

## Massachusetts State Building Code Flood Standards

8<sup>th</sup> Ed. Base & Residential Vol

May 11, 12, 2016

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## 44 CFR 60.3

- Minimum standards for National Flood Insurance Program

## International Code Series

- Massachusetts Code currently based on 2009 I Code Series
- Proposed 9<sup>th</sup> Ed based on 2015 series

## Referenced Standards

- ASCE 24 Flood Resistant Design
- ASCE 7 Minimum Design Loads

## Massachusetts State Building Code

- 8<sup>th</sup> Edition Residential Volume
- 8<sup>th</sup> Edition Base Volume

## Too Many Cooks?

- 44 CFR – FEMA
- I Codes – ICC
- ASCE 24 & 7 – ASCE
- MA Codes - BBRs

## Base Volume

- Chapter 16, Structural Design
  - Section 1612 Flood Loads
- Appendix G, Flood-Resistant Construction
- ASCE 24, Flood Resistant Design and Construction
- ASCE 7, Minimum Design Loads for Buildings and Other Structures

## Residential Volume

- Chapter 1, Scope and Administration
- Chapter 2, Definitions
- Chapter 3, Building Planning
  - Section R322 Flood-Resistant Construction
- Chapter 4, Foundations

## Basement Base Volume

The portion of a building having its floor subgrade (below ground level) on all sides. This definition of “Basement” is limited in application to the provisions of Section 1612 and Chapter 115, Appendix G (see “Basement” in Section 502.1).

Base Volume, Ch 16

## Basement Residential Volume

The portion of a building having its floor subgrade (below ground level) on all sides, but is not a crawlspace. This definition of “Basement” is limited in application to the provisions of Section R322 (see “Basement” in Section R202).

Residential Volume, Section R322.1.11

## Lowest Floor Base Volume

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

Base Volume, Section 1612.2

## Lowest Floor Residential Volume

The lowest floor shall be the floor of the lowest enclosed area, including basement, but excluding any unfinished flood-resistant enclosure that is not a basement and 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

Residential Volume, Section R322.1.5

## Substantial Improvement

### Base Volume

Any repair, reconstruction, rehabilitation, addition or improvement of a building or structure, the cost of which equals or exceeds 50 percent of the market value of the structure before the improvement or repair...

Base Volume 1612.2

## Substantial Improvement

### Residential Volume

- R105.3.1.1 Determination of Substantially Improved or Substantially Damaged Existing Buildings in Flood Hazard Areas and Coastal Dunes.

(This whole subsection was rewritten)

## Substantial Repair of a Foundation

### Base Volume G201.2

- Work to repair and/or replace a foundation that results in the repair or replacement of the portion of the foundation walls with a perimeter along the base of the foundation that equals or exceeds 50% of the perimeter of the base of the entire foundation measured in linear feet. The term "substantial repair of a foundation" also includes a building or structure including a manufactured home that has incurred a failure of a foundation regardless of the actual work done to repair or replace the foundation.

## Substantial Repair of a Foundation

### Residential Volume R105.3.1.1.1

- When work to repair or replace a foundation results in the repair or replacement of a portion of the foundation with a perimeter along the base of the foundation that equals or exceeds 50% of the perimeter of the base of the foundation measured in linear feet the *building official* shall determine it to be substantial repair of a foundation. Applications determined by the *building official* to constitute substantial repair of a foundation shall require all existing portions of the entire building or structure to meet the requirements of Section R322.

## Base Volume

- Flood Hazard Areas (A zones)
- Flood Hazard Areas Subject to High Velocity Wave Action (V zones)
- Coastal Dunes
- Design Flood/Base Flood

## Residential Volume

- Flood Hazard Areas (A zones)
- Coastal High Hazard Areas (V zones)
- Coastal dunes
- Design Flood/Base Flood

## Construction Documents Base Volume

- 1612.4 Design and Construction. The design and construction of buildings and structures located in *flood hazard areas*, including flood hazard areas subject to high-velocity wave action, shall be in accordance with Chapter 5 of ACSE 7 and ASCE 24. *Plans shall be prepared by a registered design professional.*
  - Note. In using ASCE 24, delete tables 1-1, 2-1, 4-1, 5-1, 6-1, 7-1. For elevation requirements use section 1612 and Chapter 115 Appendix G. Also, delete references to Coastal A zones and instead use requirements for A zones in Section 1612 and Appendix G.

## Construction Documents Residential Volume

- **R322.1.12 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.*

## Construction Standards Residential Volume

### R322.2.1 Elevation requirements.

1. Buildings and structures in flood hazard areas shall have the lowest floors elevated to or above the design flood elevation.
2. In areas of shallow flooding (AO Zones), buildings and structures shall have the lowest floor (including *basement*) elevated at least as high above the highest adjacent *grade* as the depth number specified in feet on the FIRM, or at least 2 feet (610 mm) if a depth number is not specified.

