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Proposal to the Board of Building Regulations and Standards

Submitted May 27, 2021

I. Summary of Proposed Changes

Climate change poses a severe threat to the health and safety of Massachusetts residents, the integrity of the Commonwealth's infrastructure, and the health of the economy. Extreme heat and precipitation events, rising sea levels, and more frequent and severe storms will continue to occur in the Northeast. As a result, new and existing structures face serious impacts because current regulations are not designed to accommodate the increased risk. This proposal to the Board of Building Regulations and Standards (BBRS) makes recommendations for incorporating climate risk, specifically flood risk, into the 10th Edition of the Massachusetts State Building Code (MSBC), with reference to language from the 2021 International Code Council (ICC) Base and Residential codes. The Appendix of this proposal includes line edits to the 2021 ICC that is recommended that the BBRS adopt for the 10th edition of the MSBC.

The BBRS has a statutory mandate to "make a continuing study of the operation of the state building code, and other laws relating to the construction of buildings to ascertain their effect upon the cost of building construction and the effectiveness of their provisions for health, safety, energy conservation and security."[1] Climate change is certain to affect the health and safety of residents in the Commonwealth. The BBRS must update code standards to reflect this new reality to fulfill its duty under the statute.

While the Commonwealth will face several compounding climate risks, this proposal focuses on flood risks, the effects of which are already being felt, and will only continue to increase in severity and frequency.

The recommended changes are summarized below:

A. **Redefine "flood hazard area" to allow local adoption of forward looking or current extent maps:** The BBRS should revise the definition of a "flood hazard area" such that it clearly allows municipalities to substitute in forward-looking or observed current extent data in the Base and Residential codes, in lieu of using Federal Emergency Management Agency (FEMA) Flood Insurance Rate Maps (FIRMS) (hereinafter "FEMA floodplain maps"), which are based on historic data. Consequently, all flood-resistant construction standards within the Base and Residential codes would be applicable to the expanded flood hazard area adopted by the municipality. Municipalities should be permitted to substitute this data so long as the extent exceeds the existing FEMA floodplain maps.

B. **Increase minimum freeboard/elevation requirements:** The BBRS should update the minimum freeboard/elevation requirements to account for sea level rise. This change is in line with what many municipalities in the Commonwealth have voluntarily elected to do through local zoning.

C. **Strengthen the variance granting process for new construction or substantial improvement/damage within flood hazard areas by aligning with FEMA standards:** The BBRS should adopt Section G106 of Appendix G – Flood Resistant Construction of the 2021 ICC, and an adapted version of the language in Section R.104.10.1 in Chapter 1 of the 2021 ICC Residential Code to reflect the criteria outlined in Federal regulation and guidance so that

[1] M.G.L. c. 143 § 94

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the state and local communities comply with National Flood Insurance Program (NFIP) guidance. These criteria should guide the Building Board of Appeals in the variance and appeal process in determining the conditions under which variances can be sought within flood hazard areas and ensure that the state's NFIP status is not endangered due to variances granted that do not meet Federal criteria.

BBRS should undertake these changes in accordance with its statutory mandate. This will help ensure the health and safety of Commonwealth residents, the integrity of its infrastructure, and the health of its economy.[2]

II. Background and Rationale

Coastal and inland flooding are imminent threats to the health and safety of Massachusetts residents. In addition to reducing the life safety risk, this proposal will also decrease the economic burden on developers, local governments, and the Commonwealth in recovering from extreme weather events. Further, it would create consistency across the Commonwealth; currently, municipalities that have identified climate change as a building code issue and are creating heightened standards ad hoc through zoning. The public health, safety and financial risks posed by climate change have been widely characterized and quantified:

- Flood maps show that approximately 321,488 properties are already at risk in Massachusetts[3] and that figure will dramatically increase in coming decades. In Boston alone, sea level rise of 36 inches by 2050 could damage assets worth an estimated $1.1 billion.[4]
- Heavy precipitation (days with greater than 1 inch of rainfall) could increase between 10-42 percent by 2050.[5]
- Evacuation costs in the Northeast region resulting from sea level rise and storms during a *single event* range between $2 billion and $6.5 billion.[6]
- Every Massachusetts resident lives in a county that was affected by at least one federally declared weather disaster since 2010. It is not just coastal communities that will be affected - inland communities in Central and Western Massachusetts will face more frequent flooding from extreme precipitation events.

This proposal aims to address several issues within the existing code that relate to flood risk. Beyond its obligation to protect the safety of residents, BBRS can ensure that Massachusetts is a leader in promoting safe, resilient development, as it has been with energy and emissions reduction. Additional background on each of the specified changes is provided below.

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[2] M.G.L. c. 143 § 94
[3] First Street Foundation. First National Flood Risk Assessment. https://floodfactor.com/state/massachusetts/25_fsid
[4] City of Boston. 2019. Climate Ready Boston. Accessed 20 April 2021 at https://www.boston.gov/sites/default/files/file/2019/12/02_20161206_executivesummary_digital.pdf
[5] Commonwealth of Massachusetts. n.d. Changes in Precipitation. Accessed 19 April 2021 at https://resilientma.org/changes/changes-in-precipitation#:~:text=Specifically%2C%20the%20annual%20frequency%20of,days%20per%20year%20by%202100
[6] Commonwealth of Massachusetts. 2011. Massachusetts Climate Adaptation Plan. Accessed 20 April 2021 at https://www.mass.gov/files/documents/2017/11/29/Full%20report.pdf

A. Allow local adoption of forward looking or current extent maps; redefine "flood hazard area:"

FEMA, Massachusetts state agencies, and municipalities agree that FEMA floodplain maps are outdated and inadequate to protect against future climate risks.[7] Flood-resistant construction standards must apply to areas that already or will imminently experience increased flooding due to climate change. This includes areas currently outside of the FEMA-designated floodplain.

FEMA floodplain maps do not take the following factors into account, and as a result are inadequate to protect the life safety of Massachusetts residents [8]:

1. Changes in storm frequency and severity
2. Sea level rise and shoreline erosion
3. Changes in topography, development, and impervious surfaces since the maps were drawn
4. Degradation of flood protecting infrastructure such as seawalls
5. Projections of increased precipitation[9]

Additionally, modeled flood flows from FEMA's Flood Insurance Studies (FIS) were conducted in the 1970s and 1980s; recent studies demonstrate that these may underestimate flood flows.[10] As FEMA has documented, 20 percent of National Flood Insurance Program (NFIP) claims were made outside of the 100-year floodplain.[11] Giving municipalities the option to expand floodplains with appropriate data that reflects the reality of local flood risks will ensure that new development and substantial improvement will be constructed with the appropriate flood-resistant construction standards.

- **The Commonwealth's continual reliance on FEMA's data will cause damage to homes, businesses, and critical facilities.** In June 2020, First Street Foundation, an organization specializing in flood modeling, released a report which found that there are 336,000 properties at risk of flooding in MA, 65 percent more than the FEMA floodplain maps indicate.[12] First Street Foundation's most recent report from June 2020 finds that FEMA underestimates the flood risk in all but three counties in Massachusetts. This report demonstrates that counties in both inland and coastal areas are subject to flood risks that are not currently being considered within the MSBC. For example, it finds that 13.9 percent of properties face flood risk from a major storm in Franklin County, in Western MA, compared

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[7] Federal Emergency Management Agency. 2015. Designing for flood levels above the BFE after Hurricane Sandy. Accessed 20 April 2021 at https://miamirivercommission.org/PDF/Agenda%2002.07.19/Agenda3/Tiffany/SandyRA5DesignAboveBFE_508_FINAL2.pdf

[8] Federal Emergency Management Agency. 2015. Designing for flood levels above the BFE after Hurricane Sandy. Accessed 20 April 2021 at https://miamirivercommission.org/PDF/Agenda%2002.07.19/Agenda3/Tiffany/SandyRA5DesignAboveBFE_508_FINAL2.pdf

[9] New York Times. 2020. New Data Reveals Hidden Flood Risk Across America. Accessed 21 April 2021 at https://www.nytimes.com/interactive/2020/06/29/climate/hidden-flood-risk-maps.html

[10] Zarriello, P. J., & Barbaro, J. R. 2014. Hydraulic Assessment of Existing and Alternative Stream Crossings Providing Fish and Wildlife Passage at Seven Sites in Massachusetts (No. 2014-5146). US Geological Survey.

[11]Federal Emergency Management Agency . 2019. Fact Sheet: Flood Plain Management, Insurance and Rebuilding. Accessed 29 April 2021 at https://www.fema.gov/press-release/20210318/fact-sheet-flood-plain-management-insurance-and-rebuilding

[12] Boston Globe. 2020. "Millions of Homes Face Substantial Flood Risk — Far More than Previously Predicted, Study Finds." https://www.bostonglobe.com/2020/07/02/metro/millions-homes-face-substantial-risk-flooding-far-more-than-previously-predicted-study-finds/.

to the 2 percent in FEMA flood zones. The percentage in this inland county is even higher than that of Suffolk County, where 13.1 percent of communities face flood risk from a major storm according to First Street data compared with 6.2 percent from FEMA data.[13] A review of NFIP claims from Metropolitan Area Planning Council (MAPC) from the month of March 2010[14] demonstrates that 93 percent of the 19,000 claims from this month were for properties outside of Special Flood Hazard Areas (SFHAs) or FEMA A and V Zones.[15,16] Not only does the Commonwealth face increasing risk, without the ability to rely on new data, development will also be subject to this information gap.

- **The Federal government currently does not have the capacity to update floodplain maps, while FEMA itself has acknowledged the deficiencies of these maps**. FEMA recognizes that its floodplain maps are out of date, but it does not have the resources to update maps using current modeling techniques, let alone account for future climate projections. In a 2013 report following Hurricane Sandy, the agency states that their maps do not use the most recent modeling techniques, forward-looking climate change data, or changes in topographic and hydraulic conditions.[17] In 2017, the Department of Homeland Security (DHS) Office of the Inspector General released a report that similarly noted that FEMA does not have the resources to update its maps using current modeling systems.[18] The Community Rating System (CRS) for FEMA's NFIP, discussed in the cost section to follow, demonstrates that FEMA understands the importance of additional risk reduction measures that take climate change into account. FEMA supports local adoption of better and forward-looking data that reflects real risk.

- **States and municipalities around the country are responding to this deficiency**. The Florida Building Commission and a research group at Florida International University concluded in an August 2019 report the importance of studying where the FEMA floodplain maps fall short, especially with regard to existing Base Flood Elevations (BFEs).[19] Similarly, Georgetown's Climate Center recommended that the Eastern Shore of Maryland make floodproofing design required for the 500-year floodplain instead of the 100-year floodplain.[20] Charlotte, North Carolina has developed future floodplain maps that take climate change and increased development into consideration and reference these maps in their

[13] New York Times. 2020. "New Data Shows an 'Extraordinary' Rise in U.S. Coastal Flooding," Accessed 21 April 2021 at https://www.nytimes.com/2020/07/14/climate/coastal-flooding-noaa.html.
[14] See disaster declaration for flooding that occurred during this month at Federal Emergency Management Agency. 2010. Massachusetts Severe Storms and Flooding. Accessed 29 April 2021 at https://www.fema.gov/pdf/news/pda/1895.pdf
[15] Data provided by MAPC via personal communication – 26 April 2021.
[16] There has been additional documentation of this at the local level. For example, the town of Marshfield has found that 40% of properties flooded in recent storms were not actually mapped in FEMA floodplain maps. See Town of Marshfield. 2018. Program for Public Information. Accessed 30 April 2021 at https://www.marshfield-ma.gov/sites/g/files/vyhlif3416/f/uploads/ppi_-_3-14_update_1.pdf
[17] Federal Emergency Management Agency. 2013. Designing for flood levels above the BFE after Hurricane Sandy. Accessed 20 April 2021 at https://miamirivercommission.org/PDF/Agenda%2002.07.19/Agenda3/Tiffany/SandyRA5DesignAboveBFE_508_FINAL2.pdf
[18] Office of the Inspector General. 2017. FEMA Needs to Improve Management of its Flood Mapping Program. https://www.oig.dhs.gov/reports/2017/fema-needs-improve-management-its-flood-mapping-program/oig-17-110-sep17
[19] Florida International University and the Florida Building Commission. 2019. Potential Implications for Sea Level Rise and Changing Rainfall for Communities in Florida Using Miami-Dade as a Case Study. https://environment.fiu.edu/coastlines-and-oceans/resources/_assets/fbc_fiu_finalreport_22aug2019.pdf
[20] James Bruggers, "Not Trusting FEMA's Flood Maps, More Storm-Ravaged Cities Set Tougher Rules," InsideClimate News, March 19, 2019, https://insideclimatenews.org/news/19032019/fema-flood-maps-risk-zones-cities-climate-change-mexico-beach-houston-outer-banks.

municipal building codes.[21] Other states have entered into partnerships with FEMA to update their maps, demonstrating that this is a deficiency that other states are recognizing.[22]

- **There is a strong interest at the state level in updating underlying floodplain data, while municipalities are already attempting to use forward looking data within zoning ordinances and climate adaptation planning.** The Baker administration and the Executive Office of Energy and Environmental Affairs (EEA) has encouraged municipalities to evaluate flood risk through the Municipal Vulnerability Preparedness (MVP) program. From 2013-2015, the Woods Hole Group, researchers from academic institutions, and from the Massachusetts Department of Transportation (MassDOT) developed a flood risk model to assess climate change vulnerability of the central artery and tunnel system in Boston commissioned by MassDOT and the Federal Highway Administration (FHWA). [23] EEA is also working to embed climate risk evaluation in its environmental review process,[24] and developing statewide climate hazard data. [25] However, a key challenge for municipalities is preemption by the state building code when it comes to integrating this data into building standards. They are limited in what they can accomplish through local zoning – though many have attempted to circumvent the statewide code through creative zoning provisions and special permit review.[26, 27,28] Many municipalities have created climate adaptation assessments, funded through MVP program planning grants.[29]

B. <u>Increase freeboard/elevation requirements within local jurisdictions where forward looking or current extent maps are not available.</u>

- **Increasing minimum freeboard requirements is a necessary step that will safeguard residents and protect property during storm events.** The proposal includes changes to

[21] Laurie Mazur, "Fill, Build and Flood: Dangerous Development in Flood-Prone Areas," US News & World Report, October 8, 2019, https://www.usnews.com/news/healthiest-communities/articles/2019-10-08/commentary-the-danger-of-development-in-flood-prone-areas.
[22] Several states, including New Jersey, have entered a Cooperating Technical Partnership with FEMA which allows them to prepare and update their floodplain maps in-house, and take future conditions into account.
[23] Kirk Bosma et al., "MassDOT-FHWA Pilot Project Report: Climate Change and Extreme Weather Vulnerability Assessments and Adaptation Options for the Central Artery," June 2015, https://www.adaptationclearinghouse.org/resources/massdot-fhwa-pilot-project-report-climate-change-and-extreme-weather-vulnerability-assessments-and-adaptation-options-for-the-central-artery.html.
[24] Massachusetts Executive Office of Energy and Environmental Affairs (EEA).2021. MEPA Interim Protocol on Climate Change Adaptation and Resiliency. https://www.mass.gov/doc/draft-mepa-interim-protocol-on-climate-change-adaptation-and-resiliency-0/download
[25]Massachusetts Executive Office of Energy and Environmental Affairs (EEA). 2021. Resilient MA Action Team (RMAT). https://www.mass.gov/info-details/resilient-ma-action-team-rmat
[26]Boston's Coastal Flood Resilience Overlay District is based on forward looking data, where the basis for this overlay district is the city's 1 percent storm probability floodplain for 2070. Proponents undergoing project review within Boston's overlay district must elevate above a new, forward-looking base flood elevation (BFE). See City of Boston. Coastal Flood Resilience Overlay District. September 9, 2020. http://www.bostonplans.org/getattachment/36aa2feb-a1dd-417f-84c6-c994ef3c4d36
[27] The City of Cambridge also has a floodplain overlay district and uses the FRM data to determine where this overlay lies.
[28] For example the communities of Canton, Manchester, Newton has named locally identified flood areas in addition to FEMA flood zones. See Town of Canton. 2018. Hazard Mitigation Plan. Accessed 29 April 2021 at https://www.town.canton.ma.us/DocumentCenter/View/3798/2018-Hazard-Mitigation-Plan-PDF, Town of Manchester. 2012. Hazard Mitigation Plan. Accessed 29 April 2021 at https://www.manchester.ma.us/DocumentCenter/View/622/FEMA-Hazard-Mitigation-Plan-2012-PDF, City of Newton. 2018. Climate Change Vulnerability Assessment. Accessed 29 April 2021 https://www.mass.gov/doc/newton-ccva-and-adaptation-action-plan/download
[29] Includes Cohasset, Wenham, Canton, Gloucester, Adams, Somerville, among others.

language in the Base and Residential Codes that adds additional freeboard requirements within flood hazard areas.

- **Some municipalities in the Commonwealth have already identified higher freeboard standards as a strategy and adopted local incentives or design guidelines to facilitate greater freeboard standards**. The coastal town of Hull provides a $500 rebate on Building Department fees to developers that elevate two feet above required freeboard.[30] Brookline's climate change design guidelines recommend one additional foot of freeboard.[31] Sandwich's climate action plan references freeboard as an important strategy to increase resilience in the city, and they are considering adapting a similar ordinance to Hull's.[32] The City of Boston recommends two feet of freeboard for critical infrastructure and one foot for all other buildings in the floodplain.[33] In addition, the Office of Coastal Zone Management ("CZM") recognizes the importance of increasing freeboard and has conducted research on how it would increase safety and lower insurance premiums.

- **States and cities outside of the Commonwealth have implemented higher freeboard standards to protect their residents and building stock.** Many states have higher freeboard requirements than those outlined in ASCE 24; for example, NY, and NJ require two feet of elevation in A Zones for certain classes of buildings. As of 2015, at least 42 municipalities have three feet freeboard requirements. This includes several counties in Florida, which made these changes after hurricanes destroyed entire communities across the region. There are also three feet freeboard requirements in several inland communities in Illinois, Tennessee, and Virginia, among others.[34] Notably, Houston TX increased freeboard to two feet within 500-year floodplains.[35] The common trend among these examples is that changes were made in reaction to disasters. It was only after these disasters occurred that these communities were able to act to reform existing standards. The Commonwealth can avoid this fate by proactively adopting higher standards and avoid having to react in the aftermath of disaster. The BBRS should modify freeboard requirements before a severe weather event impacts the state, and in doing so, protect life safety and economic investments.

C. Reform variance granting process for new construction or substantial improvement/damage within flood hazard areas:

- **The current MSBC variance process does not conform to floodplain management variance criteria as detailed in FEMA guidance, and that set forth of Title 44 Code of Federal Regulations (CFR) Part 60, Criteria for Land Management and Use, Subpart A – Requirements for Floodplain Management Regulations, Section 60.6 (44 CFR §60.6).** Because the BBRS did not adopt ICC's Appendix G – Flood-Resistant Construction, and

[30] Massachusetts Office of Coastal Zone Management. 2020. "Hull Freeboard Incentive and Storm Surge Visualization,"https://www.mass.gov/service-details/hull-freeboard-incentive-and-storm-surge-visualization.
[31] " Massachusetts Executive Office of Energy and Environmental Affairs. 2019. Brookline Climate Resilience Design Guidance"
[32] "Climate Change Vulnerability / Risk Assessment and Adaptation Study Town of Sandwich" (Woods Hole Group, August 2019).
[33] City of Boston. Coastal Flood Resilience Overlay District. September 9, 2020. http://www.bostonplans.org/getattachment/36aa2feb-a1dd-417f-84c6-c994ef3c4d36
[34] The Association of State Floodplain Managers. "States and Other Communities in FEMA CRS with Building Freeboard Requirements." https://asfpm-library.s3-us-west-2.amazonaws.com/General/States_with_freeboard_and_CRS_Communities_with_Freeboard_in_Other_states_2-27-15.pdf
[35]

because it amended the related section of ICC's residential code in the 9th edition of the MSBC, it also did not adopt related language from 44 CFR §60.6 in the Appendix. As such, the current state variance process conducted by the Building Board of Appeals does not align with FEMA statutory or regulatory requirements. BBRS should bring the Building Board of Appeals practices in line with FEMA requirements to avoid jeopardizing the state's NFIP status.

FEMA's requirements are included in the language of NFIP local bylaws for participating communities in Massachusetts. However, variances to flood-resistant construction standards may be granted at the state level by the Board of Building Appeals, where similar guidance is not currently included in the 9th edition of the MSBC. Modifications are deferred to the Building Board of Appeals, without any guidance about what conditions justify a variance. As the FEMA guidance notes, variances can "lead to an increased risk to life and property, variances from flood elevation requirements or other floodplain management requirements should be granted only rarely."[36] This guidance exists to help protect life safety and prevent financial losses. In addition, it is required for communities to maintain NFIP status, where FEMA has the legal authority to act to revoke the state's NFIP status if inappropriate variances are authorized at the state level. As such, it is critical that the new version of the code include the 2021 ICC language that aligns with the codified Federal language, as it is included in Section G106 of Appendix G – Flood Resistant Construction of the 2021 ICC, and Section R.104.10.1 in Chapter 1 of the 2021 Residential Code.

III. Pro and Con Reasons for Adoption

This proposal will improve public health and safety in Massachusetts by ensuring that new development is suitable for the increased risk of flooding due to climate change. The structures that people live, work, and depend upon should be built to standards that rely on forward-looking data, and to precautionary standards that help to avoid catastrophic losses. The recommendations in this proposal will also reduce flood insurance premiums for certain communities and the cost of lending (see cost section below), while clarifying the process from which the state grants variances. It is unclear what burden, if any, these changes will place on municipalities, including municipal inspection staff. CLF is willing to meet with and coordinate educational seminars or trainings with building officials should these changes be enacted. Any changes in the cost of new construction or substantial improvements will likely more than be offset by savings from flood insurance premium reductions, avoided losses, avoided emergency response costs, and protection of life, health, and safety. Ultimately, the benefits of these recommendations will outweigh the cost, if any, of enacting them.

A. Cost Savings from Averted Losses

The Commonwealth should be using every possible tool to ensure that properties can withstand climate risks, including the changes recommended in this proposal. Right now, there is an estimated $63B of built infrastructure in Massachusetts at significant flood risk—a sum that is greater than the economic losses resulting from the Great Recession.[37] The City of Boston could lose up to $9 billion

[36] FEMA. 2014. Variances and the National Flood Insurance Program. https://www.fema.gov/sites/default/files/2020-08/FEMA_P-993_FPM-Bulletin_Variance.pdf
[37] "89,000 Massachusetts Homes Worth $63 Billion Will Be at Risk from Tidal Flooding," Union of Concerned Scientists, June 18, 2018, https://www.ucsusa.org/about/news/89000-massachusetts-homes-worth-63-billion-will-be-risk-tidal-flooding.

worth of infrastructure due to storm surge alone.[38] Using more accurate floodplains will help ensure that developers are aware of the increased risks in areas that are outside of FEMA designated risk zones and can more adequately design and plan for those risks. FEMA has also developed report on the economic benefits of passing resilient building codes across the country, reiterating that national opinion is coalescing around the need for resilient buildings. Findings "resemble other analyses that show how modern building codes can avert billions or trillions of dollars of damage through steps such as elevating homes and making buildings more resilient to hurricane winds, tornadoes and earthquakes."[39]

The changes in this proposal will help prevent losses by both increasing minimum elevation requirements and allowing municipalities to incorporate new reference data to specify flood proof construction in new areas, potentially with new modeled BFEs. Notably, "flood damage increases rapidly once the elevation of the flood extends above the lowest floor of a building, especially in areas subject to coastal waves."[40] Thus, elevating buildings has a significant effect on curbing flood damage. In Houston for example, 84% of homes would not have flooded if the city had a freeboard requirement of two feet for all buildings in the 500-year floodplain.[41] The magnitude of this avoided loss and avoided disruption to residents' lives cannot be understated. And for homes that did experience flooding, homes with freeboard avoided $21,000 in damage per parcel.[42] Researchers found that municipalities with freeboard requirements saved about $800,000 per year in flood losses.[43]

B. <u>Flood Insurance Premium Benefits</u>

Flood insurance is widespread across the state. As of February 2020, there are 58,595 flood insurance policies issued by FEMA in MA, with an average premium of $1,514. From 2011 to 2016, flood insurance claims amounted to $45M on 2,557 flood insurance policies.[44]

It is important to note that the changes recommended in this proposal, including the recommendation to allow municipalities to apply flood-resistant construction standards to areas beyond those that are identified on FEMA floodplain maps, **will not have an impact on flood insurance requirements**. The NFIP continues to rely on FEMA floodplain maps for the purposes of premium setting and mandatory flood insurance purchase requirements. Thus, changes to the state building code will not expand the number of properties subject to mandatory flood insurance nor will it increase premiums for existing policy holders.

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[38] Boston Globe. 2020. "Crashing Coastal Property Values and the Economic Fallout of Climate Change." Accessed 21 April 2021 a https://www.bostonglobe.com/2020/07/08/opinion/crashing-coastal-property-values-economic-fallout-climate-change/

[39] Federal Emergency Management Agency. 2020. Building Codes Save: A Nationwide Study of Loss Prevention. https://www.fema.gov/emergency-managers/risk-management/building-science/building-codes-save-study#:~:text=FEMA's%20landmark%20study%2C%20%E2%80%9CBuilding%20Codes,each%20state%20and%20Washington%2C%20D.C.

[40] "Designing for Flood Levels Above the BFE."

