

2015 Flood Codes, Standards, and Building Science Tools

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Agenda

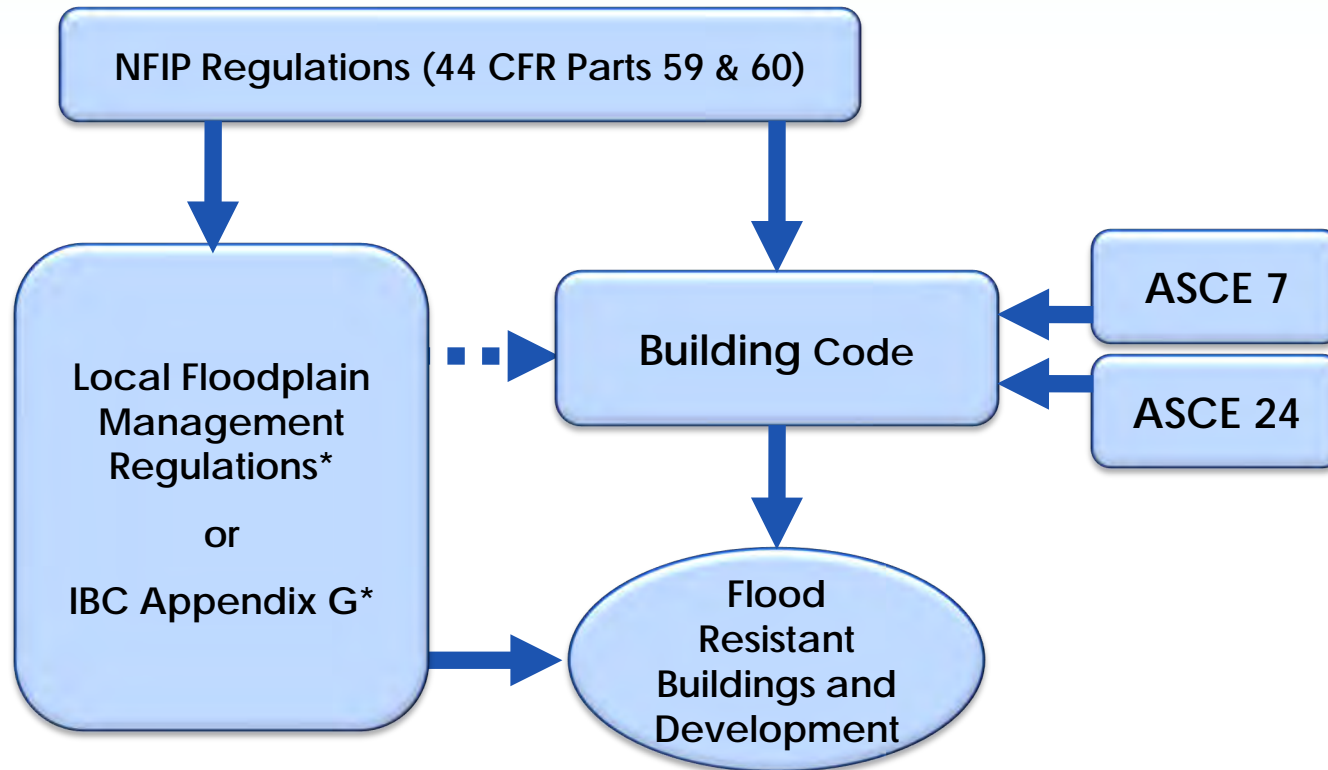
1. Introduction
2. Implementation of Post-Disaster Recommendations
3. Significant changes in ASCE 24-14
4. Significant changes in 2015 I-Codes
5. Significant changes in ICC 500
6. Coordinating Building Codes and Floodplain Management Regulations
7. Substantial Damage Estimator
8. Losses Avoided Methodology
9. Building Science Helpline & FEMA Resources

Why Building Codes?