### R322.2.1 Elevation requirements.

3. *Basement* floors shall be elevated to or above the design flood elevation.
4. For lateral additions that are a *substantial improvement*, only the addition shall be elevated so that the *lowest floor*, including basement/cellars, is located at or above *design flood elevation*.

**Exception:** Enclosed areas below the design flood elevation, including *areas that are not basements*, shall meet the requirements of Section R322.2.2.

## Enclosed Areas Below the Design Flood Elevation

**R322.2.2 Enclosed area below design flood elevation.** Enclosed areas, including crawl spaces, that are below the design flood elevation **and are not basements** shall:

1. Be used solely for parking of vehicles, building access or storage.
2. Be provided with flood openings that meet the following criteria:

- 2.1. There shall be a minimum of two openings on different sides of each enclosed area; if a building has more than one enclosed area below the design flood elevation, each area shall have openings on exterior walls.
- 2.2. The total net area of all openings shall be at least 1 square inch (645 mm<sup>2</sup>) for each square foot (0.093 m<sup>2</sup>) of enclosed area, or the openings shall be designed 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 2.6.2.2 of ASCE 24.

- 2.3. The bottom of each opening shall be 1 foot (305 mm) or less above the adjacent ground level.
- 2.4. Openings shall be not less than 3 inches (76 mm) in any direction in the plane of the wall.
- 2.5. Any louvers, screens or other opening covers shall allow the automatic flow of floodwaters into and out of the enclosed area.
- 2.6. Openings installed in doors and windows, that meet requirements 2.1 through 2.5, are acceptable; however, doors and windows without installed openings do not meet the requirements of this section.

#### **R322.1.6 Protection of mechanical 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 (*flood hazard areas* including A Zones) or R322.3 (coastal high-hazard areas including V Zones). 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.

#### **R322.1.8 Flood-resistant materials.**

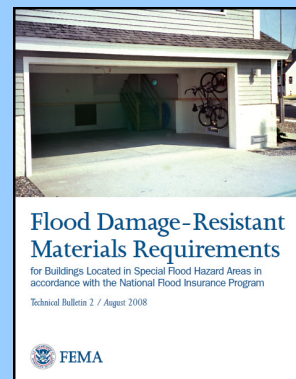
- Building materials used below the elevation required in Section R322.2 (flood hazard areas including A Zones) or R322.3 (coastal high-hazard areas including V Zones) shall comply with the following:
  1. All wood, including floor sheathing, shall be pressure-preservative-treated in accordance with AWP A U1 for the species, product, preservative and end use or be the decay-resistant heartwood of redwood, black locust or cedars. Preservatives shall be listed in Section 4 of AWP A U1.
  2. Materials and installation methods used for flooring and interior and *exterior walls* and wall coverings shall conform to the provisions of FEMA/FIA-TB-2.

### **Chapter 4 Foundations**

R408.7 Flood resistance. For buildings located in areas prone to flooding as established in Table R301.2(1):

1. Walls enclosing the under-floor space shall be provided with flood openings in accordance with Section R322.2.2.
2. The finished ground level of the under-floor space shall be equal to or higher than the outside finished ground level on at least one side.

**Exception: Deleted.**





### Openings in Foundation Walls and Walls of Enclosures

Below Elevated Buildings in Special Flood Hazard Areas in accordance with the National Flood Insurance Program