[41] Texas A&M University. 2018. "Eye of the Storm." https://www.rebuildtexas.today/wp-content/uploads/sites/52/2018/12/12-11-18-EYE-OF-THE-STORM-digital.pdf

Texas A&M University. 2018. "Eye of the Storm." https://www.rebuildtexas.today/wp-content/uploads/sites/52/2018/12/12-11-18-EYE-OF-THE-STORM-digital.pdf

[43] Texas A&M University. 2018. "Eye of the Storm." https://www.rebuildtexas.today/wp-content/uploads/sites/52/2018/12/12-11-18-EYE-OF-THE-STORM-digital.pdf

[44] Compiled from public FEMA data.

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However, the changes introduced in the proposal may help *decrease* flood insurance premiums in a community by increasing the rating of municipalities participating in FEMAs Community Rating System (CRS). Municipalities participating in CRS are encouraged to take measures to limit flood risk, including the use of forward-looking hydrology to draw floodplain boundaries and establishing more stringent building code requirements for flood hazard areas. As of April 2020, 25 municipalities in Massachusetts participate in the CRS program.[45] In exchange, communities can receive a discount on insurance premiums for property owners within the municipality. Through CRS municipalities that take measures to limit flood risk, including raising freeboard, receive insurance premium reductions for everyone in the municipality.

CZM has done its own cost-benefit analysis of up to three feet of additional freeboard and finds that total monthly payments on homes with more freeboard are smaller than homes without freeboard, as seen in Table 1, because insurance premiums decrease significantly more than mortgage payments increase.[46]

Table 1: Mortgage and Insurance Savings of 3 feet of Freeboard in Floodplains[47]		
	A Zone	V Zone
Annual Savings in NFIP Payments	$743 (60%)	$3,415 (62%)
Savings Over 30 Year Mortgage	$22,290	$102,450

Finally, adopting additional guidance for variance granting will also have cost benefits because structures authorized pursuant to variances are often subject to higher insurance premiums.

C. Impact on Costs of Lending

The financial industry is beginning to acknowledge and integrate risks into their business. Smaller banks are less willing to insure mortgages in coastal zones, especially those without resilient design requirements, and are instead selling those loans to government agencies Fannie Mac and Freddie Mac. As these property values collapse, the government could lose tax revenue and the government could see retirement savings and wealth plummet across the state.[48] Buyers are already becoming aware of the risk of buying homes in flood zones that are not designed safely—home sales grew 25% slower in flood-prone areas than in non-flood prone areas from 2011 to 2016. Researchers predict that the 30-year mortgage will no longer be offered in coastal communities in the near future, as investors refuse to invest in such risky areas.[49] Prospective buyers are worried about damage, safety, and high flood insurance premiums in flood-prone areas, thus making real estate located there more susceptible

[45] "Harwich Resiliency Efforts Lower Flood Insurance Premiums," Barnstable County, April 28, 2020, https://www.barnstablecounty.org/2020/04/28/harwich-resiliency-efforts-lower-flood-insurance-premiums/.
[46] Wes Shaw, "Using Freeboard to Elevate Structures Above Predicted Floodwaters" (MA Office of Coastal Zone Management, June 2009), https://www.mass.gov/service-details/using-freeboard-to-elevate-structures-above-predicted-floodwaters.
[47] From Massachusetts Office of Coastal Zone Management. 2016. Raise Your Home, Lower Your Monthly Payments. Accessed 30 April 2021 at https://www.mass.gov/files/documents/2016/08/tb/ssc5-freeboard.pdf
[48] Boston Globe. 2020. "Crashing Coastal Property Values and the Economic Fallout of Climate Change." Accessed 21 April 2021 at https://www.bostonglobe.com/2020/07/08/opinion/crashing-coastal-property-values-economic-fallout-climate-change/
[49] Patrick Sisson, "How Climate Change Creates a 'New Abnormal' for the Real Estate Market," Curbed, October 29, 2019, https://www.curbed.com/2019/10/29/20930330/real-estate-climate-change-federal-reserve-flooding.

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to declining property value.[50] Utilizing future floodplains and additional elevation requirements to better design and prepare for these risks is crucial for increasing confidence among residents who already own homes in flood zones and residents who are thinking about buying homes in these areas.

IV. Life Safety Benefits

Climate change is expected to increase the severity of extreme weather events, temperatures, extreme precipitation events, and sea level rise. All these conditions will exacerbate flood risks in Massachusetts. The frequency of "100-year flood events are predicted to increase significantly in the coming century and could result in flooding 25 to 75 days out of the year in some coastal communities."[51] With this are increased threats to life safety for residents of the Commonwealth.

This proposal recommends changes that will promote life safety through higher minimum elevation requirements and by allowing municipalities to mandate flood-resistant construction standards for development within the current and future floodplain.

Tropical Storm Sandy in 2012, Hurricane Harvey in 2017, and many more have demonstrated the devastating impact that storms can have on ill-prepared infrastructure and the subsequent consequences for health, safety, and the economy. Housing instability is a major issue in the aftermath of extreme weather events as resident's homes are destroyed, which often has a ripple effects on local and state budgets. For those who are fortunate enough to return to their homes after a storm, rehabilitation costs can cost hundreds of thousands of dollars—especially for those without insurance. For municipalities that are not able to substitute forward looking or current extent floodplain maps, increased minimum freeboard standards will help protect Commonwealth residents by preparing structures for greater flood risks.

Finally, making the variance process more rigorous will help to ensure that variances meet FEMAs statutory and regulatory requirements and avoid any increased risks to residents living or working at or near the specified property. Specifically, including the conditions in Appendix G and Chapter 1 of the 2021 ICC in the 10th edition of the MSBC will create a clearer process for the Building Board of Appeals to consider public welfare and the impact of variances on flood risk.

V. Cost to Building Owners

This proposal will apply the costs of flood-resistant construction to a wider area of the Commonwealth, which may increase up-front costs of building. The proposed increases in minimum elevation standards may also increase up-front costs. According to a 2008 FEMA report, three feet of freeboard increases building costs in V Zones, Coastal A Zones, and A Zones by 1.3-5.4%, 1.1-6.1%, and .7-6.8% respectively.[52] According to a more recent study by the Association of State Floodplain Managers, an additional foot of freeboard costs from $890 to $4,470 depending on the construction

[50] Ian Urbina, "Perils of Climate Change Could Swamp Coastal Real Estate," *The New York Times*, November 24, 2016, sec. Science, https://www.nytimes.com/2016/11/24/science/global-warming-coastal-real-estate.html.
[51] New York Times. 2020. "New Data Shows an 'Extraordinary' Rise in U.S. Coastal Flooding," https://www.nytimes.com/2020/07/14/climate/coastal-flooding-noaa.html.
[52] FEMA. 2008. "2008 Supplement to the 2006 Evaluation of the National Flood Insurance Program's Building Standards"

material used.[53] For homes that are already built undergoing substantial improvement, the increased cost of elevation may be higher.

However, as described above, the cost savings imposed by avoided property damage, and the reduction in flood insurance costs that will be provided are significant and likely to offset any additional costs to building owners.

VI. Petitioning for MSBC Changes, Versus ICC Changes

Communities across the nation experience different types of climate risks; advocating for code changes through ICC related to climate resilience would not be effective as a result. Massachusetts faces a specific universe of risks, where flood risk is especially prescient. The climate change projections for Massachusetts, including sea level rise, are unique and require a state-specific approach. Code changes presented here are best suited to address Massachusetts' state-specific risk, which is not universally applicable for all governments adopting the ICC. Additionally, other states apply building code differently. In Massachusetts, cities and towns are pre-empted from regulating beyond the code. As described above, municipalities in other states are increasingly addressing risks by adopting heightened standards at the local level, but this is not possible in Massachusetts. Despite the challenges of preemption, municipalities in Massachusetts are still pushing ahead with heightened standards and many have attempted to circumvent preemption with creative zoning and special permit requirements. Modernizing the MSBC to account for the heightened risk of flooding due to climate change would ease the burden on municipalities and create consistency across the state for flood-resistant construction.

[53] "The Costs & Benefits of Building Higher" (Association of State Floodplain Managers, 2018), https://sema.dps.mo.gov/programs/floodplain/documents/costs-benefits-flier.pdf.

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APPENDIX - SUGGESTED CODE CHANGES FOR INCORPORATION INTO MSBC 10th EDITION

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CHAPTER 2 DEFINITIONS

SECTION 202 DEFINITIONS

Adopt text in IBC 2021 with revisions.

ADOPTED BASE FLOOD ELEVATION (BFE): The elevation of the base flood, including wave height, for any flood hazard area designated by a community that has legally adopted a forward looking or current extent of flooding map that is more expansive than what is designated on the community's Flood Insurance Rate Map (FIRM) or Flood Hazard Boundary Map (FHBM).

[BS] DESIGN FLOOD ELEVATION. The elevation of the "*design flood*," including wave height, relative to the datum specified on the community's legally designated flood hazard map. In areas designated as Zone AO, the *design flood elevation* shall be the elevation of the highest existing grade of the building's perimeter plus the depth number (in feet) specified on the flood hazard map. In areas designated as Zone AO where a depth number is not specified on the map, the depth number shall be taken as being equal to 2 feet (610 mm). For communities that have Adopted Base Flood Elevations (BFEs) designated on their flood map, the Design Flood Elevation for a structure shall not be lower than the prescribed elevation that would result from the elevation required by code plus the Base Flood Elevation specified on a community's Flood Insurance Rate Map (FIRM) or Flood Hazard Boundary Map (FHBM).

[BS] FLOOD HAZARD AREA. The greater of the following two areas:

1. The area within a flood plain subject to a 1-percent or greater chance of *flooding* ~~in any year,~~ as designated in the community's current effective Flood Insurance Rate Map (FIRM) or Flood Hazard Boundary Map (FHBM), whichever is applicable.
2. The area designated as a flood hazard area on a community's flood hazard map, or otherwise legally designated, including forward looking flood models and the current observed extent of flooding if possible. Forward looking or current extent of flooding maps shall be adopted by city or town via ordinance or bylaw and be developed using the best available science and data.

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CHAPTER 16 STRUCTURAL DESIGN

SECTION 1612: FLOOD LOADS

Adopt text in IBC 2021 with revisions.

1612.1 General.
Within *flood hazard areas* as established in Section 1612.3, all new construction of buildings, structures and portions of buildings and structures, including *substantial improvement* and restoration of *substantial damage* to buildings and
structures, shall be designed and constructed to resist the effects of flood hazards and *flood loads*. For buildings that are located in more than one *flood hazard area*, the provisions associated with the most restrictive *flood hazard area* shall apply.

1612.2 Design and construction.
The design and construction of buildings and structures located in *flood hazard areas*, including *coastal high hazard areas*
and *coastal A zones*, shall be in accordance with Chapter 5 of ASCE 7 and ASCE 24 plus one additional extra foot of freeboard (see REVISED - ASCE 24 Tables for flood-resistant materials and dry and wet-floodproofing below).

Exception:

- Communities that have adopted forward looking or current extent floodplain maps with Adopted BFEs shall use the best available data and science to determine the appropriate elevation levels. The elevation of the lowest floor, elevation of lowest horizontal structural member, elevation below which flood damage resistant materials are used, elevation of utilities and equipment and elevation of dry-flood-proofing of non-residential structures and non-residential portions of mixed used buildings and elevation of wet flood proofing shall not be lower than the Base Flood Elevation as defined by FEMA plus the freeboard increments included in the revised ASCE 24 table below.

1612.3 Establishment of flood hazard areas.
To establish *flood hazard areas*, the applicable governing authority shall adopt a flood hazard map and supporting data. The flood hazard map shall include, at a minimum, areas of special flood hazard as identified by the Federal Emergency Management Agency in an engineering report entitled "The *Flood Insurance Study* for **[INSERT NAME OF JURISDICTION]**," dated **[INSERT DATE OF ISSUANCE]**, as amended or revised with the accompanying *Flood Insurance Rate Map* (FIRM) and Flood Boundary and *Floodway* Map (FBFM) and related supporting data along with any revisions thereto. A community may also choose to adopt a flood hazard map via ordinance or bylaw that is forward looking or describes the greatest current extent of flooding. Any such flood hazard map shall be based on the best available source of data and shall be more expansive than the special flood hazard areas identified by the Federal Emergency Management Agency on a community's FIRM or FBFM. The adopted flood *hazard areas should also include Adopted Base Flood Elevation (BFEs).*
The adopted flood hazard map and supporting data are hereby adopted by reference and declared to be part of this section.

1612.3.1 Design flood elevations.
Where *design flood elevations* are not included in the *flood hazard areas* established in Section 1612.3, or where *floodways* are not designated, the *building official* is authorized to require the applicant to do one of the following:

1. Obtain and reasonably utilize any design flood elevation and floodway data available from a federal, state or other source.
2. Determine the design flood elevation or floodway in accordance with accepted hydrologic and hydraulic engineering practices used to define special flood hazard areas. Determinations shall be undertaken by a registered design professional who shall document that the technical methods used reflect currently accepted engineering practice.

1612.3.2 Determination of impacts.
In riverine *flood hazard areas* where *design flood elevations* are specified but *floodways* have not been designated,the applicant shall provide a *floodway* analysis that demonstrates that the proposed work will not increase the *design flood elevation* more than 1 foot (305 mm) at any point within the jurisdiction of the applicable governing authority

1612.4 Flood hazard documentation.
The following documentation shall be prepared and sealed by a *registered design professional* and submitted to the *building official*:

1. For construction in *flood hazard areas* other than *coastal high hazard areas* or *coastal A zones*:
   1.1. The elevation of the *lowest floor*, including the basement, as required by the lowest floor elevation inspection in Section 110.3.3 and for the final inspection in Section 110.3.12.1.
   1.2. For fully enclosed areas below the *design flood elevation* where provisions to allow for the automatic entry and exit of floodwaters do not meet the minimum requirements in Section 2.7.2.1 of ASCE 24, *construction documents* shall include a statement that the design will provide for equalization of hydrostatic flood forces in accordance with Section 2.7.2.2 of ASCE 24.
   1.3. For *dry flood proofed* nonresidential buildings, *construction documents* shall include a statement that the *dry flood proofing* is designed in accordance with ASCE 24 and shall include the flood emergency plan specified in Chapter 6 of ASCE 24.
2. For construction in *coastal high hazard areas* and *coastal A zones*:
   2.1. The elevation of the bottom of the lowest horizontal structural member as required by the *lowest floor* elevation inspection in Section 110.3.3 and for the final inspection in Section 110.3.12.1.
   2.2. *Construction documents* shall include a statement that the building is designed in accordance with ASCE 24, including that the pile or column foundation and building or structure to be attached thereto is designed to be anchored to resist flotation, collapse and lateral movement due to the effects of wind and *flood loads* acting simultaneously on all building components, and other *load* requirements of Chapter 16.

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2.3. For breakaway walls designed to have a resistance of more than 20 psf (0.96 kN/m) determined using *allowable stress design*, *construction documents* shall include a statement that the breakaway wall is designed in accordance with ASCE 24.

2.4 For breakaway walls where provisions to allow for the automatic entry and exit of floodwaters do not meet the minimum requirements in Section 2.7.2.1 of ASCE 24, construction documents shall include a statement that the design will provide for equalization of hydrostatic flood forces in accordance with Section 2.7.2.2 of ASCE 24.

REVISED - ASCE 24 Tables for flood-resistant materials and dry and wet-floodproofing

-	-	Flood Design Class 1	Flood Design Class 2	Flood Design Class 3	Flood Design Class 4
Elevation of Lowest Floor (A Zone)	All A Zones not Identified as Coastal A Zones	BFE +2 ft	BFE + 2 ft	BFE + 2 ft	BFE + 3 ft
Minimum Elevation of Lowest Horizontal Structural Member	All V Zones and Coastal A Zones	BFE + 3 ft	BFE + 3 ft	BFE + 3 ft	BFE + 3 ft
Minimum Elevation Below Which Flood-Damage-Resistant Materials Shall be Used	All A Zones not Identified as Coastal A Zones	BFE +2 ft	BFE + 2 ft	BFE + 2 ft	BFE + 3 ft
-	All V Zones and Coastal A Zones	BFE + 3 ft	BFE + 3 ft	BFE + 3 ft	BFE + 3 ft
Minimum Elevation** of Utilities and Equipment	All A Zones not Identified as Coastal A Zones	BFE +2 ft	BFE + 2 ft	BFE + 2 ft	BFE + 3 ft
-	All V Zones and Coastal A Zones	BFE + 3 ft	BFE + 3 ft	BFE + 3 ft	BFE + 3 ft
Minimum Elevation of Dry Flood-proofing of non-residential structures and non-residential portions of mixed used buildings	All A Zones not Identified as Coastal A Zones	BFE +2 ft	BFE + 2 ft	BFE + 2 ft	BFE + 3 ft
-	All V Zones and Coastal A Zones	Not permitted	Not permitted	Not permitted	Not permitted

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Minimum Elevation of Wet Floodproofing***	All A Zones not Identified as Coastal A Zones	BFE +2 ft	BFE + 2 ft	BFE + 2 ft	BFE + 3 ft
	Zone V	Not permitted	Not permitted	Not permitted	Not permitted
*Flood design class 1 structures shall be allowed below the minimum elevation if the structure meets the wet floodproofing requirements of ASCE 24-14 section 6.3.					
**Unless otherwise permitted by ASCE 24-14 Chapter 7, except in V zones where protection of utilities and equipment below the indicated elevation is not accepted.					
***Only if permitted by ASCE 24-14 section 6.3.1.					

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APPENDIX G FLOOD-RESISTANT CONSTRUCTION

SECTION G106 VARIANCES

Adopt text in IBC 2021 with no revisions, replace the text of the corresponding section of the MSBC 9th Edition with IBC 2021 text in MSBC 10th Edition.

G106.1 General.

The *board of appeals* established pursuant to Section 113, or other established or designed board, shall hear and decide requests for variances. The board shall base its determination on technical justifications, and has the right to attach such conditions to variances as it deems necessary to further the purposes and objectives of this appendix and Section 1612.

SECTION G106 VARIANCES

G106.2 Records.

The floodplain administrator shall maintain a permanent record of all variance actions, including justification for their issuance.

G106.3 Historic structures.

A variance is authorized to be issued for the repair or rehabilitation of a historic structure upon a determination that the proposed repair or rehabilitation will not preclude the structure's continued designation as a historic structure, and the variance is the minimum necessary to preserve the historic character and design of the structure.

Exception: Within *flood hazard areas*, historic structures that do not meet one or more of the following designations:

1. Listed or preliminarily determined to be eligible for listing in the National Register of Historic Places.
2. Determined by the Secretary of the U.S. Department of Interior as contributing to the historical significance of a registered historic district or a district preliminarily determined to qualify as an historic district.
3. Designated as *historic* under a state or local historic preservation program that is approved by the Department of Interior.

G106.4 Functionally dependent facilities.

A variance is authorized to be issued for the construction or *substantial improvement* of a functionally dependent facility provided that the criteria in Section 1612.1 are met and the variance is the minimum necessary to allow the construction or *substantial improvement*, and that all due consideration has been given to methods and materials that minimize *flood* damages during the *design flood* and do not create additional threats to public safety.

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G106.5 Restrictions.

The board shall not issue a variance for any proposed development in a *floodway* if any increase in flood levels would result during the *base flood* discharge.

G106.6 Considerations.

In reviewing applications for variances, the board shall consider all technical evaluations, all relevant factors, all other portions of this appendix and the following:

1. The danger that materials and debris may be swept onto other lands resulting in further injury or damage.
2. The danger to life and property due to *flooding* or erosion damage.
3. The susceptibility of the proposed development, including contents, to *flood* damage and the effect of such damage on current and future owners.
4. The importance of the services provided by the proposed development to the community.
5. The availability of alternate locations for the proposed development that are not subject to *flooding* or erosion.
6. The compatibility of the proposed development with existing and anticipated development.
7. The relationship of the proposed development to the comprehensive plan and flood plain management program for that area.
8. The safety of access to the property in times of *flood* for ordinary and emergency vehicles.
9. The expected heights, velocity, duration, rate of rise and debris and sediment transport of the floodwaters and the effects of wave action, if applicable, expected at the site.
10. The costs of providing governmental services during and after *flood* conditions including maintenance and repair of public utilities and facilities such as sewer, gas, electrical and water systems, streets and bridges.

G106.7 Conditions for issuance.

Variances shall only be issued by the board where all of the following criteria are met:

1. A technical showing of good and sufficient cause that the unique characteristics of the size, configuration or topography of the site renders the elevation standards inappropriate.
2. A determination that failure to grant the variance would result in exceptional hardship by rendering the lot undevelopable.
3. A determination that the granting of a variance will not result in increased *flood* heights, additional threats to public safety, extraordinary public expense, nor create nuisances, cause fraud on or victimization of the public or conflict with existing local laws or ordinances.
4. A determination that the variance is the minimum necessary, considering the *flood* hazard, to afford relief.
5. Notification to the applicant in writing over the signature of the floodplain administrator that the issuance of a variance to construct a structure below the *base flood* level will result in increased premium rates for flood insurance up to amounts as high as $25 for $100 of insurance coverage, and that such construction below the *base flood* level increases risks to life and property.

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CHAPTER 1 SCOPE AND ADMINISTRATION

SECTION R104.10.1
DUTIES AND POWERS OF THE BUILDING OFFICIAL

Flood Hazard Areas

Adopt text in IBC 2021 with revisions.

R104.10.1 Flood hazard areas.

The *building official* shall not grant modifications to any provisions required in flood hazard areas as established by ~~Table R301.2~~ 780 CMR, without the granting of a variance by the Building Appeals Board. The Building Appeals Board shall not grant a variance unless a determination has been made that:

1. There is good and sufficient cause showing that the unique characteristics of the size, configuration or topography of the site render the elevation standards of Section R322 inappropriate.
2. Failure to grant the modification would result in exceptional hardship by rendering the lot undevelopable.
3. The granting of modification will not result in increased flood heights, additional threats to public safety, extraordinary public expense, cause fraud on or victimization of the public, or conflict with existing laws or ordinances.
4. The modification is the minimum necessary to afford relief, considering the flood hazard.
5. Written notice specifying the difference between the design flood elevation and the elevation to which the building is to be built, stating that the cost of flood insurance will be commensurate with the increased risk resulting from the reduced floor elevation and stating that construction below the design flood elevation increases risks to life and property, has been submitted to the applicant.

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SECTION R106 CONSTRUCTION DOCUMENT

Submittal documents consisting of *construction documents*, and other data shall be submitted in two or more sets, or in a digital format where allowed by the *building official*, with each application for a *permit*. The *construction documents* shall be prepared by a *registered design professional* where required by the statutes of the *jurisdiction* in which the project is to be constructed. Where special conditions exist, the *building official* is authorized to require additional *construction documents* to be prepared by a *registered design professional*.

Exception: The *building official* is authorized to waive the submission of *construction documents* and other data not required to be prepared by a *registered design professional* if it is found that the nature of the work applied for is such that reviewing of *construction documents* is not necessary to obtain compliance with this code.

R106.1.1 Information on construction documents.

Construction documents shall be drawn upon suitable material. Electronic media documents are permitted to be submitted where *approved* by the *building official*. *Construction documents* shall be of sufficient clarity to indicate the location, nature and extent of the work proposed and show in detail that it will conform to the provisions of this code and relevant laws, ordinances, rules and regulations, as determined by the *building official.*

R106.1.2 Manufacturer's installation instructions.

Manufacturer's installation instructions, as required by this code, shall be available on the job site at the time of inspection.

R106.1.3 Information on braced wall design.

For buildings and structures utilizing braced wall design, and where required by the *building official*, *braced wall lines* shall be identified on the *construction documents.* Pertinent information including, but not limited to, bracing methods, location and length of *braced wall panels* and foundation requirements of *braced wall panels* at top and bottom shall be provided.

R106.1.4 Information for construction in flood hazard areas.

For buildings and structures located in whole or in part in flood hazard areas as established by Table R301.2,

construction documents shall include:

1. Delineation of flood hazard areas, floodway boundaries and flood zones and the design flood elevation, as appropriate. For communities that have Adopted BFE values, documentation should be provided for any minimum elevation requirements established based on the Adopted BFE.
2. The elevation of the proposed lowest floor, including *basement*; in areas of shallow flooding (AO Zones), the height of the proposed lowest floor, including *basement*, above the highest adjacent *grade*.
3. The elevation of the bottom of the lowest horizontal structural member in coastal high-hazard areas (V Zone) and in Coastal A Zones where such zones are delineated on flood hazard maps identified in Table

R301.2 or otherwise delineated by the *jurisdiction*.

4. If design flood elevations are not included on the community's Flood Insurance Rate Map (FIRM), the *building official* and the applicant shall obtain and reasonably utilize any design flood elevation and floodway data available from other sources.

R106.1.5 Information on storm shelters.

Construction documents for *storm shelters* shall include the information required in ICC 500.

R106.2 Site plan or plot plan.

The *construction documents* submitted with the application for *permit* shall be accompanied by a site plan showing the size and location of new construction and existing structures on the site and distances from *lot lines*. In the case of demolition, the site plan shall show construction to be demolished and the location and size of existing structures and construction that are to remain on the site or plot. The *building official* is authorized to waive or modify the requirement for a site plan where the application for *permit* is for *alteration* or *repair* or where otherwise warranted.

R106.3 Examination of documents.

The *building official* shall examine or cause to be examined *construction documents* for code compliance.

R106.3.1 Approval of construction documents.

Where the *building official* issues a *permit*, the *construction documents* shall be *approved* in writing or by a stamp

hat states "REVIEWED FOR CODE COMPLIANCE." One set of *construction documents* so reviewed shall be retained by the *building official*. The other set shall be returned to the applicant, shall be kept at the site of work and shall be open to inspection by the *building official* or a duly authorized representative.