Recognition that buildings built “to code” are better able to resist all natural hazards

- Mid-80s review of “legacy” codes
- Late ‘90s, formation of International Code Council
- FEMA Building Science has participated since the initial development of the International Codes
- FEMA Building Science also serves on the ASCE committee for ASCE 24 standard referenced by I-Codes

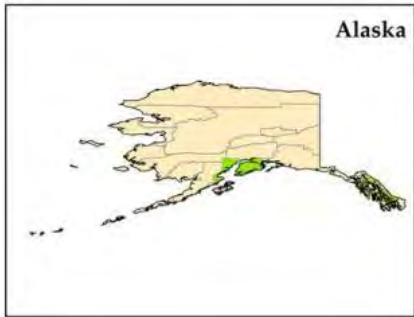
Codes and Floodplain Management



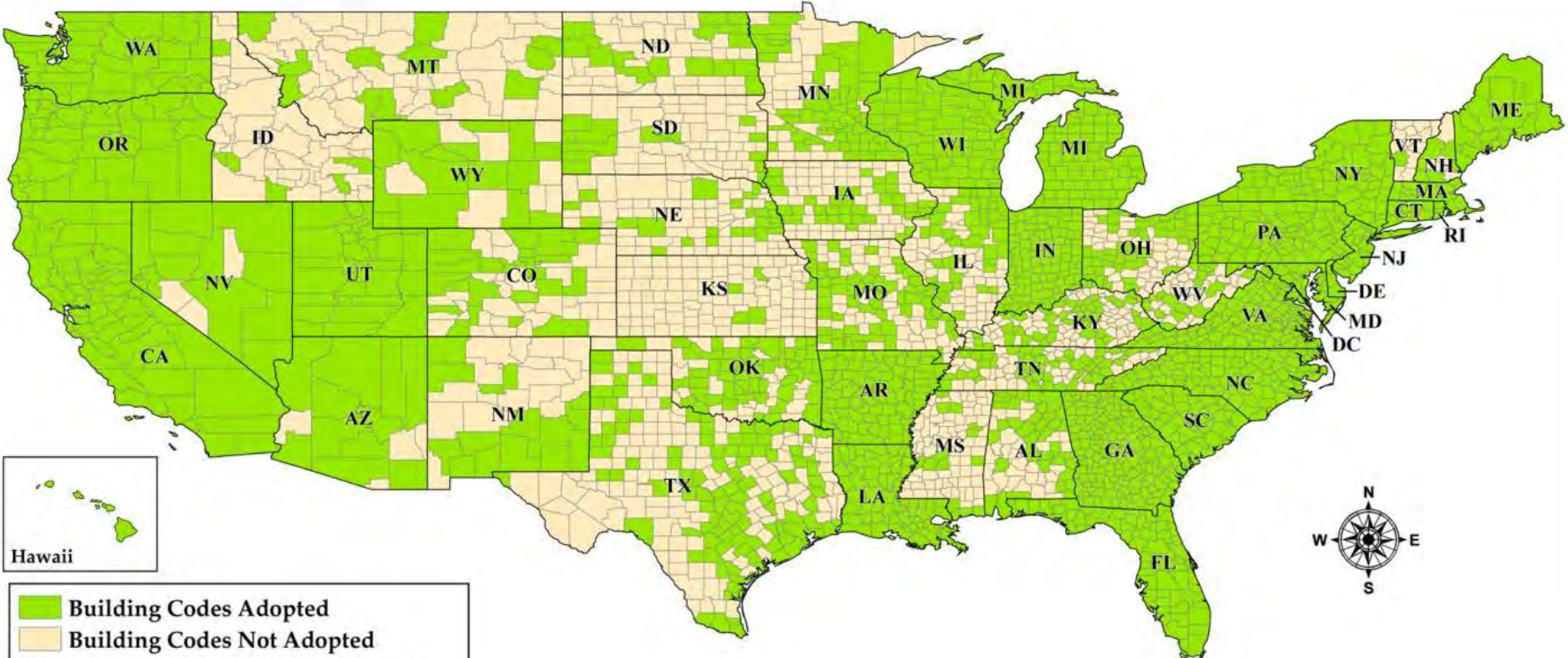
* NFIP-consistent administrative provisions, community-specific adoption of FIS and maps, and technical requirements for development outside the scope of the building code (and higher standards, in some communities).

“The 2018, 2015, 2012 and 2009 I-Code flood provisions meet or exceed the National Flood Insurance Program requirements for buildings and structures.”