Technical Bulletin 1 / August 2008

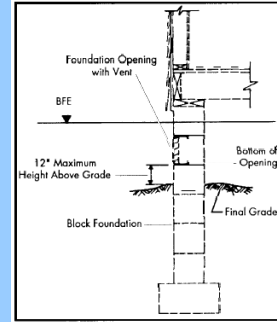


Figure 1. Opening for Solid Foundation Wall

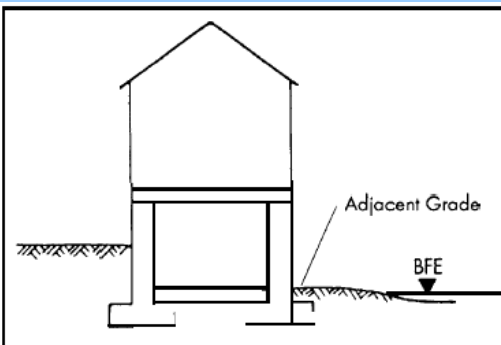


Figure 2. Compliant Grading for a Walkout Basement

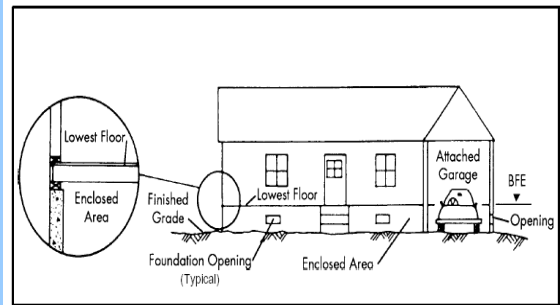
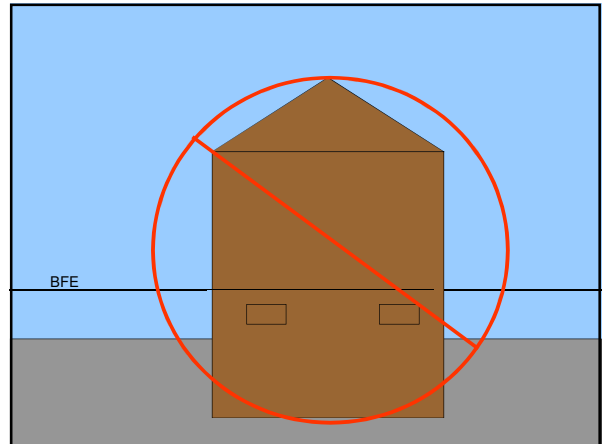
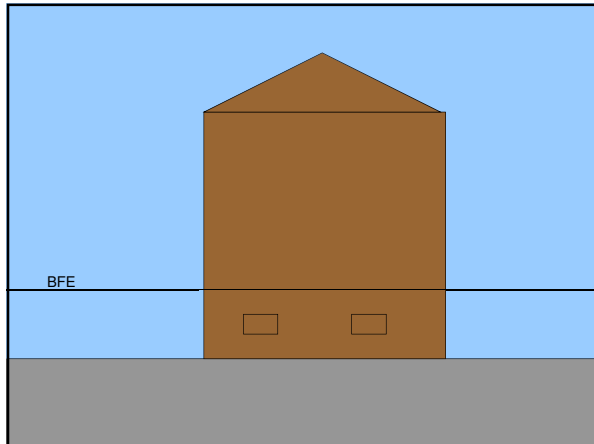