R106.3.2 Previous approvals.

This code shall not require changes in the *construction documents*, construction or designated occupancy of a structure for which a lawful *permit* has been heretofore issued or otherwise lawfully authorized, and the construction of which has been pursued in good faith within 180 days after the effective date of this code and has not been abandoned.

R106.3.3 Phased approval.

The *building official* is authorized to issue a *permit* for the construction of foundations or any other part of a building or structure before the *construction documents* for the whole building or structure have been submitted, provided that adequate information and detailed statements have been filed complying with pertinent requirements of this code. The holder of such *permit* for the foundation or other parts of a building or structure shall proceed at the holder's own risk with the building operation and without assurance that a *permit* for the entire structure will be granted.

R106.4 Amended construction documents.

Work shall be installed in accordance with the *approved construction documents*, and any changes made during construction that are not in compliance with the *approved construction documents* shall be resubmitted for approval as an amended set of *construction documents*.

R106.5 Retention of construction documents.

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One set of *approved construction documents* shall be retained by the *building official* for a period of not less than 180 days from date of completion of the permitted work, or as required by state or local laws.

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CHAPTER 3 BUILDING PLANNING

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Adopt text in IRC 2021 with revisions.

SECTION R301 DESIGN CRITERIA

SECTION R301 DESIGN CRITERIA

Buildings and structures, and parts thereof, shall be constructed to safely support all loads, including dead loads, *live loads*, roof loads, flood loads, snow loads, wind loads and seismic loads as prescribed by this code. The construction of buildings and structures in accordance with the provisions of this code shall result in a system that provides a complete load path that meets the requirements for the transfer of loads from their point of origin through the load-resisting elements to the foundation. Buildings and structures constructed as prescribed by this code are deemed to comply with the requirements of this section.

R301.1.1 Alternative provisions.

As an alternative to the requirements in Section R301.1, the following standards are permitted subject to the limitations of this code and the limitations therein. Where engineered design is used in conjunction with these standards, the design shall comply with the *International Building Code*.

1. AWC *Wood Frame Construction Manual* (WFCM).
2. AISI *Standard for Cold-Formed Steel Framing—Prescriptive Method for One- and Two-Family Dwellings* (AISI S230).
3. ICC *Standard on the Design and Construction of Log Structures*(ICC 400).

R301.1.2 Construction systems.

The requirements of this code are based on platform and balloon-frame construction for light-frame buildings. The requirements for concrete and masonry buildings are based on a balloon framing system. Other framing systems must have equivalent detailing to ensure force transfer, continuity and compatible deformations.

R301.1.3 Engineered design.

Where a building of otherwise conventional construction contains structural elements exceeding the limits of Section R301 or otherwise not conforming to this code, these elements shall be designed in accordance with accepted engineering practice. The extent of such design need only demonstrate compliance of nonconventional elements with other applicable provisions and shall be compatible with the performance of the conventional framed system. Engineered design in accordance with the *International Building Code* is permitted for buildings and structures, and parts thereof, included in the scope of this code.

R301.1.4 Intermodal shipping containers.

Intermodal shipping containers that are repurposed for use as buildings or structures shall be designed in accordance with the structural provisions in Section 3115 of the *International Building Code.*

R301.2 Climatic and geographic design criteria.

Buildings shall be constructed in accordance with the provisions of this code as limited by the provisions of this section. Additional criteria shall be established by the local *jurisdiction* and set forth in Table R301.2.

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TABLE R301.2
CLIMATIC AND GEOGRAPHIC DESIGN CRITERIA

GROUND SNOW LOADo	WIND DESIGN				SEISMIC DESIGN CATEGORYf	SUBJECT TO DAMAGE FROM			ICE BARRIER UNDERLAYMENT REQUIREDh	FLOOD HAZARDSg	AIR FREEZING INDEXi	MEAN ANNUAL TEMPj
	Speedd (mph)	Topographic effekcts	Special wind regionl	Windborne debris zonem		Weatheringa	Frost line depthb	Termitec				
—	—	—	—	—	—	—	—	—	—	—	—	—
MANUAL J DESIGN CRITERIAn												
Elevation			Altitude correction factore	Coincident wet bulb	Indoor winter design dry-bulb temperature	Indoor winter design dry-bulb temperature			Outdoor winter design dry-bulb temperture		**Heating temperature difference**	
—			—	—	—	—			—		—	

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Latitude	Daily range	Indoor summer design relative humidity	Indoor summer design relative humidity	Indoor summer design dry-bulb temperature	Outdoor summer design dry-bulb temperature	Cooling temperature difference
—	—	—	—	—	—	—

For SI: 1 pound per square foot = 0.0479 kPa, 1 mile per hour = 0.447 m/s.

a. Where weathering requires a higher strength concrete or grade of masonry than necessary to satisfy the structural requirements of this code, the frost line depth strength required for weathering shall govern. The weathering column shall be filled in with the weathering index, "negligible," "moderate" or "severe" for concrete as determined from Figure R301.2(1). The grade of masonry units shall be determined from ASTM C34, ASTM C55, ASTM C62, ASTM C73, ASTM C90, ASTM C129, ASTM C145, ASTM C216 or ASTM C652.

b. Where the frost line depth requires deeper footings than indicated in Figure R403.1(1), the frost line depth strength required for weathering shall govern. The jurisdiction shall fill in the frost line depth column with the minimum depth of footing below finish grade.

c. The jurisdiction shall fill in this part of the table to indicate the need for protection depending on whether there has been a history of local subterranean termite damage.

d. The jurisdiction shall fill in this part of the table with the wind speed from the basic wind speed map [Figure R301.2(2). Wind exposure category shall be determined on a site-specific basis in accordance with Section R301.2.1.4.

e. The jurisdiction shall fill in this section of the table to establish the design criteria using Table 10A from ACCA Manual J or established criteria determined by the jurisdiction.

f. The jurisdiction shall fill in this part of the table with the seismic design category determined from Section R301.2.2.1.

g. The jurisdiction shall fill in this part of the table with: the date of the jurisdiction's entry into the National Flood Insurance Program (date of adoption of the first code or ordinance for management of flood hazard areas); and the title and date of the currently effective Flood Insurance Study or other flood hazard study. Communities that have adopted forward looking or current extent floodplain maps should document the basis year and source of the data here.

h. In accordance with Sections R905.1.2, R905.4.3.1, R905.5.3.1, R905.6.3.1, R905.7.3.1 and R905.8.3.1, where there has been a history of local damage from the effects of ice damming, the jurisdiction shall fill in this part of the table with "YES." Otherwise, the jurisdiction shall fill in this part of the table with "NO."

i. The jurisdiction shall fill in this part of the table with the 100-year return period air freezing index (BF-days) from Figure R403.3(2) or from the 100-year (99 percent) value on the National Climatic Data Center data table "Air Freezing Index-USA Method (Base 32°F)."

j. The jurisdiction shall fill in this part of the table with the mean annual temperature from the National Climatic Data Center data table "Air Freezing Index-USA Method (Base 32°F)."

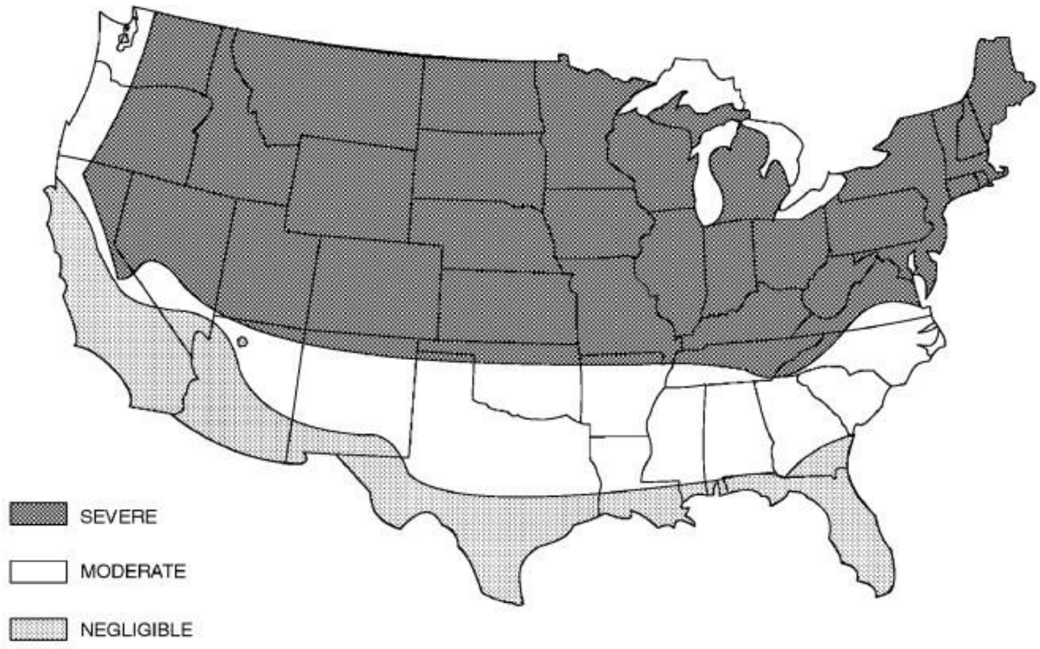
k. In accordance with Section R301.2.1.5, where there is local historical data documenting structural damage to buildings due to topographic wind speed-up effects, the jurisdiction shall fill in this part of the table with "YES." Otherwise, the jurisdiction shall indicate "NO" in this part of the table.

l. In accordance with Figure R301.2(2), where there are local historical data documenting unusual wind conditions, the jurisdiction shall fill in this part of the table with "YES" and identify any specific requirements. Otherwise, the jurisdiction shall indicate "NO" in this part of the table.

m. In accordance with Section R301.2.1.2 the jurisdiction shall indicate the wind- borne debris wind zone(s). Otherwise, the jurisdiction shall indicate "NO" in this part of the table.

n. The jurisdiction shall fill in these sections of the table to establish the design criteria using Table 1a or 1b from ACCA Manual J or established criteria determined by the jurisdiction.

o. The jurisdiction shall fill in this section of the table using the Ground Snow Loads in Figures R301.2(3) and R301.2(4).



a. Alaska and Hawaii are classified as severe and negligible, respectively.

b. Lines defining areas are approximate only. Local conditions may be more or less severe than indicated by region classification. A sever classification is where weather conditions result in significant snowfall combined with extended periods during which there is little or no natural thawing, causing deicing salts to be used extensively.

FIGURE R301.2(1)
WEATHERING PROBABILITY MAP FOR CONCRETEa, b

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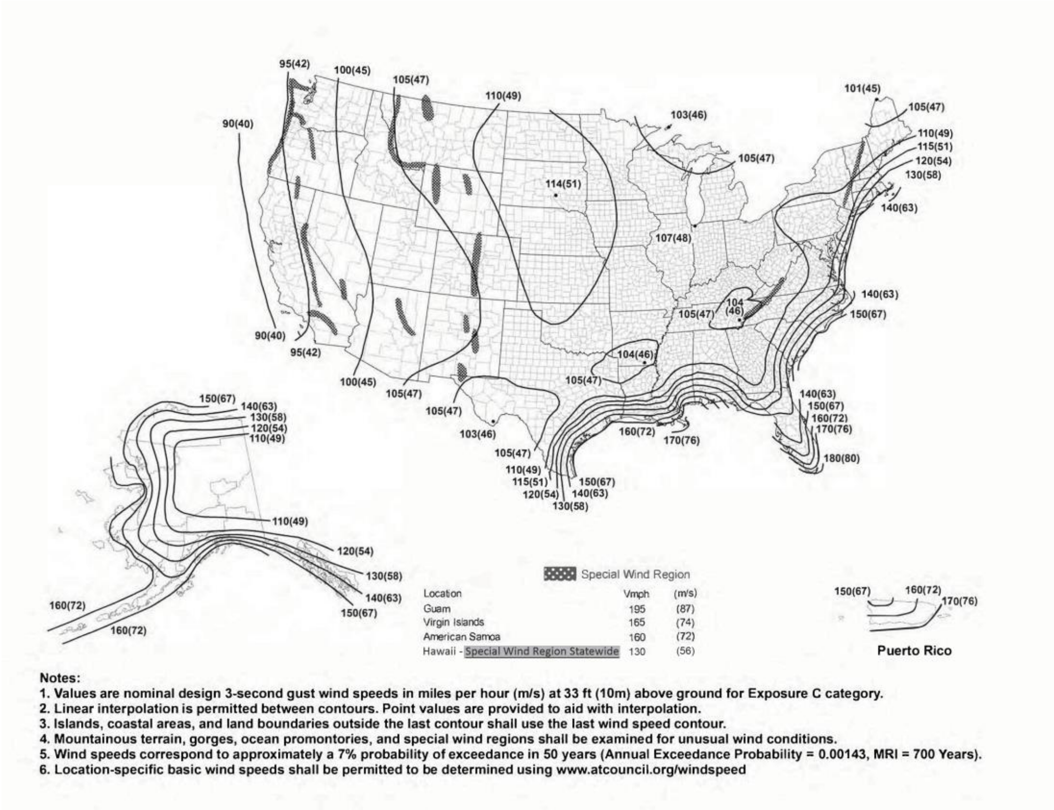

FIGURE R301.2(2) ULTIMATE DESIGN WIND SPEEDS

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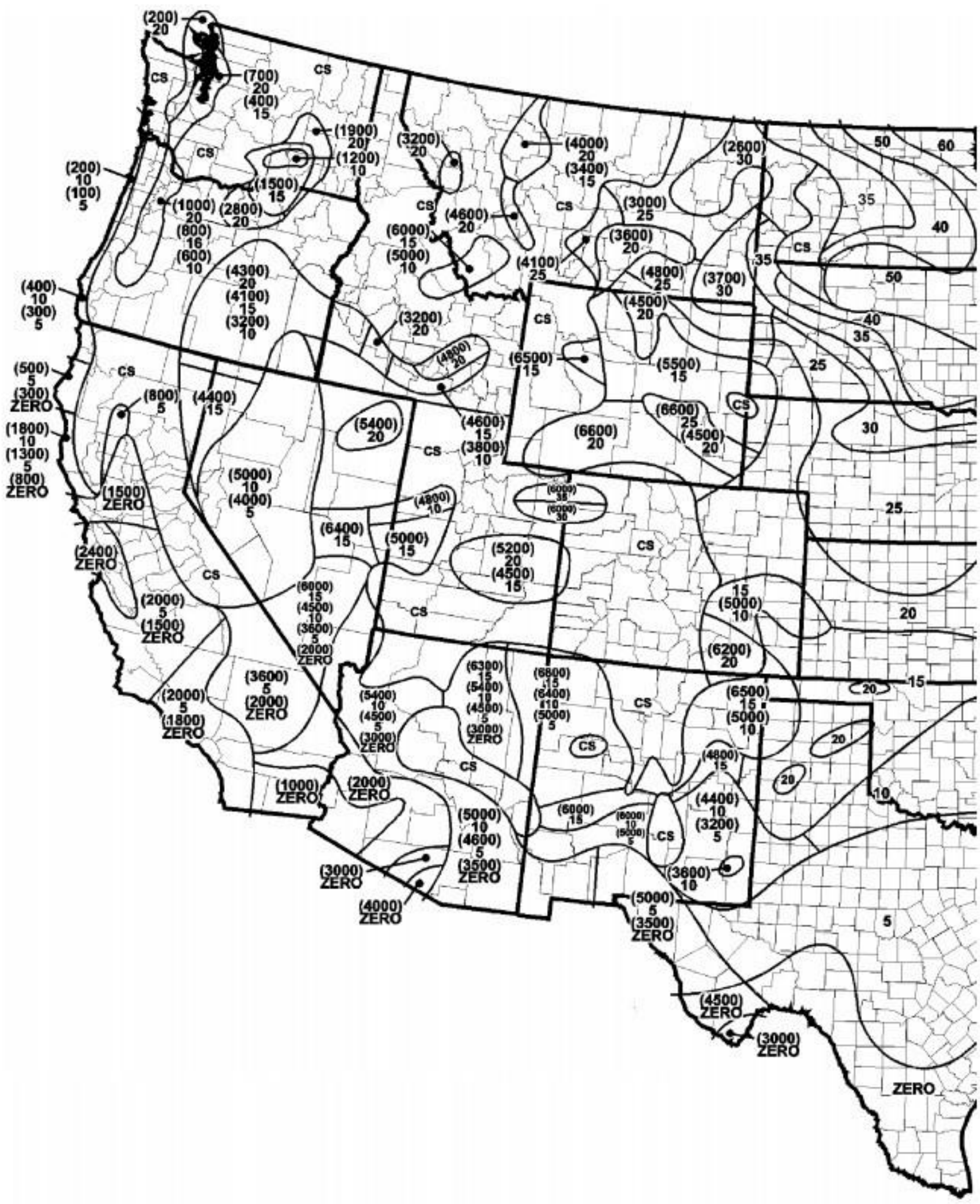

For SI: 1 foot = 34.8 mm, 1 pound per square foot =0.0479 kPa, 1 mile =1.61 km.

a. In CS areas, site-specific case studies are required to establish ground snow loads. Extreme local variations in ground snow loads in these areas preclude mapping at this scale.

b. Numbers in parentheses represent the upper elevation limits in feet for the ground snow load values presented below. Site-specific case studies are required to establish ground snow loads at elevations not covered.

FIGURE R301.2(3)

GROUND SNOW LOADS, *Pg*, FOR THE UNITED STATES (lb/ft2)

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For SI: 1 foot = 304.8 mm, 1 pound per square foot = 0.0479 kPa, 1 mile = 1.61 km.

a. In CS areas, site-specific case studies are required to establish ground snow loads. Extreme local variations in ground snow loads in these areas preclude mapping at this scale.

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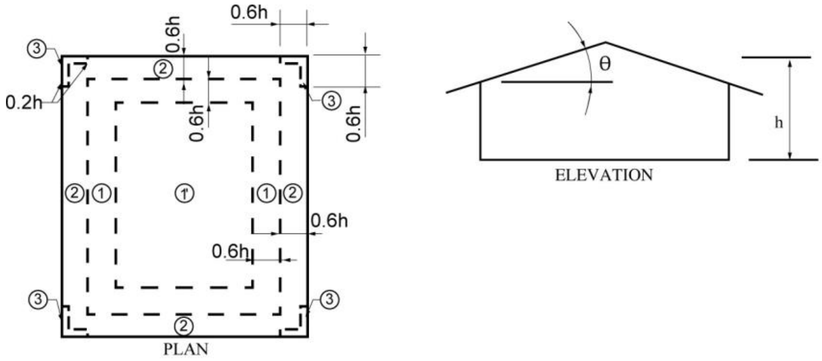
b. Numbers in parentheses represent the upper elevation limits in feet for the ground snow load values presented below. Site-specific case studies are required to establish ground snow loads at elevations not covered.

FIGURE R301.2(4)

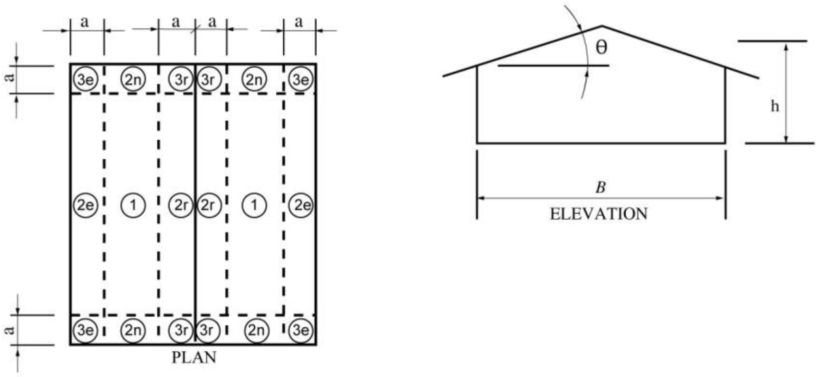
GROUND SNOW LOADS, *Pg*, FOR THE UNITED STATES (lb/ft2)

R301.2.1 Wind design criteria.

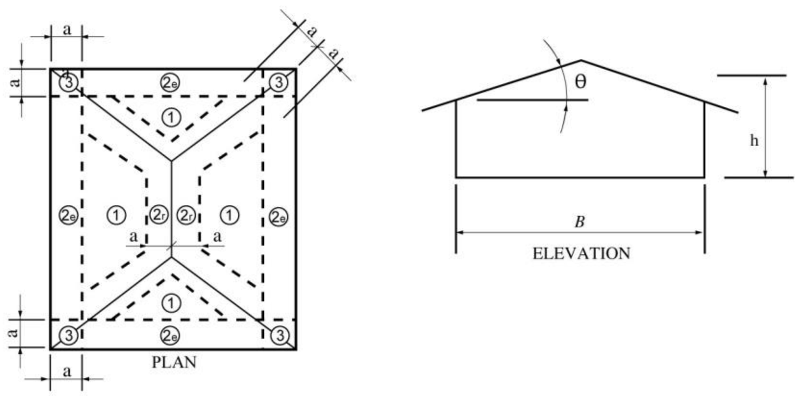
Buildings and portions thereof shall be constructed in accordance with the wind provisions of this code using the ultimate design wind speed in Table R301.2 as determined from Figure R301.2(2). The structural provisions of this code for wind loads are not permitted where wind design is required as specified in Section R301.2.1.1. Where different construction methods and structural materials are used for various portions of a building, the applicable requirements of this section for each portion shall apply. Where not otherwise specified, the wind loads listed in Table R301.2.1(1) adjusted for height and exposure using Table R301.2.1(2) shall be used to determine design load performance requirements for wall coverings, curtain walls, roof coverings, exterior windows, skylights, garage doors and exterior doors. Asphalt shingles shall be designed for wind speeds in accordance with Section R905.2.4. *Metal roof shingles* shall be designed for wind speeds in accordance with Section R905.4.4. A continuous load path shall be provided to transmit the applicable uplift forces in Section R802.11 from the *roof assembly* to the foundation. Where ultimate design wind speeds in Figure R301.2(2) are less than the lowest wind speed indicated in the prescriptive provisions of this code, the lowest wind speed indicated in the prescriptive provisions of this code shall be used.



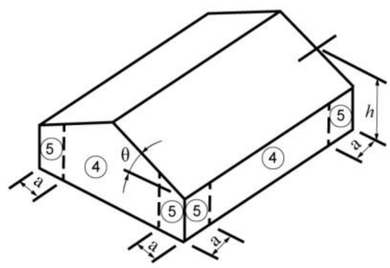
Gable and Flat Roofs $\theta \leq 7^{o}$



Gable and Flat Roofs $7^{o} < \theta \leq 45^{o}$



Hip Roofs $7^{o} < \theta \leq 45^{o}$



Walls

For SI: 1 foot = 304.8 mm, 1 degree = 0.0175 rad.
Note: a = 4 feet in all cases.