Alaska



U.S. Counties that Have Adopted Building Codes and Counties in Which Municipalities Have Adopted Building Codes



22,000 communities participate in the NFIP

As of mid-2013, approximately 70% enforce flood-resistant building codes

FEMA's Ongoing Involvement in Codes and Standards

FEMA's role will be continuous, including:

- Proposing changes to maintain consistency with the NFIP and to incorporate best practices identified in post-disaster investigations
- Defending against changes that weaken the flood provisions to be inconsistent with the NFIP
- Contributing to requests for interpretations by ICC
- Supporting training of State and local officials

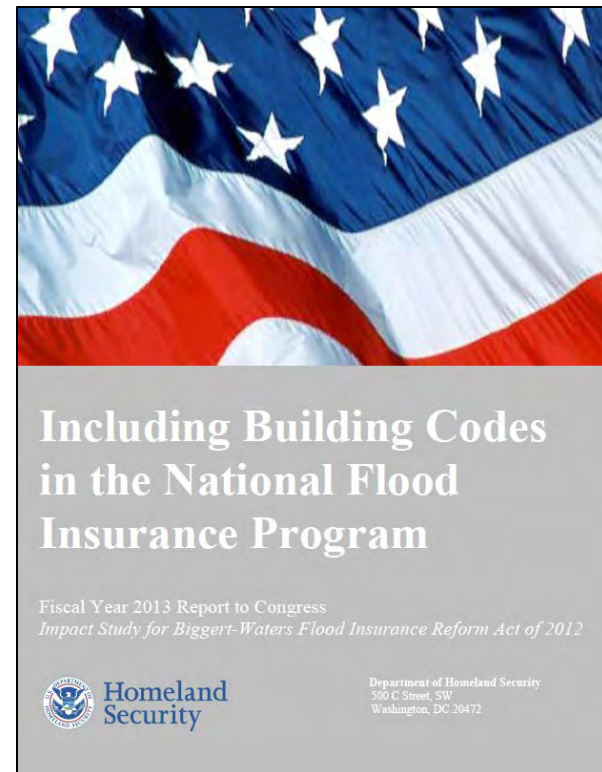
FIMA FY2012-14 Strategic Plan

Strategy 3.1.3: Promote Disaster-Resilient, Green Building Design and Construction Techniques

- The adoption and enforcement of disaster-resistant building codes is a core community action to promote effective mitigation. When communities ensure that new buildings and infrastructure are designed and constructed in accordance with national building codes and construction standards, they significantly increase local resilience now and in the future. With the advancements in building codes and guidance, there are also new opportunities to link disaster resiliency with green-building concepts. Working with building code association partners, FEMA Mitigation and Insurance will promote adoption and enforcement of disaster-resilient building codes. as well as the coordination and integration of disaster resilience and green building techniques to support local capacity to build truly mitigated and sustainable communities.

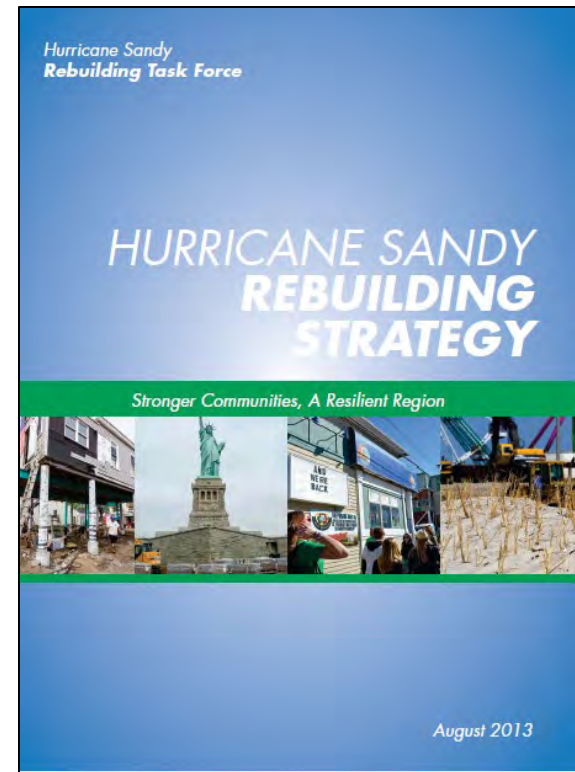
Growing Recognition of Codes

- In 2013, Congress requested a study on the impact, effectiveness and feasibility of including building codes in the NFIP.
- **Conclusion:** including building codes in the NFIP would have an overall positive impact in reducing physical flood losses and other hazard losses



Growing Recognition of Codes

- Task Force of Federal and State Agencies
- **Recommendation #25** “States and localities should adopt and enforce the most current version of the IBC and IRC.”