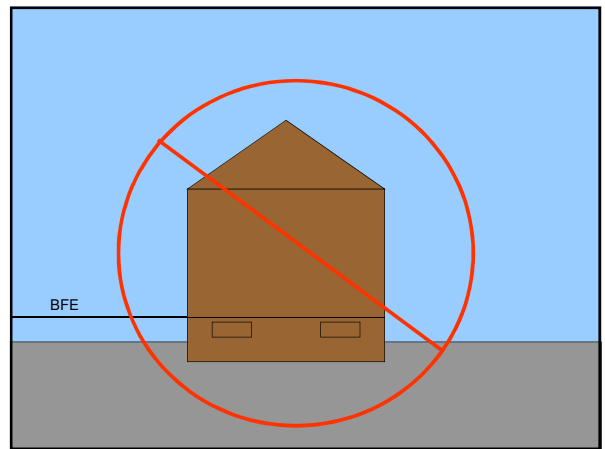
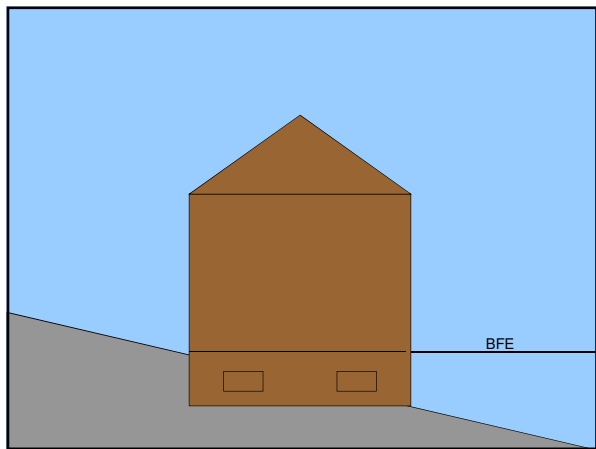
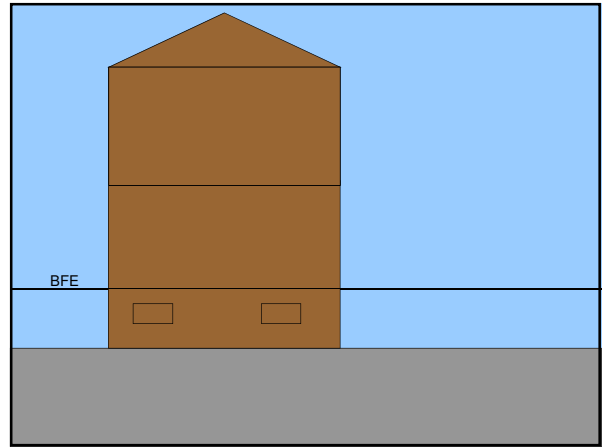
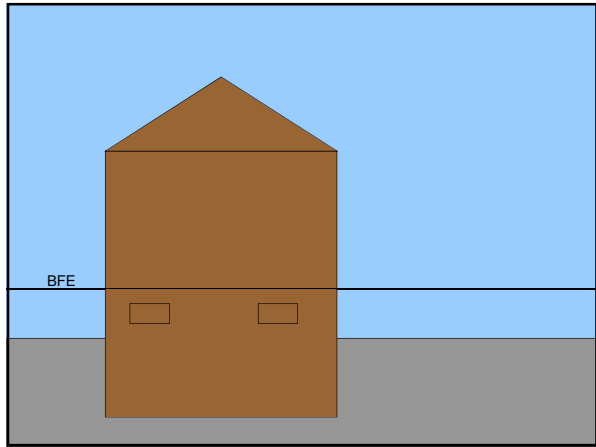
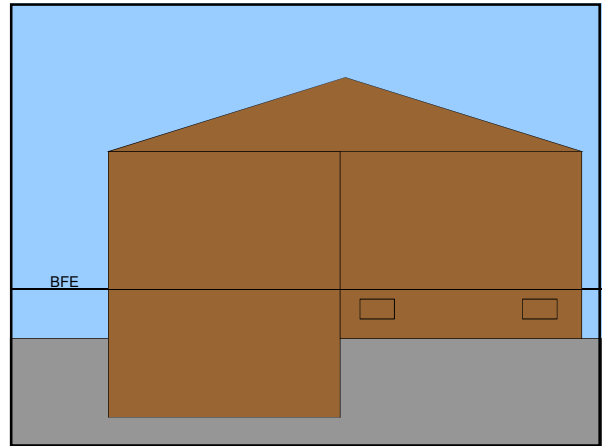
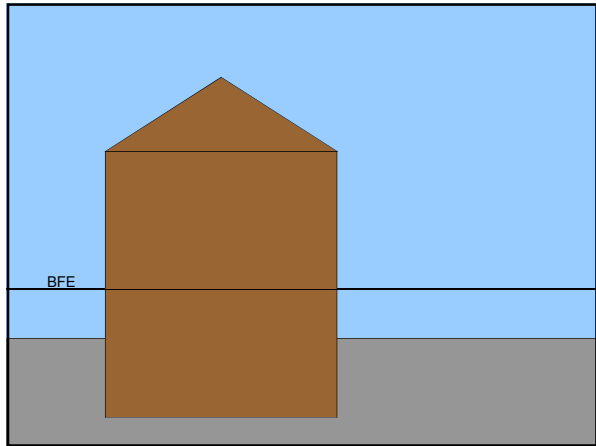
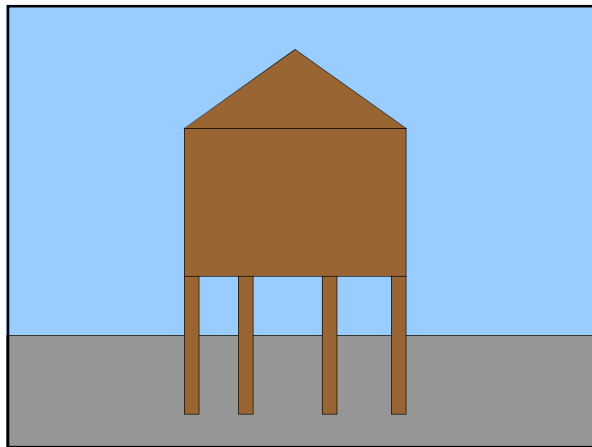
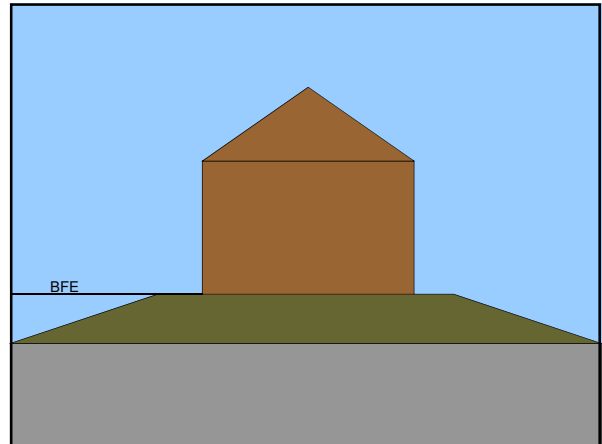
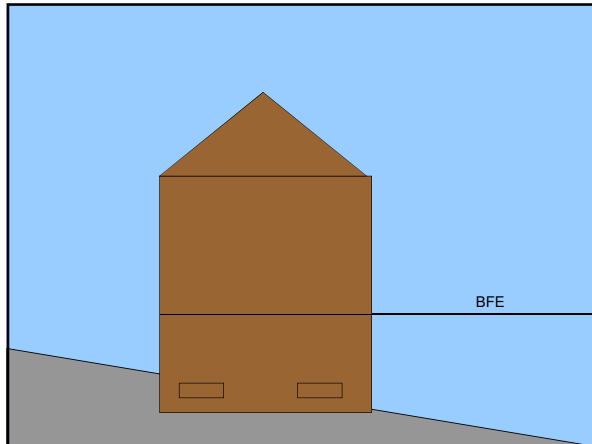