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FIGURE R301.2.1
COMPONENT AND CLADDING PRESSURE ZONES

TABLE R301.2.1(1)
COMPONENT AND CLADDING LOADS FOR A BUILDING WITH A MEAN ROOF HEIGHT OF 30 FEET LOCATED IN EXPOSURE B (ASD) (psf) a, b, c, d, e, f, g

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	ZONE	EFFECTIVE WIND AREAS (square feet)	ULTIMATE DESIGN WIND SPEED, V_{ult}																									
			90.0		95.0		105.0		115.0		130.0		150.0		170.0		95.0		105.0		115.0		130.0		150.0		170.0	
			Pos	Neg	Pos	Neg	Pos	Neg	Pos	Neg	Pos	Neg	Pos	Neg	Pos	Neg	Pos	Neg	Pos	Neg	Pos	Neg	Pos	Neg	Pos	Neg	Pos	Neg
Flat and gable roof 0 to 7 degrees	1	10.0	3.6	-13.9	4.0	-15.5	4.4	-17.2	4.8	-19.0	5.3	-20.8	5.8	-22.7	6.3	-24.8	7.4	-29.1	8.6	-33.7	9.9	-38.7	11.2	-44.0	12.7	-49.7	14.2	-55.7
	1	20.0	3.3	-13.0	3.7	-14.5	4.1	-16.0	4.5	-17.7	5.0	-19.4	5.4	-21.2	5.9	-23.1	7.0	-27.1	8.1	-31.4	9.3	-36.1	10.5	-41.1	11.9	-46.4	13.3	-52.0
	1	50.0	3.0	-11.8	3.4	-13.1	3.8	-14.5	4.1	-16.0	4.5	-17.6	5.0	-19.2	5.4	-20.9	6.3	-24.5	7.4	-28.4	8.4	-32.6	9.6	-37.1	10.8	-41.9	12.2	-47.0
	1	100.0	2.8	-10.8	3.1	-12.1	3.5	-13.4	3.8	-14.7	4.2	-16.2	4.6	-17.7	5.0	-19.2	5.9	-22.6	6.8	-26.2	7.8	-30.0	8.9	-34.2	10.0	-38.6	11.3	-43.3
	2	10.0	3.6	-18.4	4.0	-20.5	4.4	-22.7	4.8	-25.0	5.3	-27.4	5.8	-30.0	6.3	-32.7	7.4	-38.3	8.6	-44.5	9.9	-51.0	11.2	-28.1	12.7	-65.6	14.2	-73.5
	2	20.0	3.3	-17.2	3.7	-19.2	4.1	-21.2	4.5	-23.4	5.0	-25.7	5.4	-28.1	5.9	-30.6	7.0	-35.9	8.1	-41.6	9.3	-47.8	10.5	-54.3	11.9	-61.4	13.3	-68.8
	2	50.0	3.0	-15.6	3.4	-17.4	3.8	-19.3	4.1	-21.3	4.5	-23.3	5.0	-25.5	5.4	-27.8	6.3	-32.6	7.4	-37.8	8.4	-43.4	9.6	-49.4	10.8	-55.8	12.2	-62.5
	2	100.0	2.8	-14.4	3.1	-16.1	3.5	-17.8	3.8	-19.7	4.2	-21.6	4.6	-23.6	5.0	-25.7	5.9	-30.1	6.8	-35.0	7.8	-40.1	8.9	-45.7	10.0	-51.5	11.3	-57.8
	3	10.0	3.6	-25.0	4.0	-27.9	4.4	-30.9	4.8	-34.1	5.3	-37.4	5.8	-40.9	6.3	-44.5	7.4	-52.2	8.6	-60.6	9.9	-69.6	11.2	-79.1	12.7	-89.4	14.2	-100.2
	3	20.0	3.3	-22.6	3.7	-25.2	4.1	-28.0	4.5	-30.8	5.0	-33.8	5.4	-37.0	5.9	-40.3	7.0	-47.2	8.1	-54.8	9.3	-62.9	10.5	-71.6	11.9	-80.8	13.3	-90.6

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	3	50.0	3.0	-19.4	3.4	-21.7	3.8	-24.0	4.1	-26.5	4.5	-29.0	5.0	-31.7	5.4	-34.6	6.3	-40.6	7.4	-47.0	8.4	-54.0	9.6	-61.4	10.8	-69.4	12.2	-77.8
	3	100.0	2.8	-17.4	3.1	-19.0	3.5	-21.0	3.8	-23.2	4.2	-25.5	4.6	-27.8	5.0	-30.3	5.9	-35.6	6.8	-41.2	7.8	-47.3	8.9	-53.9	10.0	-60.8	11.3	-68.2
	1, 2e	10.0	5.4	-16.2	6.0	-18.0	6.7	-19.9	7.4	-22.0	8.1	-24.1	8.8	-26.4	9.6	-28.7	11.3	-33.7	13.1	39.1	15.0	44.9	17.1	-51.0	19.3	-57.6	21.6	-64.6
	1, 2e	20.0	4.9	-16.2	5.4	-18.0	6.0	-19.9	6.6	-22.0	7.2	-24.1	7.9	-26.4	8.6	-28.7	10.1	-33.7	11.7	-39.1	13.5	-44.9	15.3	-51.0	17.3	-57.6	19.4	-64.6

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Gable roof > 7 to 20 degrees	1, 2e	50.0	4.1	-9.9	4.6	-11.0	5.1	-12.2	5.6	-13.4	6.1	-14.7	6.7	-16.1	7.3	-17.5	8.6	-20.6	10.0	-23.8	11.4	-27.4	13.0	-31.1	14.7	-35.2	16.4	-39.4
	1, 2e	100.0	3.6	-5.0	4.0	-5.6	4.4	-6.2	4.8	-6.9	5.3	-7.5	5.8	-8.2	6.3	-9.0	7.4	-10.5	8.6	-12.2	9.9	-14.0	11.2	-15.9	12.7	-18.0	14.2	-20.2
	2n, 2r, 3e	10.0	5.4	-23.6	6.0	-26.3	6.7	-29.1	7.4	-32.1	8.1	-35.2	8.8	-38.5	9.6	-41.9	11.3	-49.2	13.1	-57.0	15.0	-65.4	17.1	-74.5	19.3	-84.1	21.6	-94.2
	2n, 2r, 3e	20.0	4.9	-20.3	5.4	-22.7	6.0	-25.1	6.6	-27.7	7.2	-30.4	7.9	-33.2	8.6	-36.2	10.1	-42.4	11.7	-49.2	13.5	-56.5	15.3	-64.3	17.3	-72.6	19.4	-81.4
	2n, 2r, 3e	50.0	4.1	-16.0	4.6	-17.9	5.1	-19.8	5.6	-21.8	6.1	-24.0	6.7	-26.2	7.3	-28.5	8.6	-33.5	10.0	-38.8	11.4	-44.6	13.0	-50.7	14.7	-57.2	16.4	-64.2
	2n, 2r, 3e	100.0	3.6	-12.8	4.0	-14.3	4.4	-15.8	4.8	-17.4	5.3	-19.1	5.8	-20.9	6.3	-22.8	7.4	-26.7	8.6	-31.0	9.9	-35.6	11.2	-40.5	12.7	-45.7	14.2	-51.3
	3r	10.0	5.4	-28.0	6.0	-30.2	6.7	-34.6	7.4	-38.1	8.1	-41.8	8.8	-45.7	9.6	-49.8	11.3	-58.4	13.1	-67.8	15.0	-77.8	17.1	-88.5	19.3	-99.9	21.6	-112.0
	3r	20.0	4.9	-24.0	5.4	-26.7	6.0	-29.6	6.6	-32.7	7.2	-35.9	7.9	-39.2	8.6	-42.7	10.1	-50.1	11.7	-58.1	13.5	-66.7	15.3	-75.9	17.3	-85.6	19.4	-96.0
	3r	50.0	4.1	-18.7	4.6	-20.8	5.1	-23.1	5.6	-25.4	6.1	-27.9	6.7	-30.5	7.3	-33.2	8.6	-39.0	10.0	-45.2	11.4	-51.9	13.0	-59.0	14.7	-66.6	16.4	-74.7
	3r	100.0	3.6	-14.7	4.0	-16.3	4.4	-18.1	4.8	-20.0	5.3	-21.9	5.8	-24.0	6.3	-26.1	7.4	-30.6	8.6	-35.5	9.9	-40.8	11.2	-46.4	12.7	-52.3	14.2	-58.7
	1, 2e	10.0	6.5	-12.4	7.3	-13.9	8.0	-15.4	8.9	-16.9	9.7	-18.6	10.6	-20.3	11.6	-22.1	13.6	-26.0	15.8	-30.1	18.1	-34.6	20.6	-39.3	23.3	-44.4	26.1	-49.9
	1, 2e	20.0	5.6	-12.4	6.3	-13.9	7.0	-15.4	7.7	-16.9	8.4	-18.6	9.2	-20.3	10.0	-22.1	11.7	-26.0	13.6	-30.1	15.6	-34.6	17.8	-39.3	20.1	-44.4	22.5	-49.8

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1, 2e	50.0		4.4	-10.6	5.0	-11.8	5.5	-3.1	6.1	-14.4	6.6	-15.8	7.3	-17.3	7.9	-18.8	9.3	-22.1	10.8	-25.6	12.3	-29.4	14.0	-33.5	15.9	-37.8	17.8	-42.4
1, 2e	100.0		3.6	-9.1	4.0	-10.2	4.4	-11.3	4.8	-12.4	5.3	-13.6	5.8	-14.9	6.3	-16.2	7.4	-19.0	8.6	-22.1	9.9	-25.3	11.2	-28.8	12.7	-32.5	14.2	-36.5
2n, 2r, 3e	10.0		6.5	-19.9	7.3	-22.1	8.0	-24.5	8.9	-27.0	9.7	-29.7	10.6	-32.4	11.6	-35.3	13.6	-41.4	15.8	-48.0	18.1	-55.2	20.6	-62.8	23.3	-70.8	26.1	-79.4

Gable roof > 20 to 27 degrees	2n, 2r, 3e	20.0	5.6	-17.4	6.3	-19.4	7.0	-21.5	7.7	-23.7	8.4	-26.0	9.2	-28.4	10.0	-31.0	11.7	-36.3	13.6	-42.1	15.6	-48.4	17.8	-55.0	20.1	-62.1	22.5	-69.6
	2n, 2r, 3e	50.0	4.4	-14.2	5.0	-15.8	5.5	-17.5	6.1	-19.3	6.6	-21.1	7.3	-23.1	7.9	-25.2	9.3	-29.5	10.8	-34.2	12.3	-39.3	14.0	-44.7	15.9	-50.5	17.8	-56.6
	2n, 2r, 3e	100.0	3.6	-11.7	4.0	-13.0	4.4	-14.5	4.8	-15.9	5.3	-17.5	5.8	-19.1	6.3	-20.8	7.4	-24.4	8.6	-28.3	9.9	-32.5	11.2	-37.0	12.7	-41.8	14.2	-46.8
	3r	10.0	6.5	-23.6	7.3	-26.3	8.0	-29.1	8.9	-32.1	9.7	-35.2	10.6	-38.5	11.6	-41.9	13.6	-49.2	15.8	-57.0	18.1	-65.4	20.6	-74.5	23.3	-84.1	26.1	-94.2
	3r	20.0	5.6	-19.9	6.3	-22.1	7.0	-24.5	7.7	-27.0	8.4	-29.7	9.2	-32.4	10.0	-35.3	11.7	-41.4	13.6	-48.0	15.6	-55.2	17.8	-62.8	20.1	-70.8	22.5	-79.4
	3r	50.0	4.4	-14.7	5.0	-16.3	5.5	-18.1	6.1	-20.0	6.6	-21.9	7.3	-24.0	7.9	-26.1	9.3	-30.6	10.8	-35.5	12.3	-40.8	14.0	-46.4	15.9	-52.3	17.8	-58.7
	3r	100.0	3.6	-14.7	4.0	-16.3	4.4	-18.1	4.8	-20.0	5.3	-21.9	5.8	-24.0	6.3	-26.1	7.4	-30.6	8.6	-35.5	9.9	-40.8	11.2	-46.4	12.7	-52.3	14.2	-58.7
	1, 2e, 2r	10.0	8.0	-14.7	8.9	-16.3	9.9	-18.1	10.9	-20.0	12.0	-21.9	13.1	-24.0	14.2	-26.1	16.7	-30.6	19.4	-35.5	22.2	-40.8	25.3	-16.4	28.5	-52.3	32.0	-58.7
	1, 2e, 2r	20.0	7.1	-12.4	7.9	-13.9	8.8	-15.4	9.7	-16.9	10.6	-18.6	11.6	-20.3	12.6	-22.1	14.8	-26.0	17.2	-30.1	19.8	-34.6	22.5	-39.3	25.4	-44.4	28.5	-49.8
	1, 2e, 2r	50.0	5.9	-9.5	6.6	-10.6	7.3	-11.7	8.1	-12.9	8.9	-14.2	9.7	-15.5	10.5	-16.9	12.4	-19.8	14.3	-22.9	16.5	-26.3	18.7	-30.0	21.1	-33.8	23.7	-37.9
	1, 2e, 2r	100.0	5.0	-7.3	5.6	-8.1	6.2	-9.0	6.9	-9.9	7.5	-10.8	8.2	-11.9	9.0	-12.9	10.5	-15.1	12.2	-17.6	14.0	-20.2	15.9	-22.9	18.0	-25.9	20.2	-29.0
	2n, 3r	10.0	8.0	-16.2	8.9	-18.0	9.9	-19.9	10.9	-22.0	12.0	-24.1	13.1	-26.4	-14.2	-28.7	16.7	-33.7	19.4	-39.1	22.2	-44.9	25.3	-51.0	28.5	-57.6	32.0	-64.6

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Gable roof > 27 to 45 degrees	2n, 3r	20.0	7.1	-14.4	7.9	-16.1	8.8	-17.8	9.7	-19.7	10.6	-21.6	11.6	-23.6	12.6	-25.7	14.8	-30.1	17.2	-34.9	19.8	-40.1	22.5	-45.6	25.4	-51.5	28.5	-57.8
	2n, 3r	50.0	5.9	-12.2	6.6	-13.5	7.3	-15.0	8.1	-16.5	8.9	-18.2	9.7	-19.9	10.5	-21.6	12.4	-25.4	14.3	-29.4	16.5	-33.8	18.7	-38.4	21.1	-43.4	23.7	-48.6
	2n, 3r	100.0	5.0	-10.4	5.6	-11.6	6.2	-12.9	6.9	-14.2	7.5	-15.6	8.2	-17.1	9.0	-18.6	10.5	-21.8	12.2	-25.3	14.0	-29.0	15.9	-33.0	18.0	-37.3	20.0	-41.8

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	3e	10.0	8.0	-19.9	8.9	-22.1	9.9	-24.5	10.9	-27.0	12.0	-29.7	13.1	-32.4	14.2	-35.3	16.7	-41.4	19.4	-48.0	22.2	-55.2	25.3	-62.8	28.8	-70.8	32.0	-79.4
	3e	20.0	7.1	-17.6	7.9	-19.6	8.8	-21.8	9.7	-24.0	10.6	-26.3	11.6	-28.8	12.6	-31.3	14.8	-36.8	17.2	-42.7	19.8	-49.0	22.5	-55.7	25.4	-62.9	28.5	-70.5
	3e	50.0	5.9	-14.7	6.6	-16.3	7.3	-18.1	8.1	-20.0	8.9	-21.9	9.7	-24.0	10.5	-26.1	12.4	-30.6	14.3	-35.5	16.6	-40.8	18.7	-46.4	21.1	-52.3	23.7	-58.7
	3e	100.0	5.0	-12.4	5.6	-13.9	6.2	-15.4	6.9	-16.9	7.5	-18.6	8.2	-20.3	9.0	-22.1	10.5	-26.0	12.2	-30.1	14.0	-34.6	15.9	-39.3	18.0	-44.4	20.2	-49.8
Hipped roof > 7 to 20 degreesg	1	10.0	6.5	-14.7	7.3	-16.3	8.0	-18.1	8.9	-20.0	9.7	-21.9	10.6	-24.0	11.6	-26.1	13.6	-30.6	15.8	-35.5	18.1	-40.8	20.6	-46.4	23.3	-52.3	26.1	-58.7
	1	20.0	5.6	-14.7	6.3	-16.3	7.0	-18.1	7.7	-20.0	8.4	-21.9	9.2	-24.0	10.0	-26.1	11.7	-30.6	13.6	-35.5	15.6	-40.8	17.8	-46.4	20.1	-52.3	22.5	-58.7
	1	50.0	4.4	-11.3	5.0	-12.6	5.5	-14.0	6.1	-15.4	6.6	-16.9	7.3	-18.5	7.9	-20.2	9.3	-23.7	10.8	-27.4	12.3	-31.5	14.0	-35.8	15.9	-40.4	17.8	-45.3
	1	100.0	3.6	-8.7	4.0	-9.7	4.4	-10.8	4.8	-11.9	5.3	-13.1	5.8	-14.3	6.3	-15.5	7.4	-18.2	8.6	-21.2	9.9	-24.3	11.2	-27.6	12.7	-31.2	14.2	-35.0
	2r	10.0	6.5	-19.1	7.3	-21.3	8.0	-23.6	8.9	-26.0	9.7	-28.6	10.6	-31.2	11.6	-34.0	13.6	-39.9	15.8	-46.3	18.1	-53.1	20.6	-60.4	23.3	-68.2	26.1	-76.5
	2r	20.0	5.6	-17.2	6.3	-19.2	7.0	-21.3	7.7	-23.4	8.4	-25.7	9.2	-28.1	10.0	-30.6	11.7	-35.9	13.6	-41.7	15.6	-47.9	17.8	-54.4	20.1	-61.5	22.5	-68.9
	2r	50.0	4.4	-14.7	5.0	-16.4	5.5	-18.2	6.1	-20.0	6.6	-22.0	7.3	-24.0	7.9	-26.1	9.3	-30.7	10.8	-35.6	12.3	-40.9	14.0	-46.5	15.9	-52.5	17.8	-58.8
	2r	100.0	3.6	-12.8	4.0	-14.3	4.4	-15.8	4.8	-17.4	5.3	-19.1	5.8	-20.9	6.3	-22.8	7.4	-26.7	8.6	-31.0	9.9	-35.6	11.2	-40.5	12.7	-45.7	14.2	-51.3

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2e,3	10.0	6.5	-20.6	7.3	-22.9	8.0	-25.4	8.9	-28.0	9.7	-30.8	10.6	-33.6	11.6	-36.6	13.6	-43.0	15.8	-49.8	18.1	-57.2	20.6	-65.1	23.3	-73.5	26.1	-82.4
2e,3	20.0	5.6	-18.5	6.3	-20.6	7.0	-22.9	7.7	-25.2	8.4	-27.7	9.2	-30.3	10.0	-32.9	11.7	-38.7	13.6	-44.8	15.6	-51.5	17.8	-58.6	20.1	-66.1	22.5	-74.1
2e,3	50.0	4.4	-15.8	5.0	-17.6	5.5	-19.5	6.1	-21.5	6.6	-23.6	7.3	-25.8	7.9	-28.0	9.3	-32.9	10.8	-38.2	12.3	-43.8	14.0	-49.9	15.9	-56.3	17.8	-63.1

	2e, 3	100.0	3.6	-13.7	4.0	-15.3	4.0	-16.9	4.8	-18.7	5.3	-20.5	5.8	-22.4	6.3	-24.4	7.4	-28.6	8.6	-33.2	9.9	-38.1	11.2	-43.3	12.7	-48.9	14.2	-54.8
Hipped roof ≥ 20 to 27 degrees	1	10.0	6.5	-11.7	7.3	-13.0	8.0	-14.5	8.9	-15.9	9.7	-17.5	10.6	-19.1	11.6	-20.8	13.6	-24.4	15.8	-28.3	18.1	-32.5	20.6	-37.0	23.3	-41.8	26.1	-46.8
	1	20.0	5.6	-10.4	6.3	-11.6	7.0	-12.8	7.7	-14.1	8.4	-15.5	9.2	-16.9	10.0	-18.4	11.7	-21.6	13.6	-25.1	15.6	-28.8	17.8	-32.8	20.1	-37.0	22.5	-41.5
	1	50.0	4.4	-8.6	5.0	-9.6	5.5	-10.6	6.1	-11.7	6.6	-12.8	7.3	-14.0	7.9	-15.3	9.3	-17.9	10.8	-20.8	12.3	-23.9	14.0	-27.2	15.9	-30.7	17.8	-34.4
	1	100.0	3.6	-7.3	4.0	-8.1	4.4	-9.0	4.8	-9.9	5.3	-10.8	5.8	-11.9	6.3	-12.9	7.4	-15.1	8.6	-17.6	9.9	-20.2	11.2	-22.9	12.7	-25.9	14.2	-29.0
	2e, 2r, 3	10.0	6.5	-16.2	7.3	-18.0	8.0	-19.9	8.9	-22.0	9.7	-24.1	10.6	-26.4	11.6	-28.7	13.6	-33.7	15.8	-39.1	18.1	-44.9	20.6	-51.0	23.3	-57.6	26.1	-64.6
	2e, 2r, 3	20.0	5.6	-14.4	6.3	-16.1	7.0	-17.8	7.7	-19.7	8.4	-21.6	9.2	-23.6	10.0	-25.7	11.7	-30.1	13.6	-34.9	15.6	-40.1	17.8	-45.6	20.1	-51.5	22.5	-57.8
	2e, 2r, 3	50.0	4.4	-12.2	5.0	-13.5	5.5	-15.0	6.1	-16.5	6.6	-18.2	7.3	-19.9	7.9	-21.6	9.3	-25.4	10.8	-29.4	12.3	-33.8	14.0	-38.4	15.9	-43.4	17.8	-48.6
	2e, 2r, 3	100.0	3.6	-10.4	4.0	-11.6	4.4	-12.9	4.8	-14.2	5.3	-15.6	5.8	-17.1	6.3	-18.6	7.4	-21.8	8.6	-25.3	9.9	-29.0	11.2	-33.0	12.7	-37.3	14.2	-41.8
	1	10.0	6.2	-12.4	6.9	-13.9	7.7	-15.4	8.5	-16.9	9.3	-18.6	10.2	-20.3	11.1	-22.1	13.0	-26.0	15.1	-30.1	17.3	-34.6	19.7	-39.3	22.2	-44.4	24.9	-49.8
	1	20.0	5.4	-11.0	6.0	-12.3	6.7	-13.6	7.4	-15.0	8.1	-16.5	8.9	-18.0	9.6	-19.6	11.3	-23.0	13.1	-26.7	15.1	-30.7	17.1	-34.9	19.4	-39.4	21.7	-44.2
	1	50.0	4.4	-9.2	4.9	-10.2	5.4	-11.3	5.9	-12.5	6.5	-13.7	7.1	-15.0	7.7	-16.3	9.1	-19.2	10.5	-22.2	12.1	-25.5	13.8	-29.0	15.5	-32.8	17.4	-36.7

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1	100.0	3.6	-7.8	4.0	-8.7	4.4	-9.6	4.8	-10.6	5.3	-11.6	5.8	-12.7	6.3	-13.8	7.4	-16.2	8.6	-18.8	9.9	-21.6	11.2	-24.6	12.7	-27.8	14.2	-31.1
2e	10.0	6.2	-14.8	6.9	-16.5	7.7	-18.3	8.5	-20.2	9.3	-22.1	10.2	-24.2	11.1	-26.3	13.0	-30.9	15.1	-35.9	17.3	-41.2	19.7	-46.8	22.2	-52.9	24.9	-59.3
2e	20.0	5.4	-11.7	6.0	-13.0	6.7	-14.5	7.4	-15.9	8.1	-17.5	8.9	-19.1	9.6	-20.8	11.3	-24.4	13.1	-28.3	15.1	-32.5	17.1	-37.0	19.4	-41.8	21.7	-46.8

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	2e	50.0	4.4	-7.3	4.9	-8.1	5.4	-9.0	5.9	-9.9	6.5	-10.8	7.1	-11.9	7.7	-12.9	9.1	-15.1	10.5	-17.6	12.1	-20.2	13.8	-22.9	15.5	-25.9	17.4	-29.0
Hipped roof > 27 to 45 degrees	2e	100.0	3.6	-7.3	4.0	-8.1	4.4	-9.0	4.8	-9.9	5.3	-10.8	5.8	-11.9	6.3	-12.9	7.4	-15.1	8.6	-17.6	9.9	-20.2	11.2	-22.9	12.7	-25.9	14.2	-29.0
	2r	10.0	6.2	-18.7	6.9	-20.9	7.7	-23.1	8.5	-25.5	9.3	-28.0	10.2	-30.6	11.1	-33.3	13.0	-39.1	15.1	-45.4	17.3	-52.1	19.7	-59.2	22.2	-66.9	24.9	-75.0
	2r	20.0	5.4	-15.7	6.0	-17.5	6.7	-19.4	7.4	-21.4	8.1	-23.5	8.9	-25.7	9.6	-28.0	11.3	-32.8	13.1	-38.1	15.1	-43.7	17.1	-49.8	19.4	-56.2	21.7	-63.0
	2r	50.0	4.4	-11.7	4.9	-13.1	5.4	-14.5	5.9	-16.0	6.5	-17.5	7.1	-19.2	7.7	-20.9	9.1	-24.5	10.5	-28.4	12.1	-32.6	13.8	-37.1	15.5	-41.9	17.4	-47.0
	2r	100.0	3.6	-8.7	4.0	-9.7	4.4	-10.8	4.8	-11.9	5.3	-13.1	5.8	-14.3	6.3	-15.5	7.4	-18.2	8.6	-21.2	9.9	-24.3	11.2	-27.6	12.7	-31.2	14.2	-35.0
	3	10.0	6.2	-20.0	6.9	-22.3	7.7	-24.7	8.5	-27.2	9.3	-29.9	10.2	-32.7	11.1	-35.6	13.0	-41.7	15.1	-48.4	17.3	-55.6	19.7	-63.2	22.2	-71.4	24.9	-80.0
	3	20.0	5.4	-15.0	6.0	-16.8	6.7	-18.6	7.4	-20.5	8.1	-22.5	8.9	-24.6	9.6	-26.7	11.3	-31.4	13.1	-36.4	15.1	-41.8	17.1	-47.5	19.4	-53.7	21.7	-60.2
	3	50.0	4.4	-8.7	4.9	-9.7	5.4	-10.8	5.9	-11.9	6.5	-13.1	7.1	-14.3	7.7	-15.5	9.1	-18.2	10.5	-21.2	12.1	-24.3	13.8	-27.6	15.5	-31.2	17.4	-35.0
	3	100.0	3.6	-8.7	4.0	-9.7	4.4	-10.8	4.8	-11.9	5.3	-13.1	5.8	-14.3	6.3	-15.5	7.4	-18.2	8.6	-21.2	9.9	-24.3	11.2	-27.6	12.7	-31.2	14.2	-35.0
	4	10.0	8.7	-9.5	9.7	-10.6	10.8	-11.7	11.9	-12.9	13.1	-14.2	14.3	-15.5	15.5	-16.9	18.2	-19.8	21.2	-22.9	24.3	-26.3	27.6	-30.0	31.2	-33.8	35.0	-37.9
	4	20.0	8.3	-9.1	9.3	-10.1	10.3	-11.2	11.4	-12.4	12.5	-13.6	13.6	-14.8	14.8	-16.2	17.4	-19.0	20.2	-22.0	23.2	-25.3	26.4	-28.7	29.8	-32.4	33.4	-36.4

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	4	50.0	7.8	-8.6	8.7	-9.5	9.7	-10.6	10.7	-11.7	11.7	-12.8	12.8	-14.0	13.9	-15.2	16.3	-17.9	18.9	-20.7	21.7	-23.8	24.7	-27.1	27.9	-30.6	31.3	-34.3
	4	100.0	7.4	-8.2	8.3	-9.1	9.2	-10.1	10.1	-11.1	11.1	-12.2	12.1	-13.3	13.2	-14.5	15.5	-17.1	18.0	-19.8	20.6	-22.7	23.5	-25.8	26.5	-29.2	29.7	-32.7
	4	500.0	6.5	-7.3	7.3	-8.1	8.0	-9.0	8.9	-9.9	9.7	-10.8	10.6	-11.9	11.6	-12.9	13.5	-15.1	15.8	-17.6	18.1	-20.2	20.6	-22.9	23.3	-25.9	26.1	-29.0
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	5	10.0	8.7	-11.7	9.7	-13.0	10.8	-14.5	11.9	-15.9	13.1	-17.5	14.3	-19.1	15.5	-20.8	18.2	-24.4	21.2	-28.3	24.3	-32.5	27.6	-37.0	31.2	-41.8	35.0	-46.8
	5	20.0	8.3	-10.9	9.3	-12.2	10.3	-13.5	11.4	-14.9	12.5	-16.3	13.6	-17.8	14.8	-19.4	17.4	-22.8	20.2	-26.4	23.2	-30.3	26.4	-34.5	29.8	-39.0	33.4	-43.7
	5	50.0	7.8	-9.9	8.7	-11.0	9.7	-12.2	10.7	-13.4	11.7	-14.7	12.8	-16.1	13.9	-17.5	16.3	-20.6	18.9	-23.9	21.7	-27.4	24.7	-31.2	27.9	-35.2	31.3	-39.5
	5	100.0	7.4	-9.1	8.3	-10.1	9.2	-11.2	10.1	-12.4	11.1	-13.6	12.1	-14.8	13.2	-16.1	15.5	-19.0	18.0	-22.0	20.6	-25.2	23.5	-28.7	26.5	-32.4	29.7	-36.3
	5	500.0	6.5	-7.3	7.3	-8.1	8.0	-9.0	8.9	-9.9	9.7	-10.8	10.6	-11.9	11.6	-12.9	13.6	-15.1	15.8	-17.6	18.1	-20.2	20.6	-22.9	23.3	-25.9	26.1	-29.0

For SI: 1 foot = 304.8 mm, 1 square foot = 0.0929 m2, 1 mile per hour = 0.447 m/s, 1 pound per square foot = 0.0479 kPa.

a. The effective wind area shall be equal to the span length multiplied by an effective width. This width shall be not less than one-third the span length. For cladding fasteners, the effective wind areas shall not be greater than the area that is tributary to an individual fastener.

b. For effective areas between those given, the load shall be interpolated, or the load associated with the lower effective areas shall be used.

c. Table values shall be adjusted for height and exposure by multiplying by the adjustment coefficient in Table R301.2.1(2).

d. See Figure R318.4 for locations of termite infestation probability zones.

e. Plus, and minus signs signify pressures acting toward and away from the building surfaces.

f. Positive and negative design wind pressures shall not be less than 10 psf.

g. Where the ratio of the building mean roof height to the building length or width is less than 0.8, uplift loads shall be permitted to be calculated in accordance with ASCE 7.

