (3-SECOND GUST)**
**EASTERN GULF OF MEXICO AND SOUTHEASTERN U.S. HURRICANE COASTLINE**

## SECTION 105
## NONRECTANGULAR BUILDINGS

**105.1 General.** Rectangular elements of nonrectangular buildings shall be considered separate buildings for purposes of determining shearwall requirements.

Walls may be offset by a maximum of 4 feet (1219 mm) (such as for projecting bays, inset porches or other irregular shapes) without requiring additional shearwalls or additional drag struts for the transference of lateral loads.

**105.2 Wind perpendicular to common wall.** Length of the required shearwall is M, as illustrated in Figure 105(1). This length of shearwall shall be located in the "main building."

**105.3 Wind parallel to common wall.** M is the length of shearwall required for each sidewall of the main building [Figure 105(2)]. L is the length of shearwall required for each endwall of the building leg. L for the common wall shall be added to M for the same wall. This total shearwall, or shearwall segment length, may be located anywhere in the length of the main building wall if a drag strut (see Definitions) is provided across any open spaces or other nonshearwall segments in the common wall.

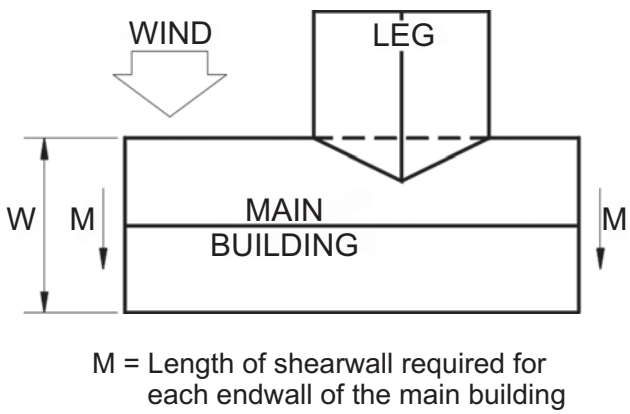



**FIGURE 105(1)**
**WIND PERPENDICULAR TO COMMON WALL**

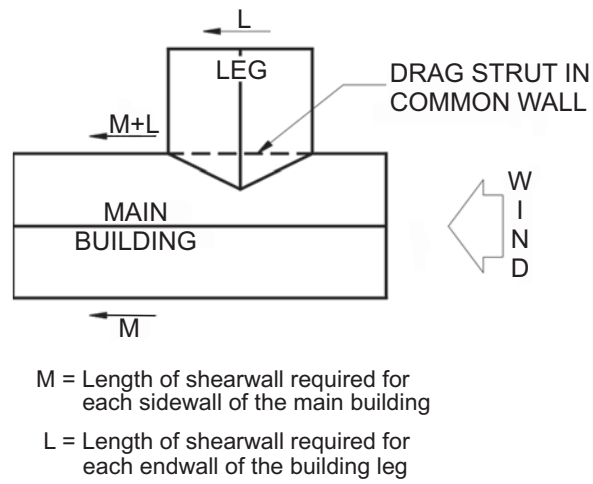



**FIGURE 105(2)**
**WIND PARALLEL TO COMMON WALL**

# CHAPTER 2

# BUILDINGS WITH CONCRETE OR MASONRY EXTERIOR WALLS

## SECTION 201
## SCOPE

This chapter prescribes construction requirements for buildings where all exterior walls above the foundation are concrete or masonry and where the building meets the parameters and requirements of Chapter 1. Interior walls and partitions may be concrete, masonry, wood framed, cold-formed steel framed, or any other approved construction. ICF and flat panel concrete walls shall be in accordance with Section 209.

## SECTION 202
## GENERAL

**202.1 Materials for masonry.**

**202.1.1 Masonry units.**

1. Concrete masonry units shall be hollow or solid unit masonry in accordance with ASTM C 90 and shall have a minimum net area compressive strength of 1900 psi (62 MPa).
2. Clay masonry units shall be in accordance with ASTM C 62, C 216, or C 652 Class H40V, and shall have a minimum net area compressive strength of 4400 psi (30.3 MPa) when using Type M or S mortar or a minimum net area compressive strength of 5500 psi (37.9 MPa) when using Type N mortar.

**202.1.2 Mortar.** In structural applications, mortar shall be either Type M or S in accordance with ASTM C 270. In veneer applications, mortar shall be Type M, S, or N in accordance with ASTM C 270.

**202.1.3 Grout.** The grout shall have a maximum coarse aggregate size of $^3/_8$ inch (9.5 mm) placed at an 8 to 11-inch (203 to 229 mm) slump and have a minimum specified compressive strength of 2000 psi (15.2 MPa) at 28 days when tested in accordance with ASTM C 1019, or shall be in accordance with ASTM C 476. Grout shall be placed in maximum 5 foot (1524 mm) lifts and properly consolidated.

**Exception:** Where the following conditions are met, place grout in lifts not exceeding 12.67 ft (3.86 m).

1. The masonry has cured for at least 4 hours.
2. The grout slump is maintained between 10 and 11 in. (254 and 279 mm).
3. No intermediate reinforced bond beams are placed between the top and the bottom of the pour height.

**202.1.4 Reinforcing steel.** The reinforcing steel shall be minimum Grade 60 and identified in accordance with ASTM A 615, A 706 or A 996.

**202.1.5 Metal accessories.** Joint reinforcement, anchors, ties and wire fabric shall conform to the following standards:

1. ASTM A 951 for joint reinforcement and wire anchors and ties.
2. ASTM A 36/A36M for plate, headed and bent bar anchors.
3. ASTM A 1008A/A1008M for sheet metal anchors and ties.

**202.1.6 Galvanization.** Metal accessories for use in exterior wall construction and not directly exposed to the weather shall be hot dip galvanized and metal accessories for use in interior wall construction shall be mill galvanized in accordance the following:

a. Mill galvanized coatings:
   1) Joint reinforcement. . . . . ASTM A 641. (0.1 oz/ft$^2$) (31 g/m$^2$)
   2) Sheet-metal ties and sheet-metal anchors. . . . . ASTM A 653 Coating Designation G60
b. Hot-dip galvanized coatings:
   1) Joint reinforcement, wire ties, and wire anchors . . . . . ASTM A 153 (1.50 oz/ft$^2$) (458 g/m$^2$)
   2) Sheet-metal ties and sheet-metal anchors. . . . . ASTM A 153 Class B
   3) Steel plates and bars (as applicable to size and form indicated). . . . . ASTM A 123 or ASTM A 153, Class B

**202.1.7 Fasteners and connectors.**

This standard contains figures showing connectors. The connectors are shown for illustrative purposes only. The illustration of the connectors is not intended to endorse any connector manufacturer. To choose the appropriate connector, please check with the connector manufacturer.

**202.1.7.1** A continuous load path between foundations, walls and roofs shall be provided. Approved connectors, anchors and other fastening devices shall be installed in accordance with the manufacturer's recommendations. Where fasteners are not otherwise specified in this standard, fasteners shall be provided in accordance with Table R602.3(1) of the *International Residential Code*. Nails, screws or bolts shall be able to resist the forces described in this standard. Nails, screws and bolts shall comply with requirements contained in the *National Design Specifications for Wood Construction*.

**202.1.7.2** Unless otherwise stated, sizes given for nails are common wire nails. For example, 8d = $2^1/_2$ inches long × 0.131-inch diameter (See Table 12.3B, Columns 2, 3 and 4, in the *National Design Specifications for Wood Construction*). Nails shall conform to the requirements of ASTM F 1667 including supplementary requirements.