Figure 3. Compliant Residential Building Built on Solid Foundation Walls With Attached Garage







**R322.3 Coastal high-hazard areas (including V Zones).**

- 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. Coastal high-hazard areas shall include all areas shown as V zones on the most recent Flood Hazard Boundary Map or Flood Insurance Rate Map. Buildings and structures constructed in whole or in part in coastal high-hazard areas shall be designed and constructed in accordance with [Sections R322.3.1](#) through [R322.3.6](#).

**R322.3.2 Elevation requirements.**

- 1. All buildings and structures erected within coastal high hazard areas shall be elevated so that the lowest portion of all structural members supporting the lowest floor, with the exception of mat or raft foundations, piling, pile caps, columns, grade beams and bracing, is located at or above the design flood elevation plus two feet.

**R322.3.2 Elevation requirements.**

2. Basement floors that are below *grade* on all sides are prohibited.
3. The use of fill for structural support is prohibited.
4. 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.
5. For lateral additions that are not substantial improvements, only the addition shall be elevated so that the bottom of the lowest horizontal structural member of the lowest floor with the exception of the pilings or pile caps is located at an elevation that is at least two feet above the design flood elevation.

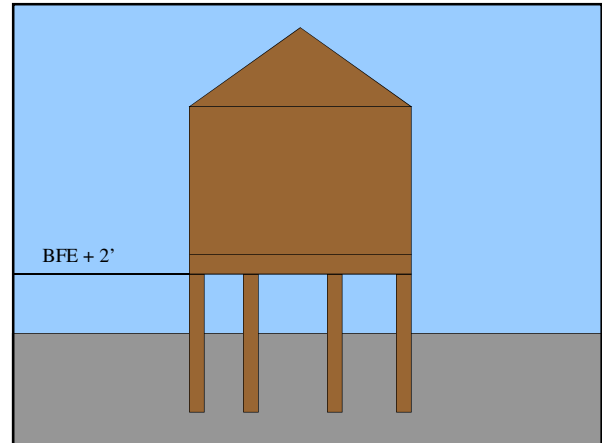
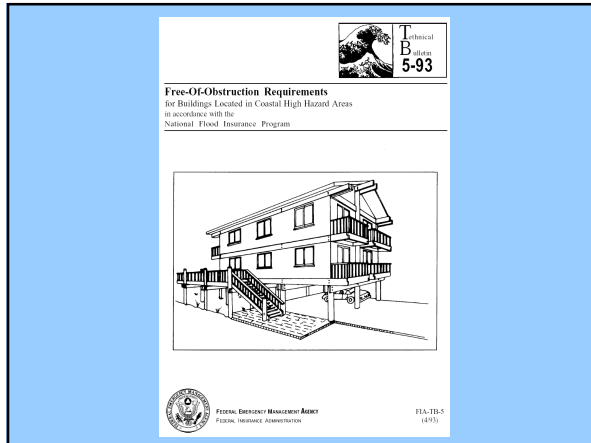


### R322.3.4 Walls below design flood elevation.

- Walls and partitions are permitted below the elevated floor, 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...

### R322.3.5 Enclosed areas below design flood elevation.

- Enclosed areas below the design flood elevation shall be used solely for parking of vehicles, building access or storage.



- Construction Standards for Non-Residential Floodproofing (A zones Only)