Implementation of MAT Recommendations

- **Additional elevation (freeboard) recommended in MAT reports since Iniki (1992)**
 - In ASCE 24 since first edition in 1998
 - IBC requires freeboard for all multifamily and commercial buildings in all flood zones
 - IBC freeboard increases as function of structure/risk category
 - New edition of ASCE 24 and 2015 I-Codes have increased freeboard

Implementation of MAT Recommendations

■ Incorporation of the Coastal A Zone concept

- Investigations identified wave-related damage in Zone A areas adjacent to Zone V
- In ASCE 24 since first edition in 1998
- IBC, by reference to ASCE 24, requires buildings in CAZ to meet same requirements as Zone V
- Recognized in 2006 IRC
- Revised FEMA FIRMs now show Limit of Moderate Wave Action (inland extent of CAZ)
- 2015 IRC requires dwellings in Coastal A Zones to meet same requirements as Zone V

Implementation of MAT Recommendations

- The 2011 MAT for tornadoes supported code change for 2015 IBC, which requires storm shelters in new schools and first responder facilities (police, fire, EMS) in 250 mph wind zone



Significant Changes in the 2014 Edition of ASCE 24

ASCE 24-14

- Cited in 2015 I-Codes
- Many amendments in 2015 I-Codes flow from this edition

ASCE 24-05 cited by 2012,
2009 and 2006 I-Codes



ASCE 24

- Specific limitations, minimum requirements, and expected performance for the design and construction of buildings and structures in flood hazard areas
- NOT a restatement of all of the NFIP regs – it is limited to requirements pertaining to design of buildings and structures (see “Highlights of ASCE 24”)
- Exceeds NFIP in some respects and has more detailed design requirements (see FEMA paper)

“Highlights of ASCE 24”

- Prepared by FEMA
- 2005 available online (2014 will be available after publication)
- Summarizes key requirements

HIGHLIGHTS OF ASCE 24-05 *Flood Resistant Design and Construction*

ASCE 24 is a referenced standard in the *International Building Code*[®]. Any building or structure that falls within the scope of the IBC that is proposed in a flood hazard area is to be designed in accordance with ASCE 24. The *International Residential Code*[®] requires that dwellings in floodways be designed in accordance with ASCE 24, and the 2009 edition of the IRC will include an alternative that allows communities to require homes in V zones to be designed in accordance with ASCE 24. Purchase a copy of ASCE 24 at www.asce.org.



ASCE 24 tells the designer the minimum requirements and expected performance for the design and construction of buildings and structures in flood hazard areas. It is not a restatement of all of the NFIP regulations, but offers additional specificity, some additional requirements, and some limitations. Buildings designed according to ASCE 24 are better able to resist flood loads and flood damage.

Highlights of ASCE 24 that complement the NFIP minimum requirements include:

Building Performance

- Freeboard is required as a function of the nature of occupancy and the flood zone (see table below). Dwellings and most other buildings have 1-foot of freeboard; certain essential facilities have 2-3 feet; only agricultural facilities, temporary facilities and minor storage facilities are allowed to have their lowest floors at the BFE.
- Flood loads and other loads are those specified in ASCE 7.
- Performance of foundations exposed to flood loads and load combinations is specified; soil characteristics and underlying strata, including soil consolidation, expansion or movement, erosion and scour, liquefaction and subsidence must be considered.
- Fill is required to be stable under conditions of flooding, including rapid rise and rapid drawdown, prolonged inundation, and erosion and scour; structural fill compaction is specified or an engineering report is required, side slopes are required to be no steeper than 1:1.5.
- Specifications for slabs-on-grade are listed depending on the purpose and location of the slabs.
- Two alternatives are specified for flood openings to allow for the automatic entry and exit of floodwaters in below-BFE enclosures: nonengineered openings which do not require certification (1 sq in per sq ft of enclosed area) and engineered openings which must be certified by a registered design professional.
- Stairs and ramps shall be designed and constructed to resist flood loads and to minimize transfer of flood loads to foundations, or to break away without causing damage.
- In V Zones and Coastal A Zones:
 - Structures shall be supported on piles, columns or shear walls.
 - Foundation depth shall take into account erosion and scour.