TABLE R301.2.1(2)
HEIGHT AND EXPOSURE ADJUSTMENT COEFFICIENTS FOR Table R301.2.1(1)

MEAN ROOF HEIGHT	EXPOSURE		
	B	C	D
15	0.82	1.21	1.47
20	0.89	1.29	1.55
25	0.94	1.35	1.61
30	1.00	1.40	1.66
35	1.05	1.45	1.70
40	1.09	1.49	1.74
45	1.12	1.53	1.78
50	1.16	1.56	1.81
55	1.19	1.59	1.84

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60	1.22	1.62	1.87

R301.2.1.1 Wind limitations and wind design required.

The wind provisions of this code shall not apply to the design of buildings where wind design is required in accordance with Figure R301.2.1.1, or where the ultimate design wind speed, *Vult*, in Figure R301.2(2) equals or exceeds 140 miles per hour (225 kph) in a special wind region.

Exceptions:

1. For concrete construction, the wind provisions of this code shall apply in accordance with the limitations of Sections R404 and R608.
2. For structural insulated panels, the wind provisions of this code shall apply in accordance with the limitations of Section R610.
3. For cold-formed steel *light-frame construction*, the wind provisions of this code shall apply in accordance with the limitations of Sections R505, R603 and R804.

In regions where wind design is required in accordance with Figure R301.2.1.1 or where the ultimate design wind speed, *Vult*, in Figure R301.2(2) equals or exceeds 140 miles per hour (225 kph) in a special wind region, the design of buildings for wind loads shall be in accordance with one or more of the following methods:

1. AWC *Wood Frame Construction Manual* (WFCM).
2. ICC *Standard for Residential Construction in High-Wind Regions* (ICC 600).
3. ASCE *Minimum Design Loads for Buildings and Other Structures* (ASCE 7).
4. AISI *Standard for Cold-Formed Steel Framing—Prescriptive Method for One- and Two-Family Dwelling*

(AISI S230).

5. *International Building Code*.

The elements of design not addressed by the methods in Items 1 through 5 shall be in accordance with the provisions of this code.

Where ASCE 7 or the *International Building Code* is used for the design of the building, the wind speed map and exposure category requirements as specified in ASCE 7 and the *International Building Code* shall be used.

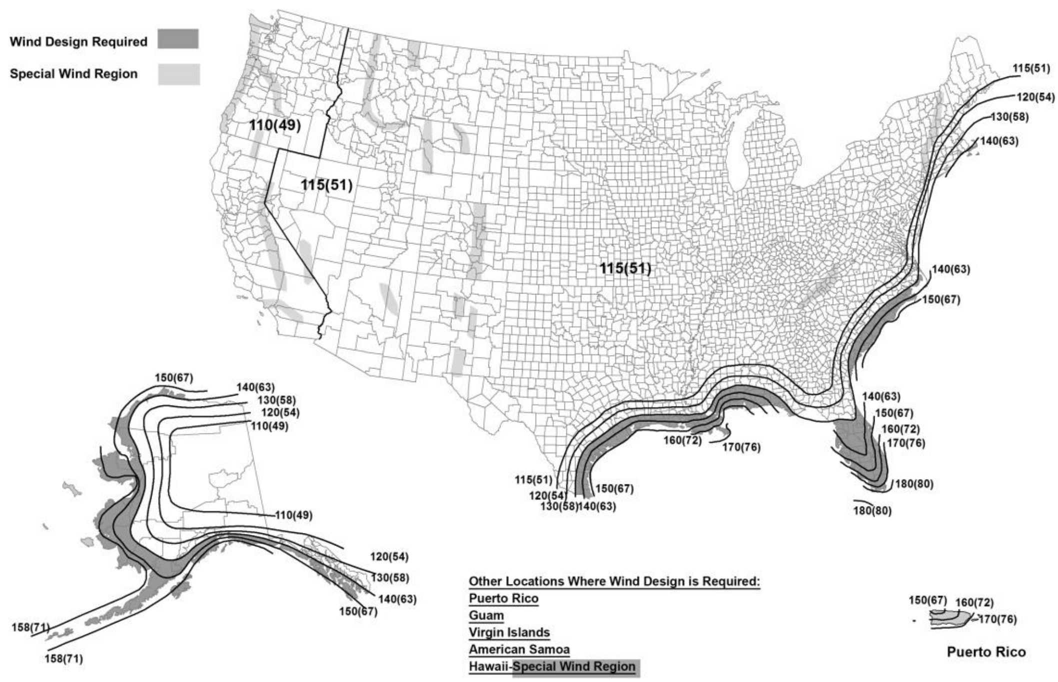

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FIGURE R301.2.1.1
REGIONS WHERE WIND DESIGN IS REQUIRED

R301.2.1.1.1 Sunrooms.
Sunrooms shall comply with AAMA/NPEA/NSA 2100. For the purpose of applying the criteria of

AAMA/NPEA/NSA 2100 based on the intended use, *sunrooms shall* be identified as one of the following categories by the permit applicant, *design professional* or the property *owner* or owner's agent in the *construction documents*. Component and cladding pressures shall be used for the design of elements that do not qualify as main windforce-resisting systems. Main windforce-resisting system pressures shall be used for the design of elements assigned to provide support and stability for the overall *sunroom*.

Category I: A thermally isolated *sunroom* with walls that are open or enclosed with insect screening or 0.5 mm (20 mil) maximum thickness plastic film. The space is nonhabitable and unconditioned.
Category II: A thermally isolated *sunroom* with enclosed walls. The openings are enclosed with translucent or transparent plastic or glass. The space is nonhabitable and unconditioned.
Category III: A thermally isolated *sunroom* with enclosed walls. The openings are enclosed with translucent or transparent plastic or glass. The *sunroom* fenestration complies with additional requirements for air infiltration resistance and water penetration resistance. The space is nonhabitable and unconditioned.
Category IV: A thermally isolated *sunroom with* enclosed walls. The *sunroom* is designed to be heated or cooled by a separate temperature control or system and is thermally isolated from the primary structure. The *sunroom* fenestration complies with additional requirements for water penetration resistance, air infiltration resistance and thermal performance. The space is nonhabitable and conditioned.
Category V: A *sunroom* with enclosed walls. The *sunroom* is designed to be heated or cooled and is open to the main structure. The *sunroom* fenestration complies with additional requirements for water penetration resistance, air infiltration resistance and thermal performance. The space is habitable and conditioned.

R301.2.1.2 Protection of openings.
Exterior glazing in buildings located in *windborne debris regions* shall be protected from windborne debris. Glazed opening protection for windborne debris shall meet the requirements of the Large Missile Test of ASTM E1886 and ASTM E1996 as modified in Section 301.2.1.2.1. Garage door glazed opening protection for windborne debris shall meet the requirements of an *approved* impact-resisting standard or ANSI/DASMA 115.
Exception: *Wood structural panels* with a thickness of not less than 7/16 inch (11 mm) and a span of not more than 8 feet (2438 mm) shall be permitted for opening protection. Panels shall be precut and attached to the framing surrounding the opening containing the product with the glazed opening. Panels shall be predrilled as required for the anchorage method and shall be secured with the attachment hardware provided. Attachments shall be designed to resist the component and cladding loads determined in accordance with either Table R301.2.1(1) or ASCE 7, with the permanent corrosion-resistant attachment hardware provided and anchors permanently installed on the building. Attachment in accordance with Table R301.2.1.2 is permitted for buildings with a mean roof height of 45 feet (13 728 mm) or less where the ultimate design wind speed, *Vult*, is 180 mph (290 kph) or less.

TABLE R301.2.1.2
WINDBORNE DEBRIS PROTECTION FASTENING SCHEDULE FOR WOOD STRUCTURAL PANELSa, b, c, d

FASTENER TYPE	FASTENER SPACING (inches)a, b		
	Panel span ≤ 4 feet	4 feet < panel span ≤ 6 feet	6 feet < panel span ≤ 8 feet
No. 8 wood-screw-based anchor with 2-inch embedment length	16	10	8
No. 10 wood-screw-based anchor with 2-inch embedment length	16	12	9
1/4-inch lag-screw-based anchor with 2-inch embedment length	16	16	16

For SI: 1 inch = 25.4 mm, 1 foot = 304.8 mm, 1 pound = 4.448 N, 1 mile per hour = 0.447 m/s.

a. This table is based on 180 mph ultimate design wind speeds, V_{ult}, and a 45- foot mean roof height.
b. Fasteners shall be installed at opposing ends of the wood structural panel. Fasteners shall be located not less than 1 inch from the edge of the panel.
c. Anchors shall penetrate through the exterior wall covering with an embedment length of not less than 2 inches into the building frame. Fasteners shall be located not less than $2^{1}/_{2}$ inches from the edge of concrete block or concrete.
d. Panels attached to masonry or masonry/stucco shall be attached using vibration-resistant anchors having an ultimate withdrawal capacity of not less than 1,500 pounds.

R301.2.1.2.1 Application of ASTM E1996.
The text of Section 2.2 of ASTM E1996 shall be substituted as follows:

2.2 ASCE Standard:
ASCE 7-10 American Society of Civil Engineers *Minimum Design Loads for Buildings and Other Structures*

The text of Section 6.2.2 of ASTM E1996 shall be substituted as follows:

6.2.2 Unless otherwise specified, select the wind zone based on the ultimate design wind speed, *Vult*, as follows:
6.2.2.1 Wind Zone 1–130 mph ≤ ultimate design wind speed, *Vult* < 140 mph.
6.2.2.2 Wind Zone 2–140 mph ≤ ultimate design wind speed, *Vult* < 150 mph at greater than 1 mile (1.6 km) from the coastline. The coastline shall be measured from the mean high-water mark.
6.2.2.3 Wind Zone 3–150 mph (67 m/s) ≤ ultimate design wind speed, *Vult* ≤ 170 mph (76 m/s), or 140 mph (54 m/s) ≤ ultimate design wind speed, *Vult* ≤ 170 mph (76 m/s) and within 1 mile (1.6 km) of the coastline. The coastline shall be measured from the mean high-water mark.
6.2.2.4 Wind Zone 4–ultimate design wind speed, *Vult* > 170 mph (76 m/s).

R301.2.1.3 Wind speed conversion.
Where referenced documents are based on nominal design wind speeds and do not provide the means for conversion between ultimate design wind speeds and nominal design wind speeds, the ultimate design wind speeds, *Vult*, of Figure R301.2(2) shall be converted to nominal design wind speeds, *Vasd*, using Table R301.2.1.3.

TABLE R301.2.1.3 WIND SPEED CONVERSIONSa

Vult	110	115	120	130	140	150	160	170	180	190	200
Vasd	85	89	93	101	108	116	124	132	139	147	155

For SI: 1 mile per hour = 0.447 m/s.
a. Linear interpolation is permitted.

R301.2.1.4 Exposure category.
For each wind direction considered, an exposure category that adequately reflects the characteristics of ground surface irregularities shall be determined for the site at which the building or structure is to be constructed. For a site located in the transition zone between categories, the category resulting in the largest wind forces shall

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

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 exposure.
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 1,500 feet (457 m) from the building site in any quadrant. This exposure shall apply to any building located within Exposure B type terrain where the building is directly adjacent to open areas of Exposure C type terrain in any quadrant for a distance of more than 600 feet (183 m). This category includes flat, open country and grasslands.
3. Exposure D. Flat, unobstructed areas exposed to wind flowing over open water, smooth mud flats, salt flats and unbroken ice for a distance of not less than 5,000 feet (1524 m). This exposure shall apply only to those buildings and other structures exposed to the wind coming from over the unobstructed area. Exposure D extends downwind from the edge of the unobstructed area a distance of 600 feet (183 m) or 20 times the height of the building or structure, whichever is greater.

R301.2.1.5 Topographic wind effects.

In areas designated in Table R301.2 as having local historical data documenting structural damage to buildings caused by wind speed-up at isolated *hills*, ridges and escarpments that are abrupt changes from the general topography of the area, topographic wind effects shall be considered in the design of the building in accordance with Section R301.2.1.5.1 or in accordance with the provisions of ASCE 7. See Figure R301.2.1.5.1(1) for topographic features for wind speed-up effect.

In these designated areas, topographic wind effects shall apply only to buildings sited on the top half of an isolated *hill*, *ridge* or escarpment where all of the following conditions exist:

1. The average slope of the top half of the *hill*, *ridge* or escarpment is 10 percent or greater.
2. The *hill*, *ridge* or escarpment is 60 feet (18 288 mm) or greater in height for Exposure B, 30 feet (9144 mm) or greater in height for Exposure C, and 15 feet (4572 mm) or greater in height for Exposure D.
3. The *hill*, *ridge* or escarpment is isolated or unobstructed by other topographic features of similar height in the upwind direction for a distance measured from its high point of 100 times its height or 2 miles (3.2 km), whichever is less. See Figure R301.2.1.5.1(3) for upwind obstruction.
4. The *hill*, *ridge* or escarpment protrudes by a factor of two or more above the height of other upwind topographic features located in any quadrant within a radius of 2 miles (3.2 km) measured from its high point.

R301.2.1.5.1 Simplified topographic wind speed-up method.

As an alternative to the ASCE 7 topographic wind provisions, the provisions of Section R301.2.1.5.1 shall be permitted to be used to design for wind speed-up effects, where required by Section R301.2.1.5.

Structures located on the top half of isolated *hills*, ridges or escarpments meeting the conditions of Section R301.2.1.5 shall be designed for an increased basic wind speed as determined by Table R301.2.1.5.1. On the high side of an escarpment, the increased basic wind speed shall extend horizontally downwind from the edge of the escarpment 1.5 times the horizontal length of the upwind slope (1.5L) or 6 times the height of the escarpment (6H), whichever is greater. See Figure R301.2.1.5.1(2) for where wind speed increase is applied.

TABLE R301.2.1.5.1

ULTIMATE DESIGN WIND SPEED MODIFICATION FOR TOPOGRAPHIC WIND EFFECTa, b

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ULTIMATE DESIGN WIND SPEED FROM FIGURE R301.2(2)(mph)	AVERAGE SLOPE OF THE TOP HALF OF HILL, RIDGE OR ESCARPMENT (percent)						
	0.10	0.125	0.15	0.175	0.20	0.23	0.25
	Required ultimate design wind speed-up, modified for topographic wind speed-up (mph)						
95	114	119	123	127	131	137	140
100	120	125	129	134	138	144	147
105	126	131	135	141	145	151	154
110	132	137	142	147	152	158	162
115	138	143	148	154	159	165	169
120	144	149	155	160	166	172	176
130	156	162	168	174	179	NA	NA
140	168	174	181	NA	NA	NA	NA
150	180	NA	NA	NA	NA	NA	NA

For SI: 1 mile per hour = 0.447 m/s, 1 foot = 304.8 mm. NA = Not Applicable.

a. Table applies to a feature height of 500 feet or less and dwellings sited a distance equal or greater than half the feature height.

b. Where the ultimate design wind speed as modified by Table R301.2.1.5.1 equals or exceeds 140 miles per hour, the building shall be considered as “wind design required” in accordance with Section R301.2.1.1.

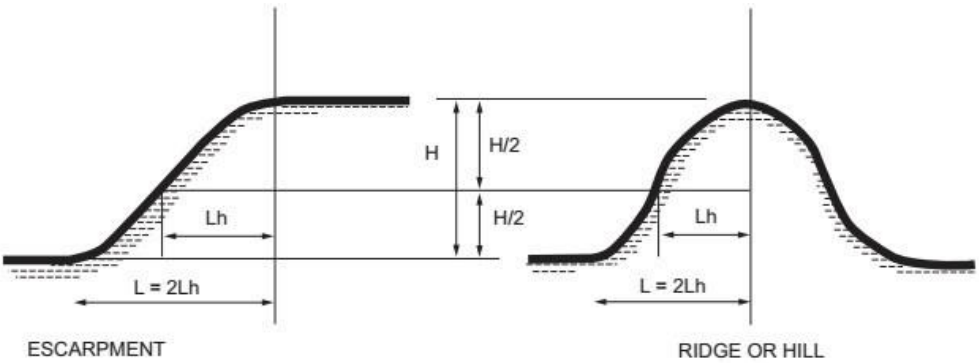

FIGURE R301.2.1.5.1(1)
TOPOGRAPHIC FEATURES FOR WIND SPEED-UP EFFECT

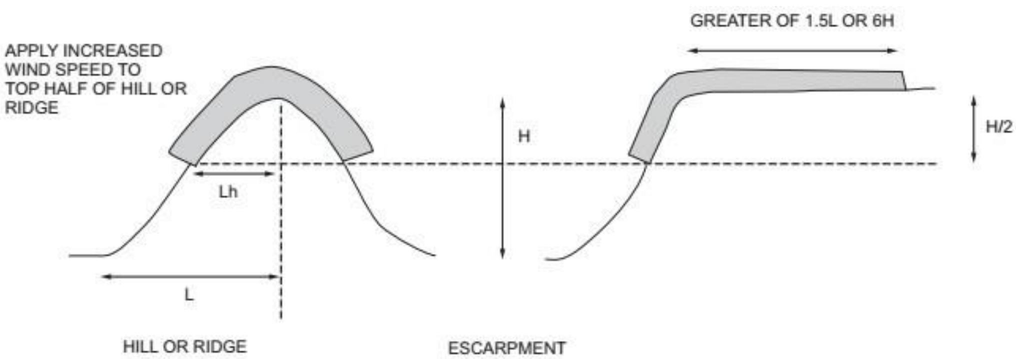

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FIGURE R301.2.1.5.1(2)
ILLUSTRATION OF WHERE ON A TOPOGRAPHIC FEATURE, WIND SPEED INCREASE IS APPLIED

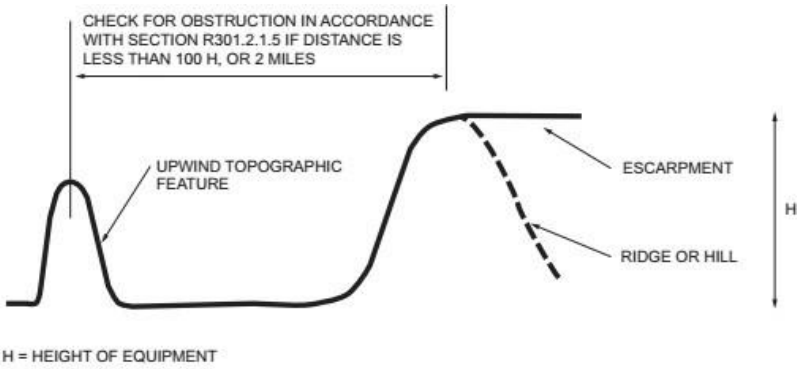

FIGURE R301.2.1.5.1(3) UPWIND OBSTRUCTION

R301.2.2 Seismic provisions.

Buildings in *Seismic Design Categories* C, D0, D1 and D2 shall be constructed in accordance with the requirements of this section and other seismic requirements of this code. The seismic provisions of this code shall apply as follows:

1. *Townhouses* in *Seismic Design Categories* C, D0, D1 and D2.
2. Detached one- and two-family *dwellings* in *Seismic Design Categories*, D0, D1 and D2.

Buildings in Seismic Design Category E shall be designed to resist seismic loads in accordance with the *International Building Code*, except where the seismic design category is reclassified to a lower seismic design category in accordance with Section R301.2.2.1. Components of buildings not required to be designed to resist seismic loads shall be constructed in accordance with the provisions of this code.

R301.2.2.1 Determination of seismic design category.

Buildings shall be assigned a seismic design category in accordance with Figures R301.2.2.1(1) through R301.2.2.1(6).

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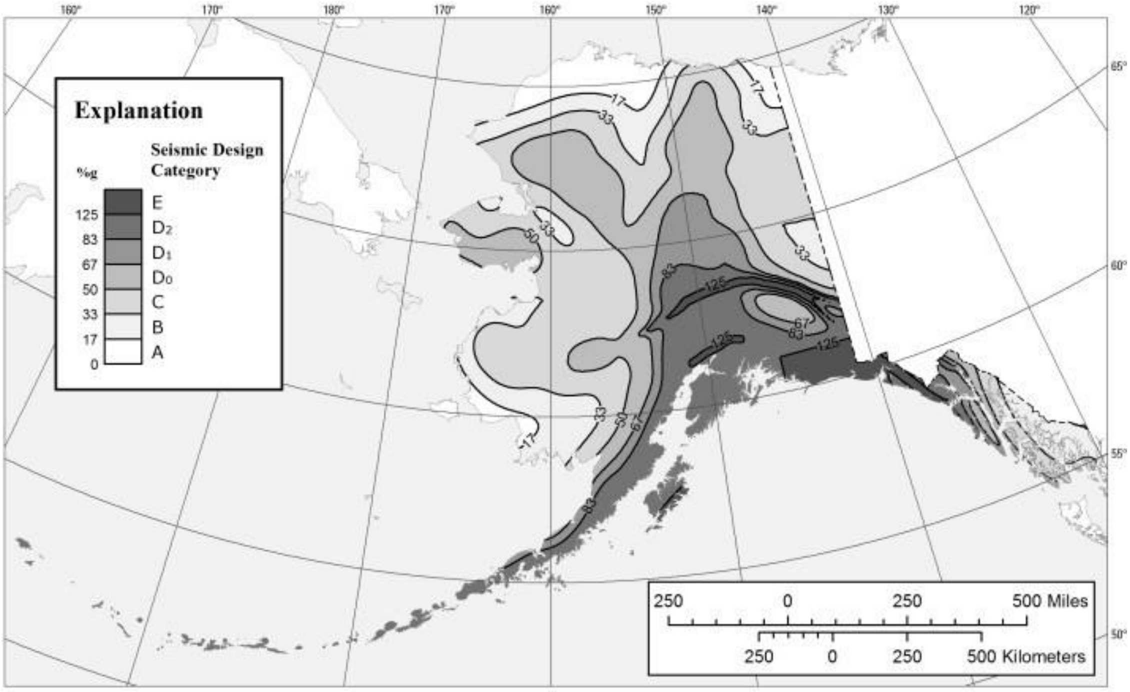

Map prepared by U.S. Geological Survey in collaboration with the Federal Emergency Management Agency (FEMA) funded Building Seismic Safety Council's (BSSC) Code Resource Support Committee (CRSC).

REFERENCES

Building Seismic Safety Council, 2015, NEHRP Recommended Seismic Provisions for New Buildings and Other Structures: FEMA P-1050, Federal Emergency Management Agency, Washington, DC.
Huang, Yin-Nan, Whittaker, A.S., and Luco, Nicolas, 2008, Maximum spectral demands in the near-fault region, Earthquake Spectra Volume 24, Issue 1, pp. 319-341.
Luco, Nicolas, Ellingwood, B.R., Hamburger, R.O., Hooper, J.D., Kimball, J.K., and Kircher, C.A., 2007, Risk-Targeted versus Current Seismic Design Maps for the Conterminous United States, Structural Engineers Association of California 2007 Convention Proceedings, pp. 163-175.
Wesson, Robert L., Boyd, Oliver S., Mueller, Charles S., Bufe, Charles G., Frankel, Arthur D., Petersen, Mark D., 2007, Revision of time-Independent probabilistic seismic hazard maps for Alaska: U.S. Geological Survey Open-File Report 2007-1043.

a. The seismic design categories and corresponding short-period design spectral response accelerations, *SDS*, shown in Figures R301.2.2.1(1) through 301.2.2.1(6) are based on soil Site Class D, used as an assumed default, as defined in Section 1613.2.2 of the *International Building Code*.