- Base Volume

### G301.3 Enclosures below base flood elevation.

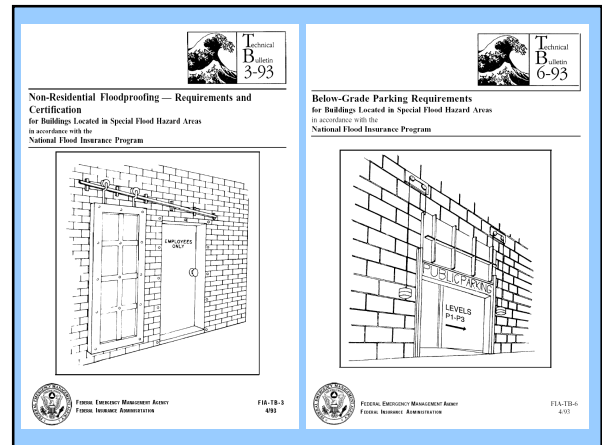
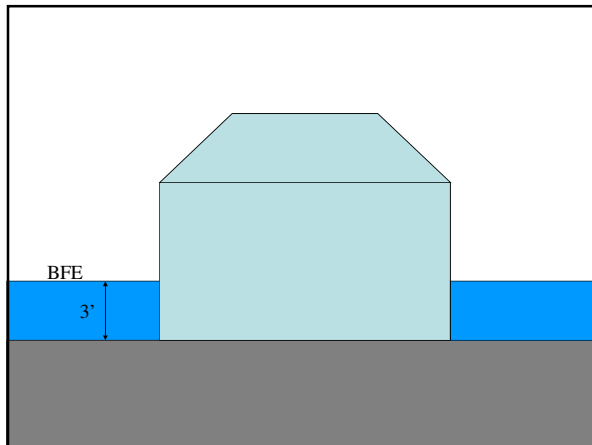
- **G301.3.1 Flood hazard areas.** Enclosed spaces including basements and cellars, are not permitted below the *base flood* elevation.
- **Exception 1:** Fully enclosed spaces in an area other than a basement/cellar, used for means of egress, entrance foyers, stairways and incidental storage are allowed but shall be designed to automatically equalize hydrostatic forces on exterior walls by allowing for the entry and exit of floodwaters in accordance with ASCE 24 Section 2.6.

### G301.3 Enclosures below base flood elevation.

- **Exception 2:** Occupancies other than R-use group may be erected with habitable enclosed spaces or floors below the *base flood* elevation provided that the following conditions are met:
  1. All space below the *base flood* elevation **plus one foot** shall be constructed with walls and floors that are substantially impermeable to the passage of water.
  2. All structural components subject to hydrostatic and hydrodynamic loads and stresses during the occurrence of flooding to the base flood elevation shall be capable of resisting such forces, including the effects of buoyancy.

### G301.3 Enclosures below base flood elevation.

- 3. All openings below the *base flood* elevation **plus one foot** shall be provided with water-tight closures and shall have adequate structural capacity to support all flood loads acting upon the closure surfaces.
- 4. All floor and wall penetrations for plumbing, mechanical and electrical systems shall be made water tight to prevent floodwater seepage through spaces between the penetration and wall construction materials. Sanitary sewer and storm drainage systems that have openings below the *base flood* elevation **plus one foot** shall be provided with shutoff valves or closure devices to prevent backwater flow during conditions of flooding.



### Coastal Dunes

(All of the coastal dune standards are MA amendments)

- **Residential Code R322.4 Coastal Dunes.**
- **Base Code Ch 1612 and Appendix G**

**R322.4 Coastal Dunes.** The following applies to construction in a coastal wetland resource:

**R322.4.1. Determination of Coastal Dunes.** To reduce flood damage, ensure the structural integrity of buildings or structures including manufactured homes, located in coastal dunes, to protect the public safety and to eliminate certain conflicts between the coastal dune performance standards set forth in the Wetlands Protection Act Regulations, 310 CMR 10.28, and this Code, R322.4 establishes requirements for design and construction in coastal dunes significant to the interests of flood control and/or storm damage prevention identified in 310 CMR 10.28: Coastal Dunes.

#### **R322.4.1 Determination of Coastal Dunes.**

- To determine whether a proposed building or structure, including a manufactured home, a lateral addition, work on a foundation that under R105.3.1.2 requires compliance with R322, or substantial improvement to a building or structure that has incurred substantial damage as the result of flooding and/or storms is located within an area that is a coastal dune significant to the interests of flood control and/or storm damage prevention, the building official shall require the submission of certain construction documents in accordance with R322.4.2.

#### **R322.4.1 Determination of Coastal Dunes.**

- **R322.4.2** For buildings and structures, including new or replacement manufactured homes, lateral additions, foundations that are replaced in total or repaired so as to constitute *substantial repair of a foundation*, or substantial repair or improvement of a building or structure that has incurred substantial damage as a result of flooding and/or storms, proposed on a parcel of land that is located wholly or partially within a coastal wetland resource area shown on the map entitled "Map of Coastal Wetland Resources For Building Officials", the building official shall require submission of one of the construction documents specified in (a) through (d) below

- (a) An Order of Conditions establishing the boundaries of all coastal wetland resource areas in a plan referenced in and accompanying the Order.
- (b) An Order of Resource Area Delineation stating that the proposed construction work is outside the boundaries of all coastal wetland resource areas as shown on a plan referenced in and accompanying the Order.

- (c) A Determination of Applicability stating that the proposed construction work is outside the boundaries of all coastal wetland resource areas as shown on a plan referenced in and accompanying the Determination or will not fill, dredge or alter a coastal wetland resource area.
- (d) A Notice of Non-significance evidencing that the proposed construction work is within a coastal wetland resource area as shown on a plan referenced in and accompanying the Notice and stating that the coastal wetland resource area is not significant to any of the interests identified in the Wetlands Protection Act, M.G.L.c. 131, § 40.