Highlights of the ASCE 24-05

1

ASCE 24: Classification of Structures

- **2005:** Equivalent to Structure/Risk Category in IBC/ASCE 7
 - Category I (agriculture facilities, temporary facilities, minor storage facilities)
 - Category II (all structures except Categories I, III and IV)
 - Category III (“substantial hazard”)
 - Category III (“essential facilities”)
- **2014:** Requires separate assignment of Flood Design Class (similar, but not the same as Structure/Risk Category)
 - To better distinguish occupancies that are “residential”

ASCE 24: CAZ like Zone V

- **2005:** RDP expected to determine conditions that contribute to flood loads, including wave height; if CAZ, then Zone V requirements apply

- **2014:** If delineated on FIRM or designated by community, the Coastal A Zone is regulated like Zone V (24-05 expected the RDP to determine wave conditions)
 - Requires open foundations (pilings, columns, shear walls)
 - Allows stem walls if designed to account for scour
 - Requires enclosures to have breakaway walls
 - AND requires flood openings

ASCE 24-14: Critical Facilities (FDC 4)

- 2014: Recognizes important facilities (critical facilities)

Flood Design Class 4

BFE +2 ft or DFE, or 500-year flood elevation, whichever is higher

		Design Class 3	Flood Design Class 4
Elevation of lowest floor (Zone A: Table 2-1)	Zone A not identified as Coastal A Zones	ft or whichever is higher	BFE +2 ft or DFE, or 500-year flood elevation, whichever is higher
Elevation of bottom of lowest horizontal structural member of the lowest floor (Zone V: Table 4-1)	Zone V and Coastal A Zones	ft or whichever is higher	BFE +2 ft or DFE, or 500-year flood elevation, whichever is higher
Dry Floodproofing of non-residential structures and non-residential portions of mixed-use buildings (Zone A: Table 6-1)	Zone A	ft or whichever is higher	BFE +2 ft or DFE, or 500-year flood elevation, whichever is higher
	Zone V and Coastal A Zones: dry floodproofing not allowed	Not permitted	Not permitted

Not shown: elevation requirements for flood damage-resistant materials, utilities, and equipment

ASCE 24-14: Zone V & CAZ, orientation

- 2014: Eliminates orientation

		Flood Design Class 1	Flood Design Class 2	Flood Design Class 3	Flood Design Class 4
Elevation of lowest floor (Zone A: Table 2-1)	Zone A not identified as Coastal A Zones	DFE	BFE +1 ft or DFE, whichever is higher	BFE +1 ft or DFE, whichever is higher	BFE +2 ft or DFE, or 500-year flood elevation, whichever is higher
Elevation of bottom of lowest horizontal structural member of the lowest floor (Zone V: Table 4-1)	Zone V and Coastal A Zones	DFE	BFE +1 ft or DFE, whichever is higher	BFE +1 ft or DFE, whichever is higher	BFE +2 ft or DFE, or 500-year flood elevation, whichever is higher

ASCE 24-14: Flood Openings

- Engineered openings:
 - Emphasis on performance
 - Changes in coefficient of discharge to better account for the obstructing effects of louvers, faceplates, grills
- Nonengineered and engineered openings:
 - Separates installation from design because all flood openings have the same installation requirements

ASCE 24-14: Zone V & CAZ

- Requires exterior door at the top of stairways enclosed with breakaway walls
 - To minimize exposure to wave splash and runup and wind-driven rain
- Requires flood openings in breakaway walls
 - To limit failure of walls during more frequent (shallower) flooding