FIGURE R301.2.2.1(1)
SEISMIC DESIGN CATEGORIES—ALASKAa

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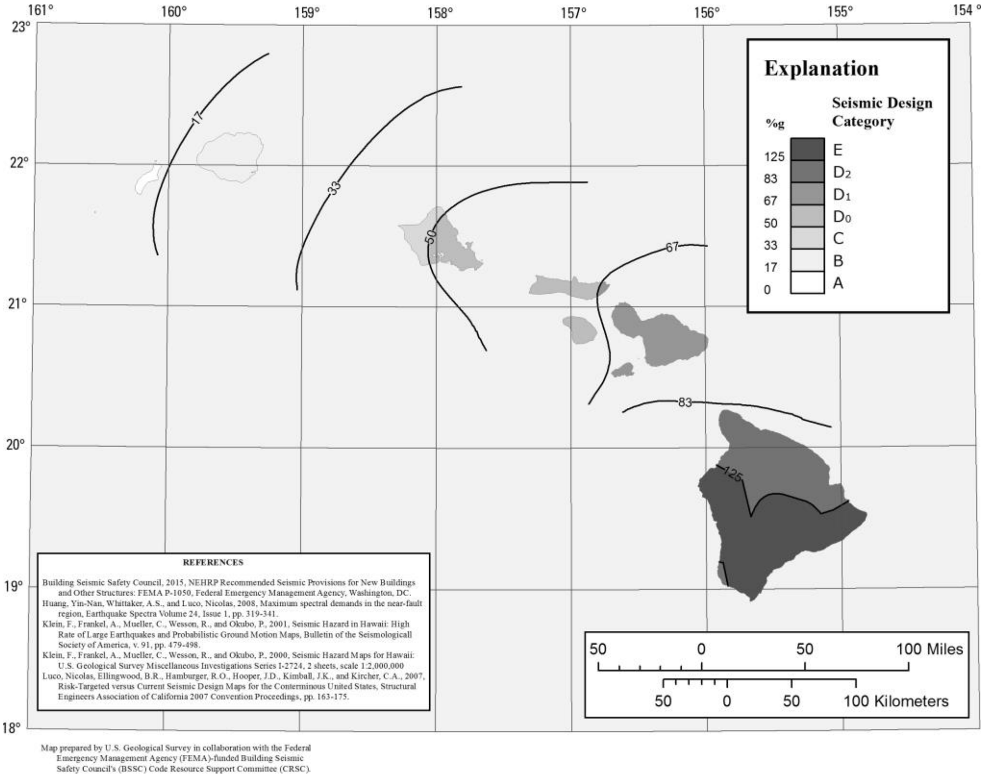

a. The seismic design categories and corresponding short-period design spectral response accelerations, *SDS*, shown in Figures R301.2.2.1(1) through 301.2.2.1(6) are based on soil Site Class D, used as an assumed default, as defined in Section 1613.2.2 of the *International Building Code*.

FIGURE R301.2.2.1(2) SEISMIC DESIGN CATEGORIES—HAWAIIa

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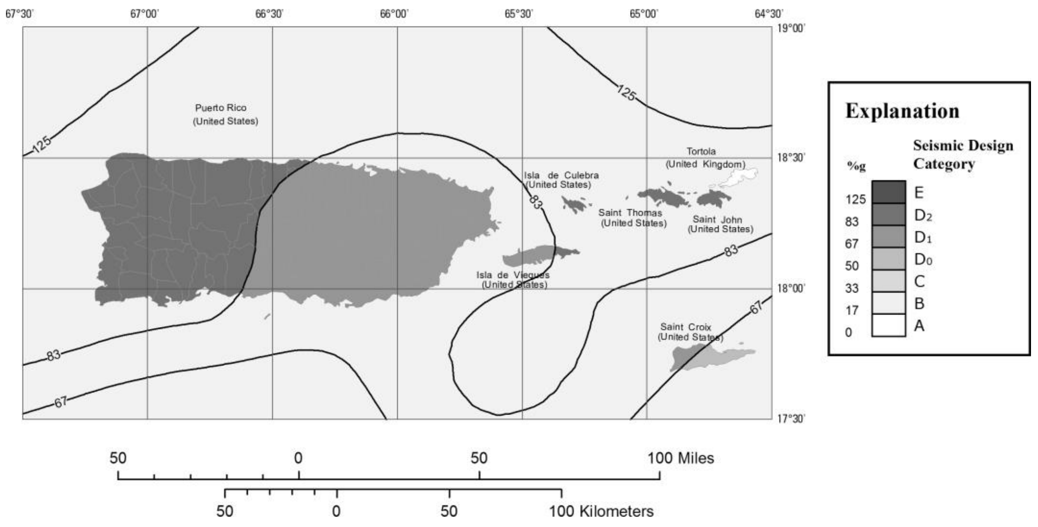

REFERENCES

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Huang, Yin-Nan, Whittaker, A.S., and Luco, Nicolas, 2008, Maximum spectral demands in the near-fault region, Earthquake Spectra Volume 24, Issue 1, pp. 319-341.

Luco, Nicolas, Ellingwood, B.R., Hamburger, R.O., Hooper, J.D., Kimball, J.K., and Kircher, C.A., 2007, Risk-Targeted versus Current Seismic Design Maps for the Conterminous United States, Structural Engineers Association of California 2007 Convention Proceedings, pp. 163-175.

Mueller, C., Frankel, A., Petersen, M., and Leyendecker, E., 2003, Documentation for 2003 USGS Seismic Hazard Maps for Puerto Rico and the U.S. Virgin Islands, U.S. Geological Survey Open-File Report 03-379.

Map prepared by U.S. Geological Survey in collaboration with the Federal Emergency Management Agency (FEMA)-funded Building Seismic Safety Council's (BSSC) Code Resource Support Committee (CRSC).

a. The seismic design categories and corresponding short-period design spectral response accelerations, *SDS*, shown in Figures R301.2.2.1(1) through 301.2.2.1(6) are based on soil Site Class D, used as an assumed default, as defined in Section 1613.2.2 of the *International Building Code*.

FIGURE R301.2.2.1(3)
SEISMIC DESIGN CATEGORIES—PUERTO RICOa

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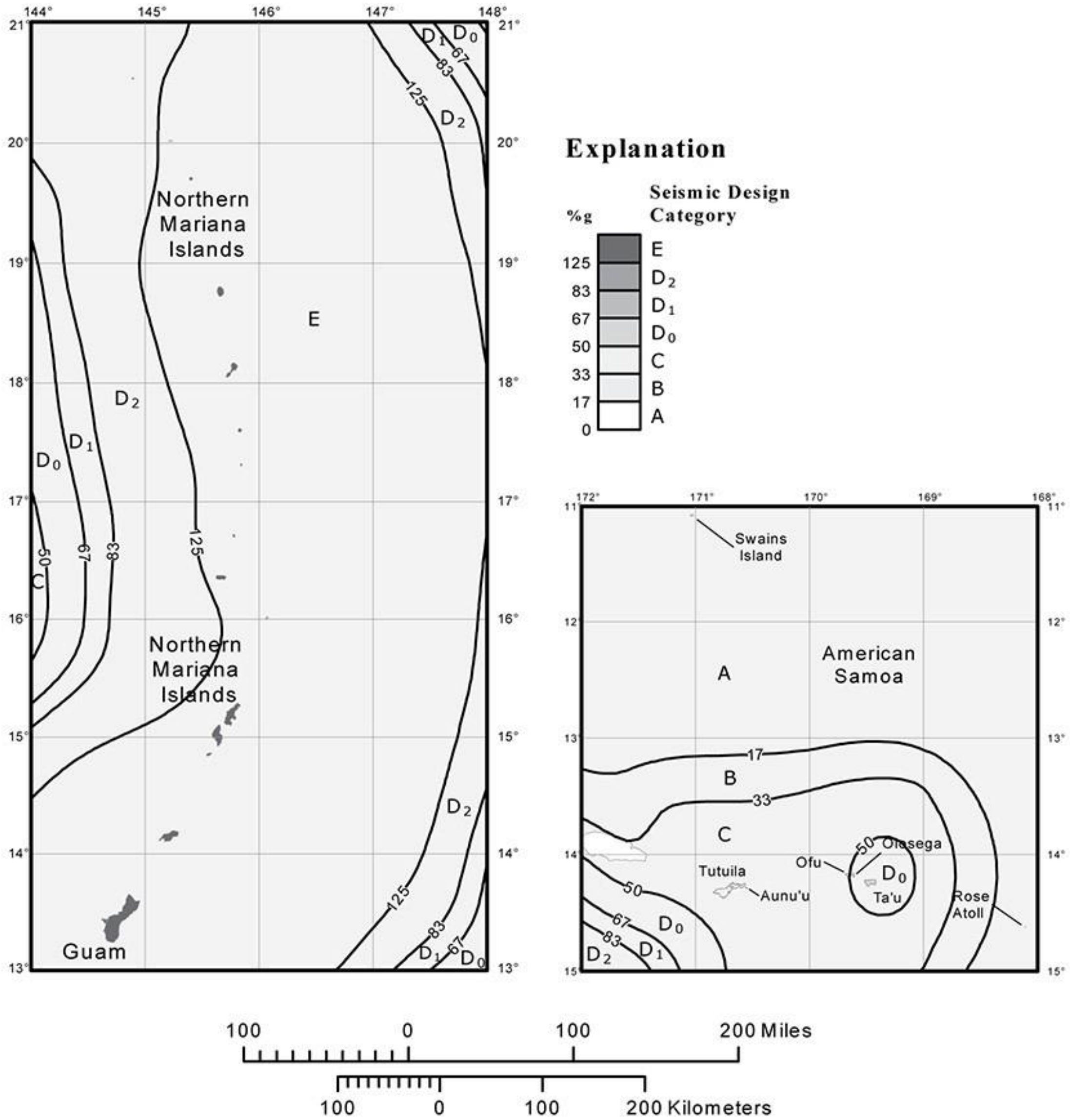

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a. The seismic design categories and corresponding short-period design spectral response accelerations, *SDS*, shown in Figures R301.2.2.1(1) through 301.2.2.1(6) are based on soil Site Class D, used as an assumed default, as defined in Section 1613.2.2 of the *International Building Code*.

FIGURE R301.2.2.1(4)

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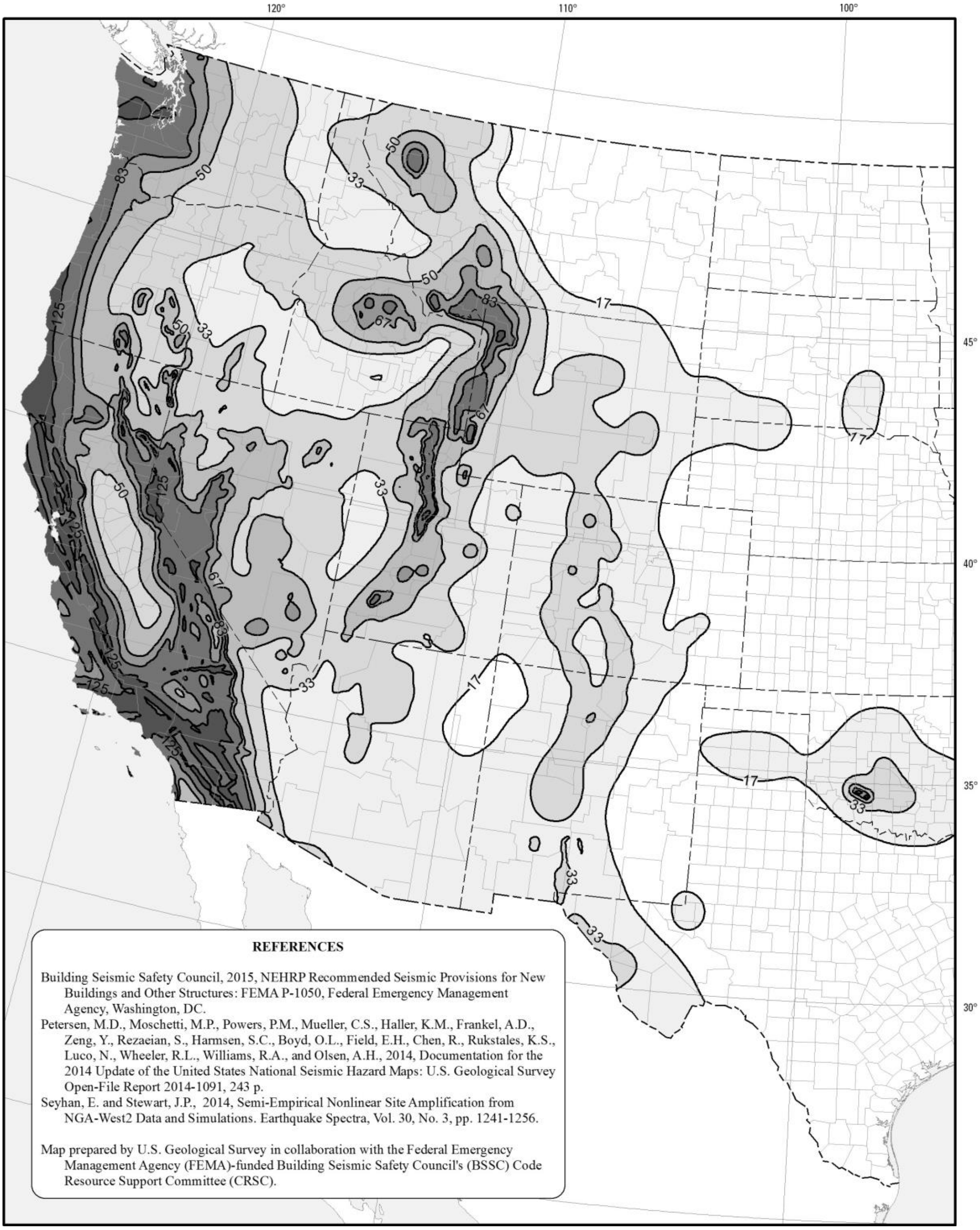
SEISMIC DESIGN CATEGORIES—NORTHERN MARIANA ISLANDS AND AMERICAN SAMOAa



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a. The seismic design categories and corresponding short-period design spectral response accelerations, *SDS*, shown in Figures R301.2.2.1(1) through 301.2.2.1(6) are based on soil Site Class D, used as an assumed default, as defined in Section 1613.2.2 of the *International Building Code*.

FIGURE R301.2.2.1(5)

SEISMIC DESIGN CATEGORIES—UNITED STATESa

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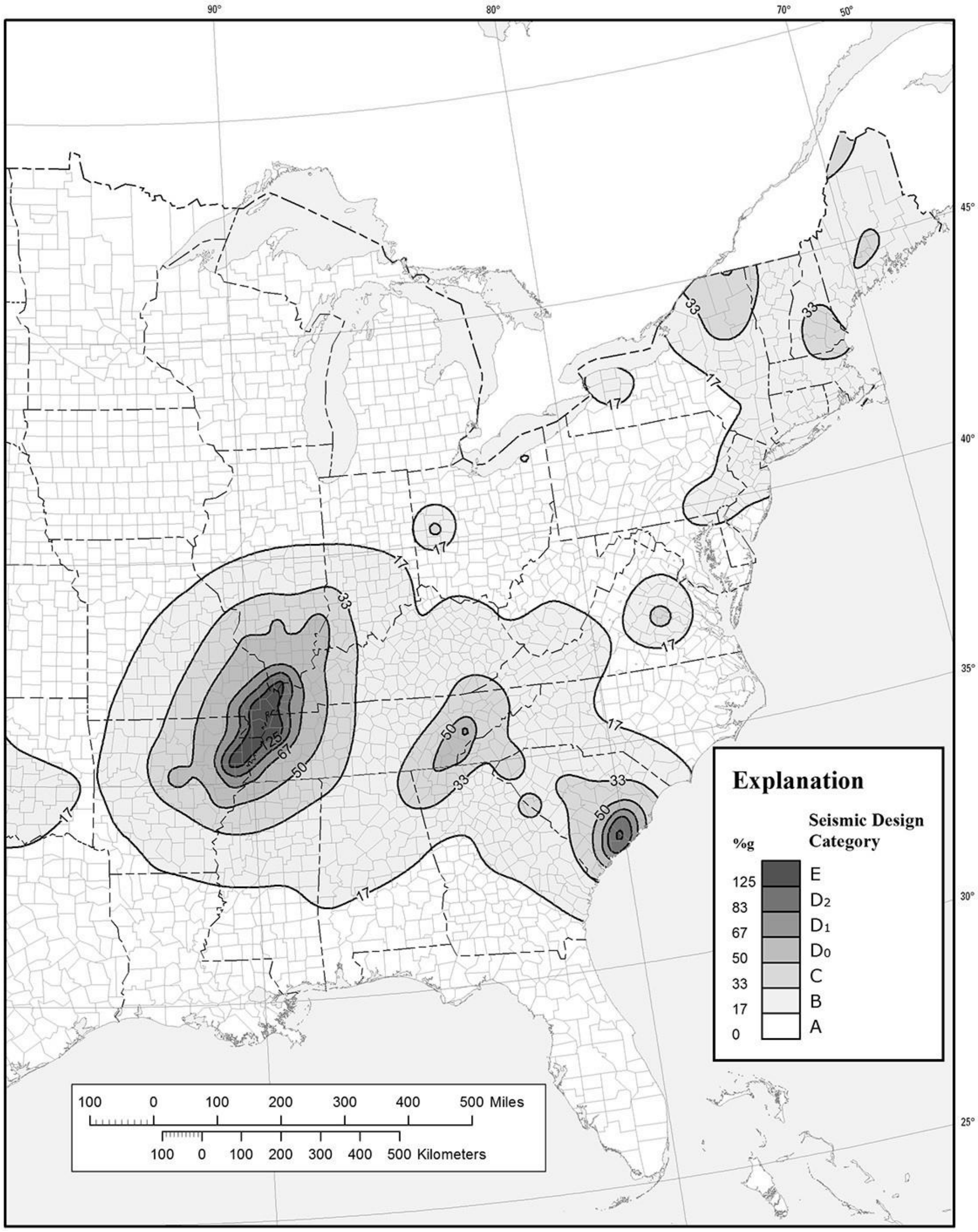

a. The seismic design categories and corresponding short-period design spectral response accelerations, *SDS*, shown in Figures R301.2.2.1(1) through 301.2.2.1(6), are based on soil Site Class D, used as an assumed default, as defined in Section 1613.2.2 of the *International Building Code*.

FIGURE R301.2.2.1(6)

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SEISMIC DESIGN CATEGORIES—UNITED STATESa

R301.2.2.1.1 Alternate determination of seismic design category.

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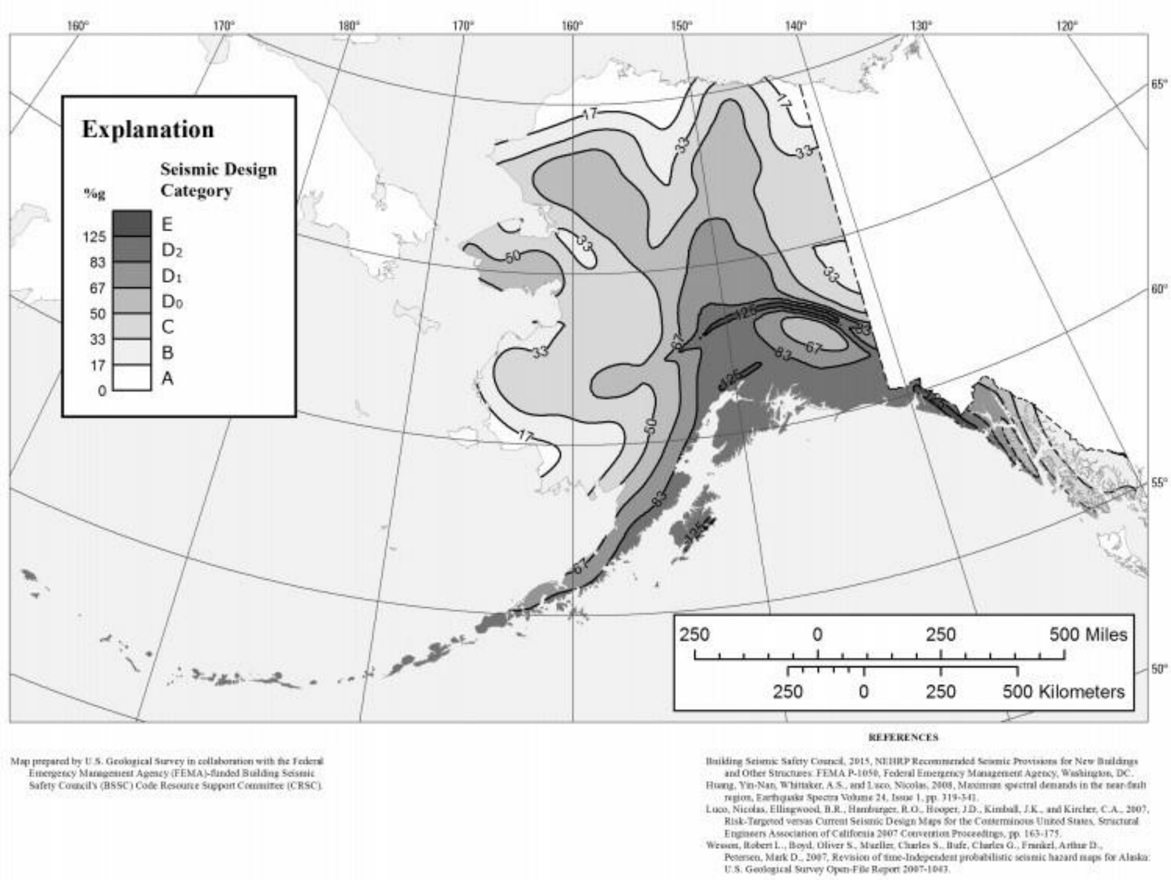
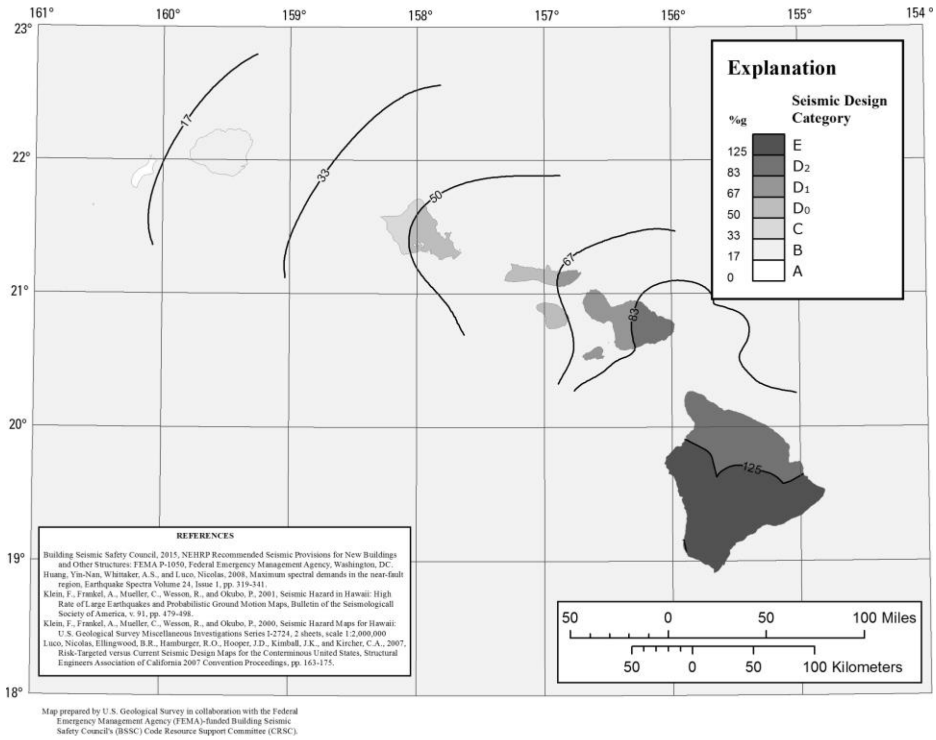
If soil conditions are determined by the building official to be Site Class A, B, or D, the seismic design category and short-period design spectral response accelerations, *SDS*, for a site shall be allowed to be determined in accordance with Figures R301.2.2.1.1(1) through R301.2.2.1.1(6), or Section 1613.2 of the *International Building Code*. The value of *SDS* determined in accordance with Section 1613.2 of the *International Building Code* is permitted to be used to set the seismic design category in accordance with Table R301.2.2.1.1, and to interpolate between values in Tables R602.10.3(3) and R603.9.2(1) and other seismic design requirements of this code.

a. The seismic design categories and corresponding short-period design spectral response accelerations, *SDS*,



shown in Figures R301.2.2.1.1(1) through 301.2.2.1.1(6) are permitted to be used where soil conditions are determined by the building official to be Site Class A, B or D.

FIGURE R301.2.2.1.1(1)
ALTERNATE SEISMIC DESIGN CATEGORIES—ALASKAa



a. The seismic design categories and corresponding short-period design spectral response accelerations, *SDS*, shown in Figures R301.2.2.1.1(1) through 301.2.2.1.1(6) are permitted to be used where soil conditions are determined by the building official to be Site Class A, B or D.