#### **R322.4.5 Elevation requirements.**

- **R322.4.5 Elevation requirements.** For new buildings and *structures*, new foundations, replacement or substantial repair of a foundation, or repair of a substantially damaged structure where damage is the result of a storm or flooding the entire structure shall be elevated so that the bottom of the lowest horizontal structural member of the lowest floor with the exception of pilings or pile caps is located at the elevation required by the Order of Conditions of the local Conservation Commission...

#### **R322.4.5 Elevation requirements.**

- **R322.4.6 Foundations.** Foundations for work meeting the elevation requirements of Section **R322** shall consist of open pilings without footings to allow the movement of the dune.
- Exception...
- **R322.4.7 Enclosed areas below design flood elevation.** Enclosures are not permitted below the lowest horizontal structural member of the lowest floor.

## Documentation Requirements

- **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.

## Documentation Requirements

**1612.5 Flood hazard documentation.** The following documentation shall be prepared and sealed by a *registered design professional* and submitted to the *building official*:

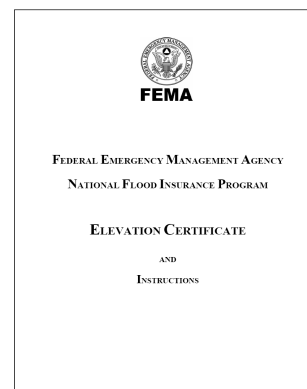
1. For construction in *flood hazard areas* not subject to high-velocity wave action:

1.1. The elevation of the lowest floor, including the basement, as required by the lowest floor elevation inspection in Section 110.3.3.

## Documentation Requirements

2. For construction in *flood hazard areas subject to high-velocity wave action*:

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.



National Flood Insurance Program Elevation Certificate and Instructions

The National Flood Insurance Program (NFIP) Elevation Certificate (EC)/DMA form 096-0-333 is an administrative tool of the NFIP which is to be used to provide elevation information necessary to ensure compliance with community floodplain management ordinances, to determine the proper insurance premium rate, or support a request for a letter of map amendment (LOMA).

The EC form is currently under review at the Office of Management and Budget (OMB) and they have extended the expiration date of this form to November 30, 2015. Until their review process is complete, please continue to use the existing form. Upon OMB approval, FEMA will update this record with the new Elevation Certificate form.

File Name	Size	Publication Date
Formerly E-033	52.72K	February 14, 2013
Formerly E-033	1.44M	February 14, 2013
Module PDF form	52.72K	February 13, 2013

U.S. DEPARTMENT OF HOMELAND SECURITY  
Federal Emergency Management Agency  
National Flood Insurance Program

**ELEVATION CERTIFICATE** (OMB No. 1902-0038)  
Expires February 10, 2016

**SECTION A - PROPERTY INFORMATION**

1. Building Name: \_\_\_\_\_  
 2. Building Street Address (Including "W", "S", "E", "N", "SW", "SE", "NW", "NE", "1/4", "1/2", "3/4", "P.O. Box and Box No.): \_\_\_\_\_  
 City: \_\_\_\_\_ State: \_\_\_\_\_ Zip: \_\_\_\_\_  
 3. Property Description (Lot and Block Number, Tax Parcel Number, Legal Description, etc.): \_\_\_\_\_

**SECTION B - FLOOD HAZARD INFORMATION AND DATA COLLECTION**

4. Address (Use A.A., Residential; Non-Residential: Address, Apartment, etc.): \_\_\_\_\_ Hazard Zone:  HAZ 100  HAZ 100X  
 5. Latitude/Longitude: \_\_\_\_\_  
 6. Major or minor Levee/Barrier of the building (See Certificate's legend and other flood insurance information):  Major Levee/Barrier  Minor Levee/Barrier  
 7. Building Use:  Residential  Commercial/Industrial  Other: \_\_\_\_\_  
 8. Special Use:  Special Use  Other: \_\_\_\_\_  
 9. Other: \_\_\_\_\_  
 10. Other: \_\_\_\_\_

**SECTION C - REQUIRED ELEVATION INFORMATION (REQUIRED REQUIREMENTS)**

11. Building Use:  Residential  Commercial/Industrial  Other: \_\_\_\_\_  
 12. Building Use:  Residential  Commercial/Industrial  Other: \_\_\_\_\_  
 13. Building Use:  Residential  Commercial/Industrial  Other: \_\_\_\_\_  
 14. Building Use:  Residential  Commercial/Industrial  Other: \_\_\_\_\_  
 15. Building Use:  Residential  Commercial/Industrial  Other: \_\_\_\_\_  
 16. Building Use:  Residential  Commercial/Industrial  Other: \_\_\_\_\_  
 17. Building Use:  Residential  Commercial/Industrial  Other: \_\_\_\_\_  
 18. Building Use:  Residential  Commercial/Industrial  Other: \_\_\_\_\_  
 19. Building Use:  Residential  Commercial/Industrial  Other: \_\_\_\_\_  
 20. Building Use:  Residential  Commercial/Industrial  Other: \_\_\_\_\_

FEMA Form 01-01, February 2009 See reverse side for instructions. Replaces all previous editions.