Significant Changes in the Flood Provisions of the 2015 I-Codes

Chapter 1 Administrative

- **Previous editions of IBC & IEBC:** No specific provisions for making Substantial Improvement / Substantial Damage determinations
- **2015 IBC & IEBC:** Specify the building official makes SI/SD determinations

Chapter 1 Administrative

- **Previous editions of IRC:** Building official makes “findings” and the Board of Appeals makes SI/SD determinations
- **2015 IRC:** Specify the building official makes SI/SD determinations
 - In Chapter 3, clarifies flood provisions apply to new dwellings and SI/SD

2015 IRC Amendments

- **Previous editions of IRC:** Permits use of ASCE 24 as alternative in Zone V
- **2015 IRC:** Permits use of ASCE 24 as alternative in all flood zones



2015 IRC Amendments

- **Previous editions of IRC:**
 - **Zone A:** lowest floor at or above DFE
 - **Zone V:** bottom of lowest horizontal structural member at or above DFE or BFE + 1 ft (function of orientation relative to the direction of wave approach)

- **2015 IRC:** Minimum elevation in all flood zones is BFE + 1 ft, or DFE, whichever is higher (freeboard)
- **2015 IRC:** Eliminate Zone V orientation

2015 IRC Amendments

- **Previous editions of IRC:** Coastal A Zone treated like Zone A except lowest floor required to be one foot higher
- **2015 IRC:** Coastal A Zone – if Limit of Moderate Wave Action delineated on FIRM or designated by communities, treated like Zone V
 - Stem wall foundation allowed, if wave action and scour accounted for in design

Coastal A Zone: During the base flood conditions, the potential for breaking wave height shall be greater than or equal to 1 ½ feet (457 mm). The inland limit of the CAZ is (a) the Limit of Moderate Wave Action if delineated on a FIRM, or (b) designated by the authority having jurisdiction.

2015 IRC Amendments

- **2015 IRC:** Requires exterior door at the top of stairways enclosed with breakaway walls (Zone V & CAZ)
 - To minimize exposure to wave splash and runup and wind-driven rain
- **2015 IRC:** Requires flood openings in breakaway walls
- **2015 IRC:** Requirements for tanks

2015 IBC Amendments

- Reference ASCE 24-14 (first printing shows “ASCE 24-13,” errata to be issued)
- Add definitions for “Coastal A Zone” and “Limit of Moderate Wave Action”



2015 IEBC Amendments

Existing buildings that are Substantially Improved or repaired after Substantial Damage:

- **Previous editions:** Required compliance with IBC Section 1612
- **2015 IEBC:** Requires compliance with flood provisions of IBC or IRC, as applicable to the occupancy



2015 IEBC Amendments

- **Chapter 11 Additions**
- 1103.5: new item so that new foundations and replacement foundations shall comply with flood requirements (regardless of whether SI/SD)



Significant Changes in
ICC/NSAA 500-14,
*Standard for the Design
and Construction of
Storm Shelters*

ICC 500-2014

- Completion due by December 2014
- Incorporated by reference in 2015 IBC

ICC 500: Flood Loads

- **2008:** Design for buoyancy forces and hydrostatic loads
- **2014:**
 - Design for buoyancy forces and hydrostatic loads
 - Flood loads determined in accordance with ASCE 7-10
 - Design flood elevation = minimum floor elevation from Section 401

ICC 500: Flood Hazard Area Siting Criteria

- **2008:** No requirements for community shelter siting
- **2014:** Community shelters shall be located outside of Zone V and floodways
 - Exception: Allowed in V Zones where permitted by Board of Appeals

Reducing Flood Losses through the International Codes: Coordinating Building Codes and Floodplain Management

Satisfying NFIP Requirements

- To participate in the NFIP, communities must have enforceable floodplain management regulations that are consistent with the Part 60 requirements for land management and use.
- The NFIP definition of “floodplain management regulations” is broad:

Flood plain management regulations means zoning ordinances, subdivision regulations, building codes, health regulations, special purpose ordinances (such as a flood plain ordinance, grading ordinance and erosion control ordinance) and other applications of police power. The term describes such state or local regulations, in any combination thereof, which provide standards for the purpose of flood damage prevention and reduction.

Codes: Advantages & Considerations

- What are the advantages?
- What are some things to consider when administering flood provisions for buildings through the building codes?