FIGURE R301.2.2.1.1(2)

ALTERNATE SEISMIC DESIGN CATEGORIES—HAWAIIa

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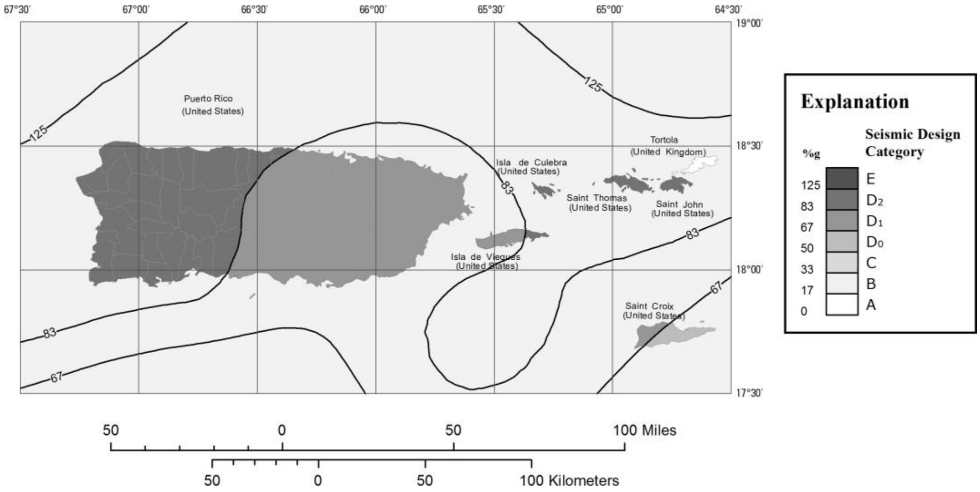

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Map prepared by U.S. Geological Survey in collaboration with the Federal Emergency Management Agency (FEMA)-funded Building Seismic Safety Council's (BSSC) Code Resource Support Committee (CRSC).

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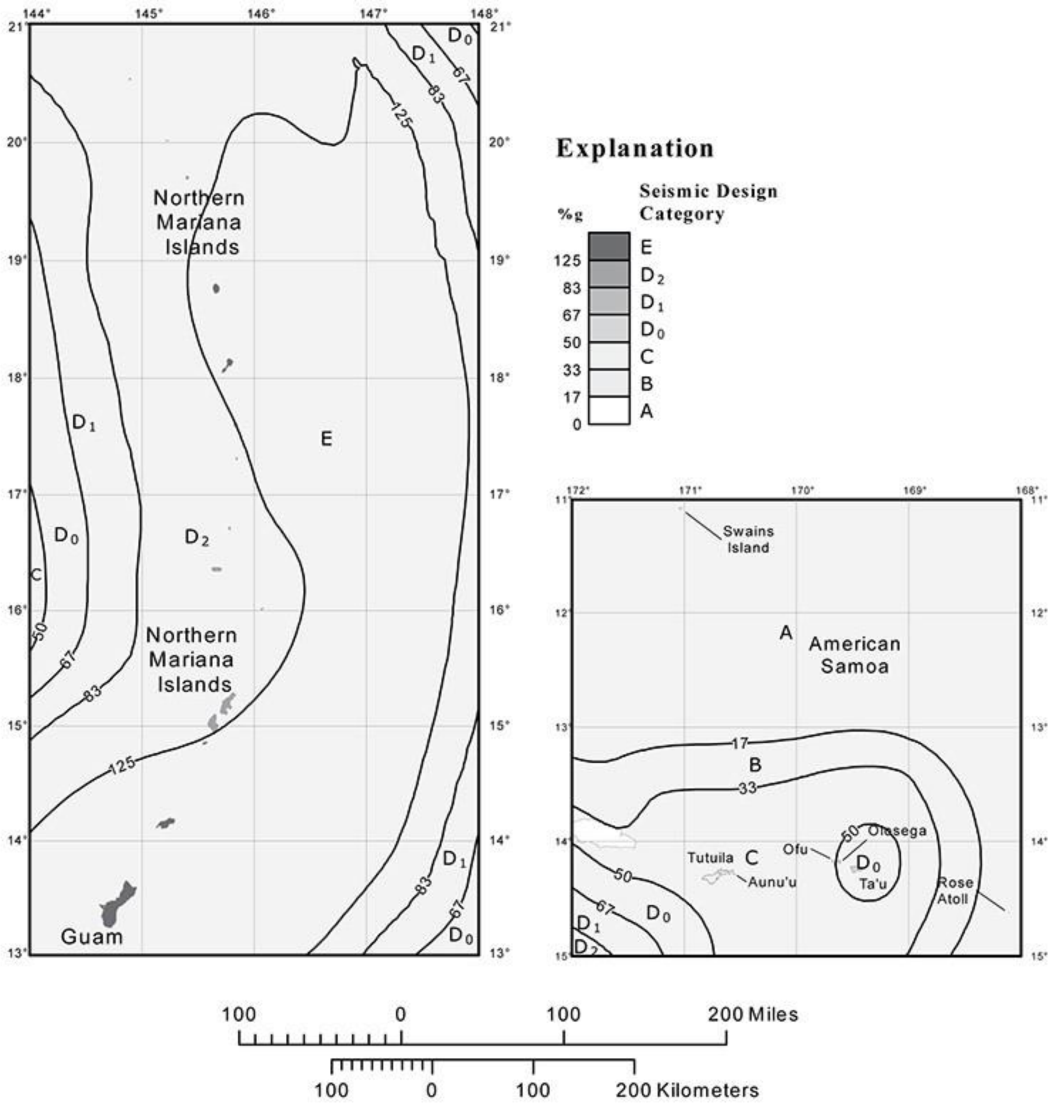
a. The seismic design categories and corresponding short-period design spectral response accelerations, *SDS*, shown in Figures R301.2.2.1.1(1) through 301.2.2.1.1(6) are permitted to be used where soil conditions are determined by the building official to be Site Class A, B or D.

FIGURE R301.2.2.1.1(3)

ALTERNATE SEISMIC DESIGN CATEGORIES—PUERTO RICOa



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conditions are determined by the building official to be Site Class A, B or D.

FIGURE R301.2.2.1.1(4)
ALTERNATE SEISMIC DESIGN CATEGORIES—NORTHERN MARIANA ISLANDS AND AMERICAN SAMOAa

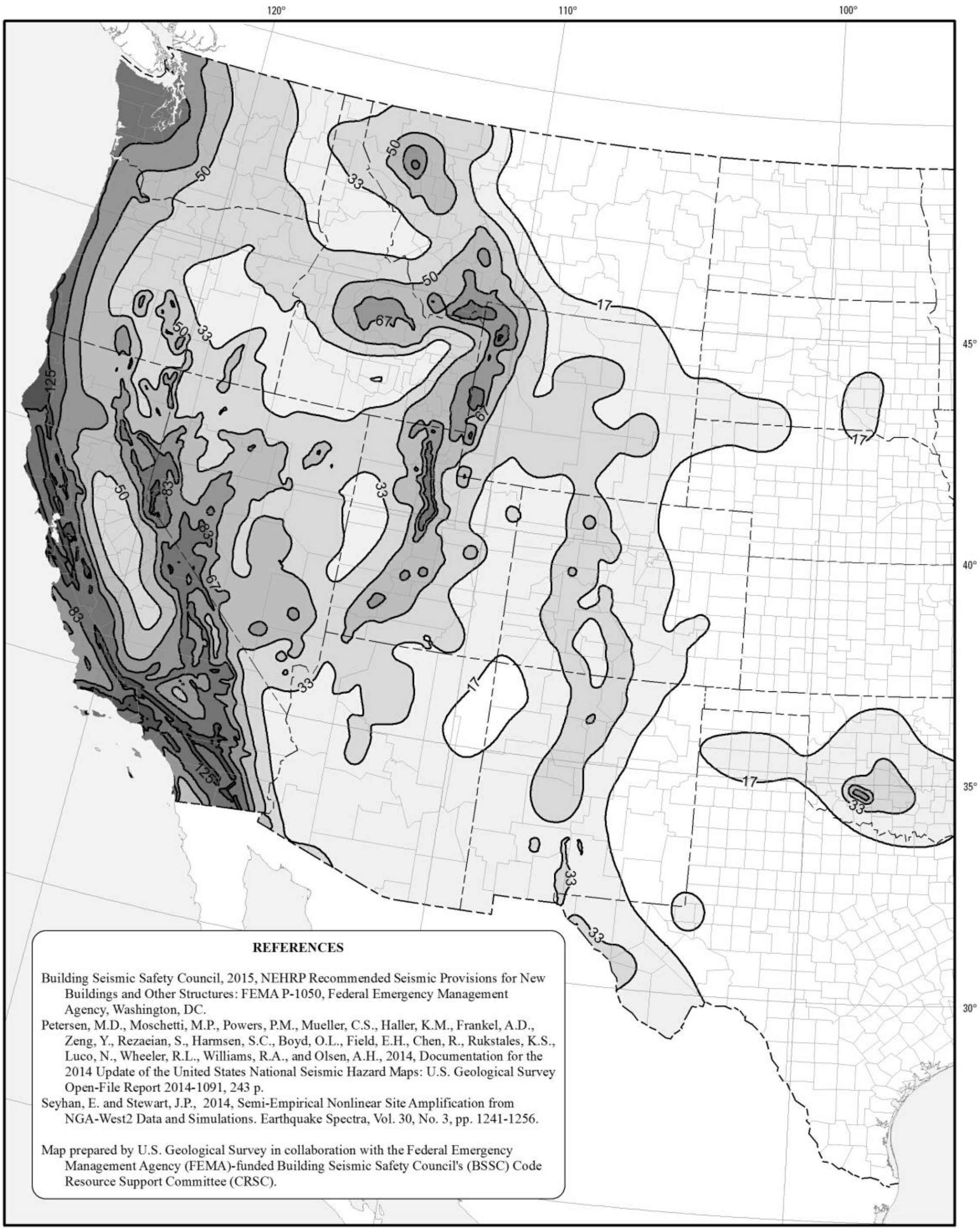

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FIGURE R301.2.2.1.1(5)

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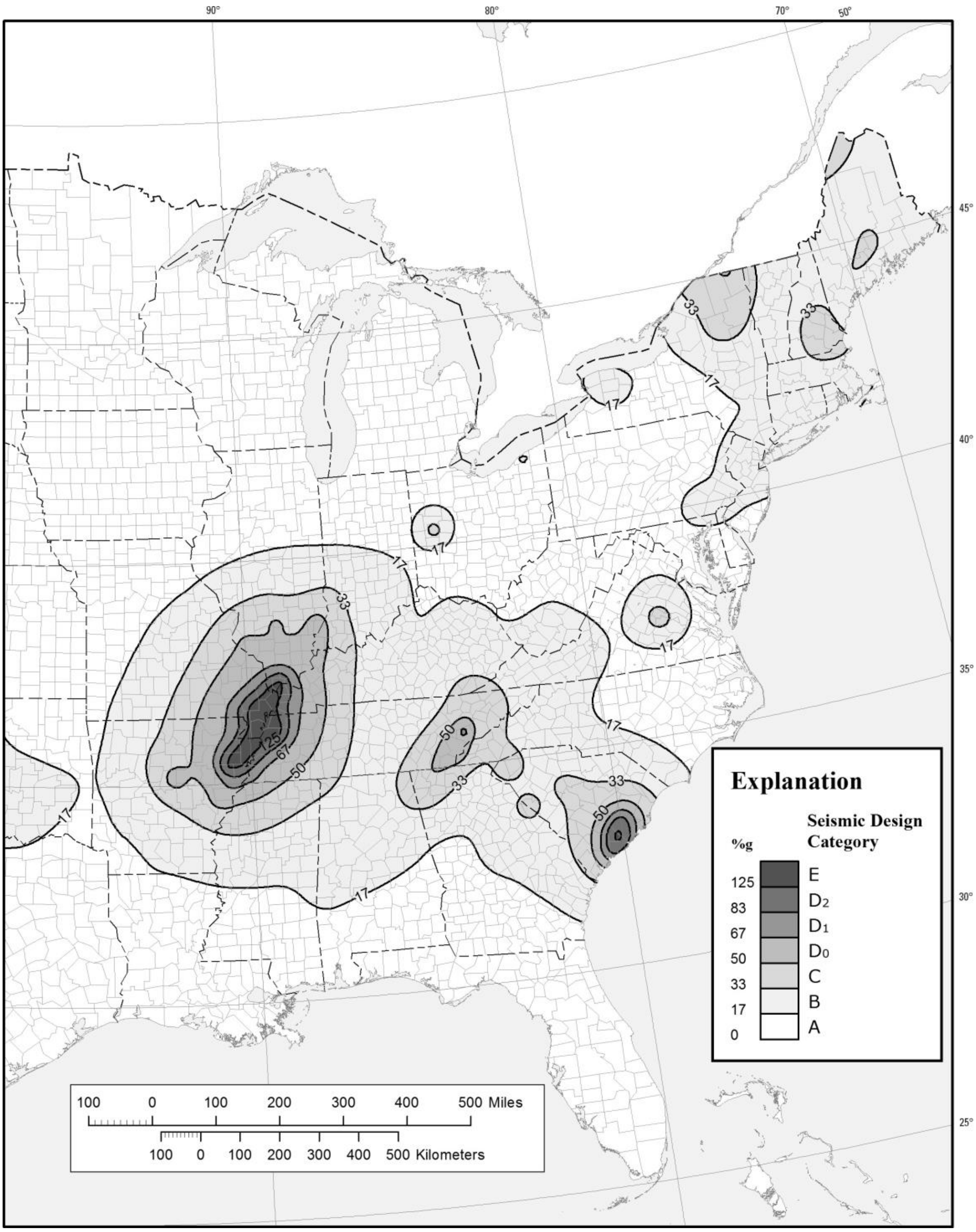
ALTERNATE SEISMIC DESIGN CATEGORIES—UNITED STATESa



a. The seismic design categories and corresponding short-period design spectral response accelerations, *SDS*, shown in Figures R301.2.2.1.1(1) through 301.2.2.1.1(6) are permitted to be used where soil conditions are determined by the building official to be Site Class A, B or D.

FIGURE R301.2.2.1.1(6)

ALTERNATE SEISMIC DESIGN CATEGORIES—UNITED STATESa

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TABLE R301.2.2.1.1
SEISMIC DESIGN CATEGORY DETERMINATION

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CALCULATED *SDS*	SEISMIC DESIGN CATEGORY
SDS ≤ 0.17g	A
0.17g < *SDS* ≤ 0.33g	B
0.33g < *SDS* ≤ 0.50g	C
0.50g < *SDS* ≤ 0.67g	D0
0.67g < *SDS* ≤ 0.83g	D1
0.83g < *SDS* ≤ 1.25g	D2
1.25g < *SDS*	E

R301.2.2.1.2 Alternative determination of Seismic Design Category E.

Buildings located in Seismic Design Category E in accordance with Figures R301.2.2.1(1)through R301.2.2.1(6), or Figures R301.2.2.1.1(1)through R301.2.2.1.1(6)where applicable, are permitted to be reclassified as being in Seismic Design Category D2 provided that one of the following is done:

1. A more detailed evaluation of the seismic design category is made in accordance with the provisions and maps of the *International Building Code*. Buildings located in Seismic Design Category E in accordance with Table R301.2.2.1.1 but located in Seismic Design Category D in accordance with the *International Building Code*, shall be permitted to be designed using the Seismic Design Category D2 requirements of this code.
2. Buildings located in Seismic Design Category E that conform to the following additional restrictions are permitted to be constructed in accordance with the provisions for Seismic Design Category D2 of this code:
   - 2.1. All exterior shear wall lines or *braced wall panels* are in one plane vertically from the foundation to the uppermost *story*.
   - 2.2. Floors shall not cantilever past the *exterior walls*.
   - 2.3. The building is within the requirements of Section R301.2.2.6 for being considered as regular.

R301.2.2.2 Weights of materials.

Average dead loads shall not exceed 15 pounds per square foot (720 Pa) for the combined roof and ceiling assemblies (on a horizontal projection) or 10 pounds per square foot (480 Pa) for floor assemblies, except as further limited by Section R301.2.2. Dead loads for walls above *grade* shall not exceed:

1. Fifteen pounds per square foot (720 Pa) for exterior light-frame wood walls.
2. Fourteen pounds per square foot (670 Pa) for exterior light-frame cold-formed steel walls.
3. Ten pounds per square foot (480 Pa) for interior light-frame wood walls.
4. Five pounds per square foot (240 Pa) for interior light-frame cold-formed steel walls.
5. Eighty pounds per square foot (3830 Pa) for 8-inch-thick (203 mm) masonry walls.
6. Eighty-five pounds per square foot (4070 Pa) for 6-inch-thick (152 mm) concrete walls.
7. Ten pounds per square foot (480 Pa) for SIP walls.

Exceptions:

1. Roof and ceiling dead loads not exceeding 25 pounds per square foot (1190 Pa) shall be permitted provided that the wall bracing amounts in Section R602.10.3 are increased in accordance with Table R602.10.3(4).
2. Light-frame walls with stone or masonry veneer shall be permitted in accordance with the provisions of Sections R702.1 and R703.
3. Fireplaces and chimneys shall be permitted in accordance with Chapter 10.

R301.2.2.3 Stone and masonry veneer.

Anchored stone and masonry veneer shall comply with the requirements of Sections R702.1 and R703.

R301.2.2.4 Masonry construction.

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Masonry construction in *Seismic Design Categories* D0 and D1 shall comply with the requirements of Section R606.12.1. Masonry construction in Seismic Design Category D2 shall comply with the requirements of Section R606.12.4.

R301.2.2.5 Concrete construction.

Buildings with exterior above-*grade* concrete walls shall comply with PCA 100 or shall be designed in accordance

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with ACI 318.

Exception: Detached one- and two-family dwellings in Seismic Design Category C with exterior above-*grade* concrete walls are allowed to comply with the requirements of Section R608.

R301.2.2.6 Irregular buildings.

The seismic provisions of this code shall not be used for structures, or portions thereof, located in *Seismic Design Categories* C, D0, D1 and D2 and considered to be irregular in accordance with this section. A building or portion of a building shall be considered to be irregular where one or more of the conditions defined in Items 1 through 8 occur. Irregular structures, or irregular portions of structures, shall be designed in accordance with accepted engineering practice to the extent the irregular features affect the performance of the remaining structural system. Where the forces associated with the irregularity are resisted by a structural system designed in accordance with accepted engineering practice, the remainder of the building shall be permitted to be designed using the provisions of this code.

1. ***Shear wall* or braced wall offsets out of plane.** Conditions where exterior *shear wall* lines or *braced wall panels* are not in one plane vertically from the foundation to the uppermost story in which they are required.

Exception: For wood *light-frame construction*, floors with cantilevers or setbacks not exceeding four times the nominal depth of the wood floor joists are permitted to support *braced wall panels* that are out of plane with *braced wall panels* below provided that all of the following are satisfied:

1. Floor joists are nominal 2 inches by 10 inches (51 mm by 254 mm) or larger and spaced not more than 16 inches (406 mm) on center.
2. The ratio of the back span to the cantilever is not less than 2 to 1.
3. Floor joists at ends of *braced wall panels* are doubled.
4. For wood-frame construction, a continuous rim joist is connected to ends of cantilever joists. Where spliced, the rim joists shall be spliced using a galvanized metal tie not less than 0.058 inch (1.5 mm) (16 gage) and 11/2 inches (38 mm) wide fastened with six 16d nails on each side of the splice; or a block of the same size as the rim joist and of sufficient length to fit securely between the joist space at which the splice occurs, fastened with eight 16d nails on each side of the splice.
5. Gravity loads carried at the end of cantilevered joists are limited to uniform wall and roof loads and the reactions from headers having a span of 8 feet (2438 mm) or less.

2. **Lateral support of roofs and floors.** Conditions where a section of floor or roof is not laterally supported by *shear walls* or *braced wall lines* on all edges.

Exception: Portions of floors that do not support *shear walls*, *braced wall panels* above, or roofs shall be permitted to extend not more than 6 feet (1829 mm) beyond a *shear wall* or *braced wall line*.

3. ***Shear wall or* braced wall offsets in plane.** Conditions where the end of a *braced wall panel* occurs over an opening in the wall below and extends more than 1 foot (305 mm) horizontally past the edge of the opening. This provision is applicable to *shear walls* and *braced wall panels* offset in plane and to *braced wall panels* offset out of plane in accordance with the exception to Item 1.

Exception: For wood light-frame wall construction, one end of a *braced wall panel* shall be permitted to extend more than 1 foot (305 mm) over an opening not more than 8 feet (2438 mm) in width in the wall below provided that the opening includes a header in accordance with all of the following:

1. The building width, loading condition and framing member species limitations of Table R602.7(1) shall apply.
2. The header is composed of:
   2.1. Not less than one 2 × 12 or two 2 × 10 for an opening not more than 4 feet (1219 mm) wide.
   2.2. Not less than two 2 × 12 or three 2 × 10 for an opening not more than 6 feet (1829 mm) in width.
   2.3. Not less than three 2 × 12 or four 2 × 10 for an opening not more than 8 feet (2438 mm) in width.
3. The entire length of the *braced wall panel* does not occur over an opening in the wall below.

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4. **Floor and roof opening.** Conditions where an opening in a floor or roof exceeds the lesser of 12 feet (3658 mm) or 50 percent of the least floor or roof dimension.

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5. **Floor level offset.** Conditions where portions of a floor level are vertically offset.

Exceptions:

1. Framing supported directly by continuous foundations at the perimeter of the building.
2. For wood *light-frame construction*, floors shall be permitted to be vertically offset where the floor framing is lapped or tied together as required by Section R502.6.1.

6. **Perpendicular *shear wall and* wall bracing.** Conditions where *shear walls and braced wall lines* do not occur in two perpendicular directions.
7. **Wall bracing in stories containing masonry or concrete construction.** Conditions where stories above *grade plane* are partially or completely braced by wood wall framing in accordance with Section R602 or cold-formed steel wall framing in accordance with Section R603 include masonry or concrete construction. Where this irregularity applies, the entire story shall be designed in accordance with accepted engineering practice.

Exceptions: Fireplaces, chimneys and masonry veneer in accordance with this code.

8. **Hillside *light-frame construction*.** Conditions in which all of the following apply:
   8.1. The grade slope exceeds 1 unit vertical in 5 units horizontal where averaged across the full length of any side of the dwelling.
   8.2. The tallest cripple wall clear height exceeds 7 feet (2134 mm), or where a post and beam system occurs at the dwelling perimeter, the post and beam system tallest post clear height exceeds 7 feet (2134 mm).
   8.3. Of the total plan area below the lowest framed floor, whether open or enclosed, less than 50 percent is living space having interior wall finishes conforming to Section R702.

Where Item 8 is applicable, design in accordance with accepted engineering practice shall be provided for the floor immediately above the cripple walls or post and beam system and all structural elements and connections from this diaphragm down to and including connections to the foundation and design of the foundation to transfer lateral loads from the framing above.

Exception: Light-frame construction in which the lowest framed floor is supported directly on concrete or masonry walls over the full length of all sides except the downhill side of the dwelling need not be considered an irregular dwelling under Item 8.

R301.2.2.7 Height limitations.

Wood-framed buildings shall be limited to three *stories* above *grade plane* or the limits given in Table R602.10.3(3). Wood-framed buildings in Seismic Design Category D2 exceeding two *stories* shall be designed for wind and seismic loads in accordance with accepted engineering practice. Cold-formed steel-framed buildings shall be limited to less than or equal to three *stories* above *grade plane* in accordance with AISI S230.

Mezzanines as defined in Section R202 that comply with Section R325 shall not be considered as *stories*.

Structural insulated panel buildings shall be limited to two *stories* above *grade plane*.

R301.2.2.8 Cold-formed steel framing in Seismic Design Categories D0, D1 and D2.

In *Seismic Design Categories* D0, D1 and D2 in addition to the requirements of this code, cold-formed steel framing shall comply with the requirements of AISI S230.

R301.2.2.9 Masonry chimneys.

In *Seismic Design Categories* D0, D1 and D2, masonry chimneys shall be reinforced and anchored to the building in accordance with Sections R1003.3 and R1003.4.

R301.2.2.10 Anchorage of water heaters.

In *Seismic Design Categories* D0, D1 and D2, and in *townhouses* in Seismic Design Category C, water heaters and thermal storage units shall be anchored against movement and overturning in accordance with Section M1307.2 or P2801.8.

R301.2.3 Snow loads.

Wood-framed construction, cold-formed, steel-framed construction and masonry and concrete construction, and *structural insulated panel* construction in regions with ground snow loads 70 pounds per square foot (3.35 kPa) or less, shall be in accordance with Chapters 5, 6 and 8. Buildings in regions with ground snow loads greater than 70 pounds per square foot (3.35 kPa) shall be designed in accordance with accepted engineering practice.

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R301.2.4 Floodplain construction.
Buildings and structures constructed in whole or in part in flood hazard areas (including A or V Zones or forward looking or current extent floodplain areas) as established in Table R301.2, and substantial improvement and *repair* of substantial damage of buildings and structures in flood hazard areas, shall be designed and constructed in accordance with Section R322. Buildings and structures that are located in more than one flood hazard area shall comply with the provisions associated with the most restrictive flood hazard area. Buildings and structures located in whole or in part in identified floodways shall be designed and constructed in accordance with ASCE 24 as modified in this code.
R301.2.4.1 Alternative provisions.
As an alternative to the requirements in Section R322, ASCE 24 is permitted subject to the limitations of this code and the limitations therein.
R301.3 Story height.
The wind and seismic provisions of this code shall apply to buildings with *story heights* not exceeding the following:

1. For wood wall framing, the *story height* shall not exceed 11 feet 7 inches (3531 mm) and the laterally unsupported bearing wall stud height permitted by Table R602.3(5).