U.S. DEPARTMENT OF HOMELAND SECURITY Federal Emergency Management Agency National Flood Insurance Program		<b>ELEVATION CERTIFICATE</b>	OMB No. 1503-0008 Expires February 25, 2009
Important: Read the instructions on pages 1-3.			
<b>SECTION A - PROPERTY INFORMATION</b>			For Insurance Company Use:
A1. Building Owner's Name			Policy Number
A2. Building Street Address (including Apt., Unit, Suite, and/or Bldg. No.) or P.O. Route and Box No.			Company NAIC Number
City	State	ZIP Code	
A3. Property Description (Lot and Block Numbers, Tax Parcel Number, Legal Description, etc.)			
A4. Building Use (e.g., Residential, Non-Residential, Addition, Accessory, etc.)			
A5. Latitude/Longitude: Lat. _____ Long. _____		Horizontal Datum: <input type="checkbox"/> NAD 1927 <input type="checkbox"/> NAD 1983	
A6. Attach at least 2 photographs of the building if the Certificate is being used to obtain flood insurance.			
A7. Building Diagram Number _____			
A8. For a building with a crawl space or enclosure(s), provide:		A9. For a building with an attached garage, provide:	
a) Square footage of crawl space or enclosure(s) _____ sq ft	b) No. of permanent flood openings in the crawl space or enclosure(s) walls within 1.0 foot above adjacent grade _____		
c) Total net area of flood openings in A8.b _____ sq in	c) Total net area of flood openings in A9.b _____ sq ft		

<b>SECTION B - FLOOD INSURANCE RATE MAP (FIRM) INFORMATION</b>					
B1. NFIP Community Name & Community Number		B2. County Name		B3. State	
B4. Map/Panel Number	B5. Suffix	B6. FIRM Index Date	B7. FIRM Panel Effective/Revised Date	B8. Flood Zone(s)	B9. Base Flood Elevation(s) (Zone AD, use base flood depth)
B10. Indicate the source of the Base Flood Elevation (BFE) data or base flood depth entered in Item B9. <input type="checkbox"/> FIC Study <input type="checkbox"/> FEMA <input type="checkbox"/> Community Determined <input type="checkbox"/> Other (Describe) _____					
B11. Indicate elevation datum used for BFE in Item B9: <input type="checkbox"/> NAVD 1929 <input type="checkbox"/> NAVD 1988 <input type="checkbox"/> Other (Describe) _____					
B12. Is the building located in a Coastal Barrier Resource System (CBRS) area or Coastal Protected Area (CPA)? Designation Date: _____ <input type="checkbox"/> CBRS <input type="checkbox"/> CPA					

<b>SECTION C - BUILDING ELEVATION INFORMATION (SURVEY REQUIRED)</b>	
C1. Building elevations are based on: <input type="checkbox"/> Construction Drawings? <input type="checkbox"/> Building Under Construction? <input type="checkbox"/> Finished Construction *A new Elevation Certificate will be required when construction of the building is complete.	
C2. Elevations - Zones 4, 4-AS, AE, AE-1, A, (with BFE), VE, V1-V99, V (with BFE), AR, AR-A, AR-AE, AR-A1-AS, AR-AH, AR-AD. Complete items C2.a-g below according to the building diagram specified in Item A7.	
Benchmark Utilized: _____ Vertical Datum: _____	Conversion Comments: _____
Check the measurement used.	
a) Top of bottom floor (including basement, crawl space, or enclosure floor) _____ feet	<input type="checkbox"/> meters (Puerto Rico only)
b) Top of the next higher floor _____ feet	<input type="checkbox"/> meters (Puerto Rico only)
c) Bottom of the lowest horizontal structural member (V Zones only) _____ feet	<input type="checkbox"/> meters (Puerto Rico only)
d) Attached garage (top of slab) _____ feet	<input type="checkbox"/> meters (Puerto Rico only)
e) Lowest elevation of machinery or equipment servicing the building (Describe type of equipment in Comments) _____ feet	<input type="checkbox"/> meters (Puerto Rico only)
f) Lowest adjacent finished grade (LAG) _____ feet	<input type="checkbox"/> meters (Puerto Rico only)
g) Highest adjacent finished grade (HAG) _____ feet	<input type="checkbox"/> meters (Puerto Rico only)

• Flood Hazard Management Program  
  
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