Exception: A *story height* not exceeding 13 feet 7 inches (4140 mm) is permitted provided that the maximum wall stud clear height does not exceed 12 feet (3658 mm), the wall studs are in accordance with Exception 2 or 3 of Section R602.3.1 or an engineered design is provided for the wall framing members, and wall bracing for the building is in accordance with Section R602.10. Studs shall be laterally supported at the top and bottom plate in accordance with Section R602.3.

2. For cold-formed steel wall framing, the *story height* shall be not more than 11 feet 7 inches (3531 mm) and the unsupported bearing wall stud height shall be not more than 10 feet (3048 mm).
3. For masonry walls, the *story height* shall be not more than 13 feet 7 inches (4140 mm) and the bearing wall clear height shall be not more than 12 feet (3658 mm).

Exception: An additional 8 feet (2438 mm) of bearing wall clear height is permitted for gable end walls.

4. For insulating concrete form walls, the maximum *story height* shall not exceed 11 feet 7 inches (3531 mm) and the maximum unsupported wall height per *story* as permitted by Section R608 tables shall not exceed 10 feet (3048 mm).
5. For structural insulated panel (SIP) walls, the *story height* shall be not more than 11 feet 7 inches (3531 mm) and the bearing wall height per *story* as permitted by Section R610 tables shall not exceed 10 feet (3048 mm).

For walls other than wood-framed walls, individual walls or wall studs shall be permitted to exceed these limits as permitted by Chapter 6, provided that the *story heights* of this section are not exceeded. An engineered design shall be provided for the wall or wall framing members where the limits of Chapter 6 are exceeded. Where the *story height* limits of this section are exceeded, the design of the building, or the noncompliant portions thereof, to resist wind and seismic loads shall be in accordance with the *International Building Code*.
R301.4 Dead load.
The actual weights of materials and construction shall be used for determining dead load with consideration for the dead load of fixed service equipment.
R301.5 Live load.
The minimum uniformly distributed *live load* shall be as provided in Table R301.5.

TABLE R301.5
MINIMUM UNIFORMLY DISTRIBUTED LIVE LOADS (in pounds per square foot)

USE	UNIFORM LOAD (psf)	CONCENTRATED LOAD (lb)
Uninhabitable attics without storageb	10	—
Uninhabitable attics with limited storageb, g	20	—
Habitable attics and attics served with fixed stairs	30	—

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Balconies (exterior) and deckse	40	—
Fire escapes	40	—
Guards	—	200h, i
Guard in-fill componentsf		50h
Handraild	200h	—
Passenger vehicle garagesa	50a	2,000h

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Areas other than sleeping areas	40	—
Sleeping areas	30	—
Stairs	40c	300c-

For SI: 1 inch = 25.4 mm, 1 pound per square foot = 0.0479 kPa, 1 square inch = 645 mm^2, 1 pound = 4.45 N.

a. Elevated garage floors shall be capable of supporting the uniformly distributed live load or a 2,000-pound concentrated load applied on an area of 41/2 inches by 41/2 inches, whichever produces the greater stresses.

b. Uninhabitable attics without storage are those where the clear height between joists and rafters is not more than 42 inches, or where there are not two or more adjacent trusses with web configurations capable of accommodating an assumed rectangle 42 inches in height by 24 inches in width, or greater, within the plane of the trusses. This live load need not be assumed to act concurrently with any other live load requirements.

c. Individual stair treads shall be capable of supporting the uniformly distributed live load or a 300-pound concentrated load applied on an area of 2 inches by 2 inches, whichever produces the greater stresses.

d. A single concentrated load applied in any direction at any point along the top. For a guard not required to serve as a handrail, the load need not be applied to the top element of the guard in a direction parallel to such element.

e. See Section R507.1 for decks attached to exterior walls.

f. Guard in-fill components (all those except the handrail), balusters and panel fillers shall be designed to withstand a horizontally applied normal load of 50 pounds on an area equal to 1 square foot. This load need not be assumed to act concurrently with any other live load requirement.

g. Uninhabitable attics with limited storage are those where the clear height between joists and rafters is 42 inches or greater, or where there are two or more adjacent trusses with web configurations capable of accommodating an assumed rectangle 42 inches in height by 24 inches in width, or greater, within the plane of the trusses.

The live load need only be applied to those portions of the joists or truss bottom chords where all of the following conditions are met:

1. The attic area is accessed from an opening not less than 20 inches in width by 30 inches in length that is located where the clear height in the attic is not less than 30 inches.
2. The slopes of the joists or truss bottom chords are not greater than 2 units vertical in 12 units horizontal.
3. Required insulation depth is less than the joist or truss bottom chord member depth.

The remaining portions of the joists or truss bottom chords shall be designed for a uniformly distributed concurrent live load of not less than 10 pounds per square foot.

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h. Glazing used in handrail assemblies and guards shall be designed with a load adjustment factor of 4. The load adjustment factor shall be applied to each of the concentrated loads applied to the top of the rail, and to the load on the in-fill components. These loads shall be determined independent of one another, and loads are assumed not to occur with any other live load.

i. Where the top of a guard system is not required to serve as a handrail, the single concentrated load shall be applied at any point along the top, in the vertical downward direction and in the horizontal direction away from the walking surface. Where the top of a guard is also serving as the handrail, a single concentrated load shall be applied in any direction at any point along the top. Concentrated loads shall not be applied concurrently.

R301.6 Roof load.

The roof shall be designed for the *live load* indicated in Table R301.6 or the ground snow load indicated in Table R301.2, whichever is greater.

TABLE R301.6
MINIMUM ROOF LIVE LOADS IN POUNDS-FORCE PER SQUARE FOOT OF HORIZONTAL PROJECTION

ROOF SLOPE	TRIBUTARY LOADED AREA IN SQUARE FEET FOR ANY STRUCTURAL MEMBER		
	0 to 200	201 to 600	Over 600
Flat or rise less than 4 inches per foot (1:3)	20	16	12
Rise 4 inches per foot (1:3) to less than 12 inches per foot (1:1)	16	14	12
Rise 12 inches per foot (1:1) and greater	12	12	12

For SI: 1 square foot = 0.0929 m^2, 1 pound per square foot = 0.0479 kPa, 1 inch per foot = 83.3 mm/m.

R301.7 Deflection.

The allowable deflection of any structural member under the *live load* listed in Sections R301.5 and R301.6 or wind loads determined by Section R301.2.1 shall not exceed the values in Table R301.7.

TABLE R301.7
ALLOWABLE DEFLECTION OF STRUCTURAL MEMBERSb, c

STRUCTURAL MEMBER	ALLOWABLE DEFLECTION
Rafters having slopes greater than 3:12 with finished ceiling not attached to rafters	*L*/180
Interior walls and partitions	*H*/180
Floors	*L*/360
Ceilings with brittle finishes (including plaster and stucco)	*L*/360
Ceilings with flexible finishes (including gypsum board)	*L*/240
All other structural members	*L*/240
Exterior walls—wind loadsa with plaster or stucco finish	*H*/360
Exterior walls—wind loadsa with other brittle finishes	*H*/240
Exterior walls—wind loadsa with flexible finishes	*H*/120d
Lintels supporting masonry veneer wallse	*L*/600

Note: *L* = span length, *H* = span height.

a. For the purpose of the determining deflection limits herein, the wind load shall be permitted to be taken as 0.7 times the component and cladding (ASD) loads obtained from Table R301.2.1(1).

b. For cantilever members, *L* shall be taken as twice the length of the cantilever.

c. For aluminum structural members or panels used in roofs or walls of sunroom additions or patio covers, not supporting edge of glass or sandwich panels, the total load deflection shall not exceed *L*/60. For continuous aluminum structural members supporting edge of glass, the total load deflection shall not exceed *L*/175 for each glass lite or *L*/60 for the entire length of the member, whichever is more stringent. For sandwich panels used in roofs or walls of sunroom additions or patio covers, the total load deflection shall not exceed *L*/120.

d. Deflection for exterior walls with interior gypsum board finish shall be limited to an allowable deflection of *H*/180.

e. Refer to Section R703.8.2. The dead load of supported materials shall be included when calculating the deflection of these members.

R301.8 Nominal sizes.

For the purposes of this code, dimensions of lumber specified shall be deemed to be nominal dimensions unless specifically designated as actual dimensions.

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Key:
Black and/or blue text= Base 2021 IRC language
~~*Black text*~~ = Base 2021 IBC language struck by proposed amendment
Red text = Proposed amendment

Adopt text in IRC 2021 with revisions.

SECTION R322
FLOOD-RESISTANT CONSTRUCTION

R322.1 General.
Buildings and structures constructed in whole or in part in flood hazard areas, including A or V Zones and Coastal A Zones or forward looking or current extent floodplain areas, as established in Table R301.2, and substantial improvement and *repair* of substantial damage of buildings and structures in flood hazard areas, shall be designed and constructed in accordance with the provisions contained in this section. Buildings and structures that are located in more than one flood hazard area shall comply with the provisions associated with the most restrictive flood hazard area. Buildings and structures located in whole or in part in identified floodways shall be designed and constructed in accordance with ASCE 24 as modified in this code.

R322.1.1 Alternative provisions.
As an alternative to the requirements in Section R322, ASCE 24 is permitted subject to the limitations of this code and the limitations therein.

R322.1.2 Structural systems.
Structural systems of buildings and structures shall be designed, connected and anchored to resist flotation, collapse or permanent lateral movement due to structural loads and stresses from flooding equal to the design flood elevation.

R322.1.3 Flood-resistant construction.
Buildings and structures erected in areas prone to flooding shall be constructed by methods and practices that minimize flood damage.

R322.1.4 Establishing the design flood elevation.
The design flood elevation shall be used to define flood hazard areas. At a minimum, the design flood elevation shall be the higher of the following:

1. The base flood elevation at the depth of peak elevation of flooding, including wave height, that has a 1-percent (100-year flood) or greater chance of being equaled or exceeded in any given year.
2. The elevation of the design flood associated with the area designated on a flood hazard map adopted by the community, or otherwise legally designated.

R322.1.4.1 Determination of design flood elevations.
If design flood elevations are not specified, the *building official* is authorized to require the applicant to comply with either of the following:

1. Obtain and reasonably use data available from a federal, state or other source.
2. Determine the design flood elevation in accordance with accepted hydrologic and hydraulic engineering practices used to define special flood hazard areas. Determinations shall be undertaken by a registered *design professional* who shall document that the technical methods used reflect currently accepted engineering practice. Studies, analyses and computations shall be submitted in sufficient detail to allow thorough review and *approval*.

R322.1.4.2 Determination of impacts.

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In riverine flood hazard areas where design flood elevations are specified but floodways have not been designated, the applicant shall demonstrate that the effect of the proposed buildings and structures on design flood elevations, including fill, when combined with other existing and anticipated flood hazard area encroachments, will not increase the design flood elevation more than 1 foot (305 mm) at any point within the *jurisdiction*.

R322.1.5 Lowest floor.

The lowest floor shall be the lowest floor of the lowest enclosed area, including *basement*, and excluding any unfinished flood-resistant enclosure that is useable solely for vehicle parking, building access or limited storage provided that such enclosure is not built so as to render the building or structure in violation of this section.

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R322.1.6 Protection of mechanical, plumbing and electrical systems.
Electrical systems, *equipment* and components; heating, ventilating, air-conditioning; plumbing *appliances* and plumbing fixtures; *duct systems*; and other service *equipment* shall be located at or above the elevation required in Section R322.2 or R322.3. If replaced as part of a substantial improvement, electrical systems, *equipment* and components; heating, ventilating, air-conditioning and plumbing *appliances* and plumbing fixtures; *duct systems*; and other service *equipment* shall meet the requirements of this section. Systems, fixtures, and *equipment* and components shall not be mounted on or penetrate through walls intended to break away under flood loads.
Exception: Locating electrical systems, *equipment* and components; heating, ventilating, air-conditioning; plumbing *appliances* and plumbing fixtures; *duct systems*; and other service *equipment* is permitted below the elevation required in Section R322.2 or R322.3 provided that they are designed and installed to prevent water from entering or accumulating within the components and to resist hydrostatic and hydrodynamic loads and stresses, including the effects of buoyancy, during the occurrence of flooding to the required elevation in accordance with ASCE 24. Electrical wiring systems are permitted to be located below the required elevation provided that they conform to the provisions of the electrical part of this code for wet locations.
R322.1.7 Protection of water supply and sanitary sewage systems.
New and replacement water supply systems shall be designed to minimize or eliminate infiltration of flood waters into the systems in accordance with the plumbing provisions of this code. New and replacement sanitary sewage systems shall be designed to minimize or eliminate infiltration of floodwaters into systems and discharges from systems into floodwaters in accordance with the plumbing provisions of this code and Chapter 3 of the *International Private Sewage Disposal Code.*
R322.1.8 Flood-resistant materials.
Building materials and installation methods used for flooring and interior and exterior walls and wall coverings below the elevation required in Section R322.2 or R322.3 shall be flood damage-resistant materials that conform to the provisions of FEMA TB-2.
R322.1.9 Manufactured homes.
The bottom of the frame of new and replacement *manufactured homes* on foundations that conform to the requirements of Section R322.2 or R322.3, as applicable, shall be elevated to or above the elevations specified in Section R322.2 (flood hazard areas including A Zones) or R322.3 in coastal high-hazard areas (V Zones and Coastal A Zones). The anchor and tie-down requirements of the applicable state or federal requirements shall apply. The foundation and anchorage of *manufactured homes* to be located in identified floodways shall be designed and constructed in accordance with ASCE 24.
R322.1.10 As-built elevation documentation.
A registered *design professional* shall prepare and seal documentation of the elevations specified in Section R322.2 or R322.3.

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R322.2 Flood hazard areas (including A Zones).
Areas that have been determined to be prone to flooding and that are not subject to high-velocity wave action shall be designated as flood hazard areas, including areas designated in forward-looking or current extent of flooding in a map adopted by the community. Flood hazard areas that have been delineated as subject to wave heights between 11/2 feet (457 mm) and 3 feet (914 mm) or otherwise designated by the *jurisdiction* shall be designated as Coastal A Zones and are subject to the requirements of Section R322.3. Buildings and structures constructed in whole or in part in flood hazard areas shall be designed and constructed in accordance with Sections R322.2.1 through R322.2.4.

R322.2.1 Elevation requirements.

1. Buildings and structures in flood hazard areas, not including flood hazard areas designated as Coastal A Zones, shall have the lowest floors elevated to or above the base flood elevation ~~plus 1 foot (305 mm),~~ 2 feet or the design flood elevation as determined by the best available data, whichever is higher.
2. In areas of shallow flooding (AO Zones), buildings and structures shall have the lowest floor (including *basement*) elevated to a height above the highest adjacent *grade* of not less than the depth number specified in feet (mm) on the FIRM plus 1 foot (305 mm), or not less than 3 feet (915 mm) if a depth number is not specified.
3. *Basement* floors that are below *grade* on all sides shall be elevated to or above base flood elevation ~~1 foot (305 mm),~~ 2 feet or the design flood elevation as determined by the best available data, whichever is higher.
4. Garage and carport floors shall comply with one of the following:
   - 4.1. They shall be elevated to or above the elevations required in Item 1 or Item 2, as applicable.
   - 4.2. They shall be at or above *grade* on not less than one side. Where a garage or carport is enclosed by walls, the garage or carport shall be used solely for parking, building access or storage.

Exception: Enclosed areas below the elevation required in this section, including *basements* with floors that are not below *grade* on all sides, shall meet the requirements of Section R322.2.2.

R322.2.2 Enclosed area below required elevation.
Enclosed areas, including crawl spaces, that are below the elevation required in Section R322.2.1 shall:

1. Be used solely for parking of vehicles, building access or storage.
2. Be provided with flood openings that meet the following criteria and are installed in accordance with Section R322.2.2.1:
   - 2.1. The total net area of nonengineered openings shall be not less than 1 square inch (645 mm2) for each square foot (0.093 m2) of enclosed area where the enclosed area is measured on the exterior of the enclosure walls, or the openings shall be designed as engineered openings and the *construction documents*.

shall include a statement by a registered *design professional* that the design of the openings will provide for equalization of hydrostatic flood forces on exterior walls by allowing for the automatic entry and exit of floodwaters as specified in Section 2.7.2.2 of ASCE 24.

   - 2.2. Openings shall be not less than 3 inches (76 mm) in any direction in the plane of the wall.
   - 2.3. The presence of louvers, blades, screens and faceplates or other covers and devices shall allow the automatic flow of floodwater into and out of the enclosed areas and shall be

accounted for in the determination of the net open area.

R322.2.2.1 Installation of openings.
The walls of enclosed areas shall have openings installed such that:

1. There shall be not less than two openings on different sides of each enclosed area; if a building has more than one enclosed area, each area shall have openings.
2. The bottom of each opening shall be not more than 1 foot (305 mm) above the higher of the final interior grade or floor and the finished exterior grade immediately under each opening.
3. Openings shall be permitted to be installed in doors and windows; doors and windows without installed openings do not meet the requirements of this section.

R322.2.3 Foundation design and construction.
Foundation walls for buildings and structures erected in flood hazard areas shall meet the requirements of Chapter 4.
Exception: Unless designed in accordance with Section R404:

1. The unsupported height of 6-inch (152 mm) plain masonry walls shall be not more than 3 feet (914 mm).
2. The unsupported height of 8-inch (203 mm) plain masonry walls shall be not more than 4 feet (1219 mm).
3. The unsupported height of 8-inch (203 mm) reinforced masonry walls shall be not more than 8 feet (2438 mm).

For the purpose of this exception, unsupported height is the distance from the finished *grade* of the under-floor space to the top of the wall.
R322.2.4 Tanks.
Underground tanks shall be anchored to prevent flotation, collapse and lateral movement under conditions of the base flood. Above-ground tanks shall be installed at or above the elevation required in Section R322.2.1 or shall be anchored to prevent flotation, collapse and lateral movement under conditions of the base flood.
R322.3 Coastal high-hazard areas (including V Zones and Coastal A Zones, where designated).
Areas that have been determined to be subject to wave heights in excess of 3 feet (914 mm) or subject to high-velocity wave action or wave-induced erosion shall be designated as coastal high-hazard areas, including areas designated in forward-looking or current extent of flooding in a map adopted by the community. Flood hazard areas that have been designated as subject to wave heights between 11/2 feet (457 mm) and 3 feet (914 mm) or otherwise designated by the *jurisdiction* shall be designated as Coastal A Zones. Buildings and structures constructed in whole or in part in coastal high-hazard areas and Coastal A Zones, where designated, shall be designed and constructed in accordance with Sections R322.3.1 through R322.3.10.

R322.3.1 Location and site preparation.

1. New buildings and buildings that are determined to be substantially improved pursuant to Section R105.3.1.1 shall be located landward of the reach of mean high tide.
2. For any alteration of sand dunes and mangrove stands, the *building official* shall require submission of an engineering analysis that demonstrates that the proposed alteration will not increase the potential for flood damage.

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R322.3.2 Elevation requirements.

1. Buildings and structures erected within coastal high-hazard areas and Coastal A Zones, shall be elevated so that the bottom of the lowest horizontal structural members supporting the lowest floor, with the exception of piling, pile caps, columns, grade beams and bracing, is elevated to or above the base flood elevation plus ~~1 foot (305 mm)~~ 3 ft or the design flood elevation, whichever is higher.
2. *Basement* floors that are below *grade* on all sides are prohibited.
3. Garages used solely for parking, building access or storage, and carports shall comply with Item 1 or shall be at or above *grade* on not less than one side and, if enclosed with walls, such walls shall comply with Item 6.

.4. The use of fill for structural support is prohibited.

.5. Minor grading, and the placement of minor quantities of fill, shall be permitted for landscaping and for drainage purposes under and around buildings and for support of parking slabs, pool decks, patios and walkways.

.6. Walls and partitions enclosing areas below the elevation required in this section shall meet the requirements of Sections R322.3.5 and R322.3.6.

R322.3.3 Foundations.

Buildings and structures erected in coastal high-hazard areas and Coastal A Zones shall be supported on pilings or columns and shall be adequately anchored to such pilings or columns and shall comply with the following:

1. The space below the elevated building shall be either free of obstruction or, if enclosed with walls, the walls shall meet the requirements of Section R322.3.5.
2. Pilings shall have adequate soil penetrations to resist the combined wave and wind loads (lateral and uplift) and pile embedment shall include consideration of decreased resistance capacity caused by scour of soil strata surrounding the piling.
3. Columns and their supporting foundations shall be designed to resist combined wave and wind loads, lateral and uplift, and shall include consideration of decreased resistance capacity caused by scour of soil strata surrounding the columns. Spread footing, mat, raft or other foundations that support columns shall not be permitted where soil investigations that are required in accordance with Section R401.4 indicate that soil material under the spread footing, mat, raft or other foundation is subject to scour or erosion from wave-velocity flow conditions. If permitted, spread footing, mat, raft or other foundations that support columns shall be designed in accordance with ASCE 24.
4. Flood and wave loads shall be those associated with the design flood. Wind loads shall be those required by this code.
5. Foundation designs and *construction documents* shall be prepared and sealed in accordance with Section R322.3.9.

Exception: In Coastal A Zones, stem wall foundations supporting a floor system above and backfilled with soil or gravel to the underside of the floor system shall be permitted provided that the foundations are designed to
account for wave action, debris impact, erosion and local scour. Where soils are susceptible to erosion and local scour, stem wall foundations shall have deep footings to account for the loss of soil.

R322.3.4 Concrete slabs.

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Concrete slabs used for parking, floors of enclosures, landings, decks, walkways, patios and similar uses that are located beneath structures, or slabs that are located such that if undermined or displaced during base flood conditions could cause structural damage to the building foundation, shall be designed and constructed in accordance with one of the following:

1. To be structurally independent of the foundation system of the structure, to not transfer flood loads to the main structure, and to be frangible and break away under flood conditions prior to base flood conditions. Slabs shall be a maximum of 4 inches (102 mm) thick, shall not have turned-down edges, shall not contain reinforcing, shall have isolation joints at pilings and columns, and shall have control or construction joints in both directions spaced not more than 4 feet (1219 mm) apart.
2. To be self-supporting, structural slabs capable of remaining intact and functional under base flood conditions, including erosion and local scour, and the main structure shall be capable of resisting any added flood loads and effects of local scour caused by the presence of the slabs.

R322.3.5 Walls below required elevation.

Walls and partitions are permitted below the elevation required in Section R322.3.2, provided that such walls and partitions are not part of the structural support of the building or structure and:

1. Electrical, mechanical and plumbing system components are not to be mounted on or penetrate through walls that are designed to break away under flood loads; and
2. Are constructed with insect screening or open lattice; or
3. Are designed to break away or collapse without causing collapse, displacement or other structural damage to the elevated portion of the building or supporting foundation system. Such walls, framing and connections shall have a resistance of not less than 10 (479 Pa) and not more than 20 pounds per square foot (958 Pa) as determined using allowable stress design; or
4. Where wind loading values of this code exceed 20 pounds per square foot (958 Pa), as determined using allowable stress design, the *construction documents* shall include documentation prepared and sealed by a registered *design professional* that:
   - 4.1. The walls and partitions below the required elevation have been designed to collapse from a water load less than that which would occur during the base flood.
   - 4.2. The elevated portion of the building and supporting foundation system have been designed to withstand the effects of wind and flood loads acting simultaneously on structural and nonstructural building components. Water-loading values used shall be those associated with the design flood. Wind-loading values shall be those required by this code.
5. Walls intended to break away under flood loads as specified in Item 3 or 4 have flood openings that meet the criteria in Section R322.2.2, Item 2.

R322.3.6 Enclosed areas below required elevation.

Enclosed areas below the elevation required in Section R322.3.2 shall be used solely for parking of vehicles, building access or storage.

R322.3.6.1 Protection of building envelope.

An exterior door that meets the requirements of Section R609 shall be installed at the top of stairs that provide access to the building and that are enclosed with walls designed to break away in accordance with Section R322.3.5.

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R322.3.7 Stairways and ramps.
Stairways and *ramps* that are located below the lowest floor elevations specified in Section R322.3.2 shall comply with one or more of the following:

1. Be designed and constructed with open or partially open *risers* and *guards*.
2. *Stairways* and *ramps* not part of the required means of egress shall be designed and constructed to break

away during design flood conditions without causing damage to the building or structure, including foundation.

3. Be retractable, or able to be raised to or above the lowest floor elevation, provided that the ability to be retracted or raised prior to the onset of flooding is not contrary to the means of egress requirements of the code.
4. Be designed and constructed to resist flood loads and minimize transfer of flood loads to the building or structure, including foundation.

Areas below *stairways* and *ramps* shall not be enclosed with walls below the required i n Section R322.3.2 elevation unless such walls are constructed in accordance with Section R322.3.5.

R322.3.8 Decks and porches.
Attached decks and porches shall meet the elevation requirements of Section R322.3.2 and shall either meet the foundation requirements of this section or shall be cantilevered from or knee braced to the building or structure. Self- supporting decks and porches that are below the elevation required in Section R322.3.2 shall not be enclosed by solid, rigid walls, including walls designed to break away. Self-supporting decks and porches shall be designed and constructed to remain in place during base flood conditions or shall be frangible and break away under base flood conditions.

R322.3.9 Construction documents.
The *construction documents* shall include documentation that is prepared and sealed by a registered *design professional* that the design and methods of construction to be used meet the applicable criteria of this section.

R322.3.10 Tanks.
Underground tanks shall be anchored to prevent flotation, collapse and lateral movement under conditions of the base flood. Above-ground tanks shall be installed at or above the elevation required in Section R322.3.2. Where elevated on platforms, the platforms shall be cantilevered from or knee braced to the building or shall be supported on foundations that conform to the requirements of Section R322.3.