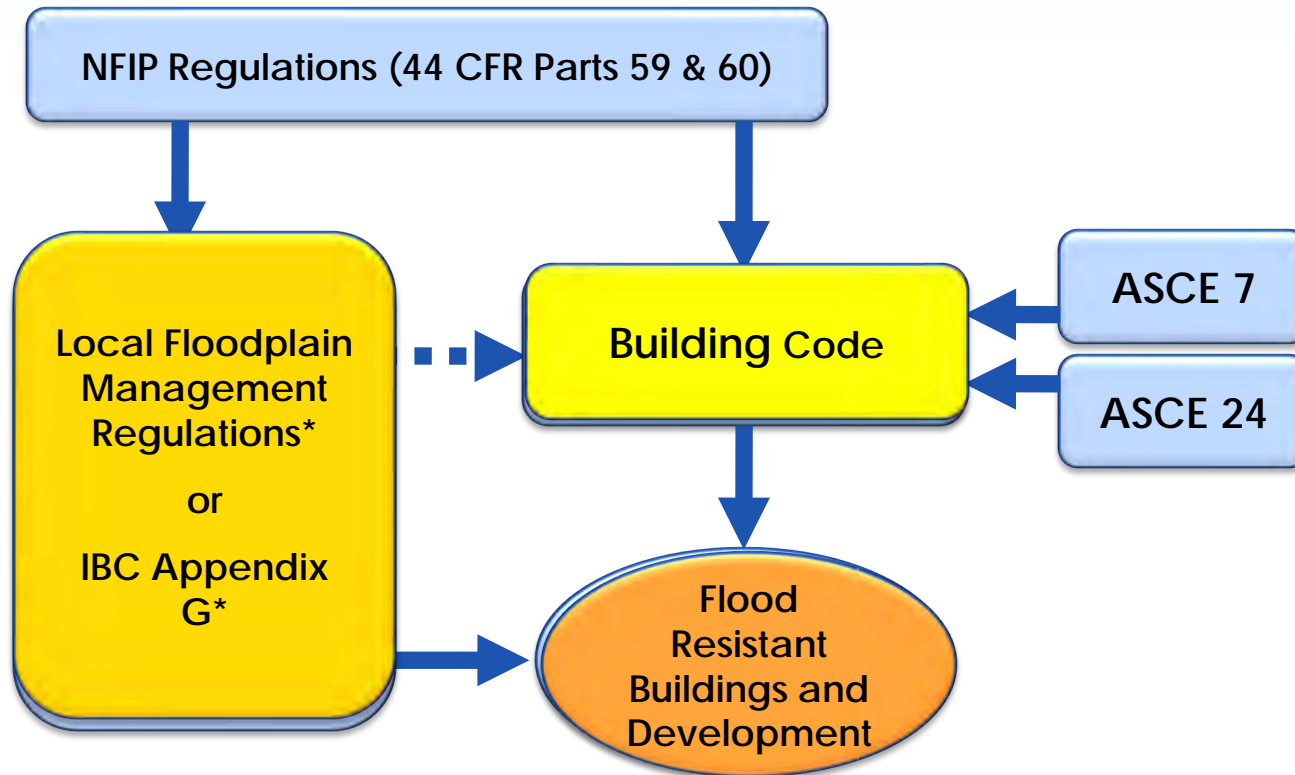
Advantages

- Avoid differences; fewer conflicts
- All hazard-related building construction requirements are in one place
- Improved construction quality
- Codes have some “higher standards” and some more specific provisions than the NFIP
- Permits are issued for all buildings and structures
- Strengthened enforcement
- Effective, routine inspections
- Improved compliance for existing buildings

Considerations

- Codes only apply to buildings and structures – NFIP requires communities to regulate “development”
- Planning and zoning are valuable tools to “guide development” in ways that codes do not
- In most States, it’s more difficult for communities to modify or adopt higher standards that affect buildings
- Certain structures may be exempt from the code (State-specific) or not required to get permits (e.g., certain sheds, fences, etc.)

Fitting it All Together



* NFIP-consistent administrative provisions, community-specific adoption of FIS and maps, and technical requirements for development outside the scope of the building code (and higher standards, in some communities).

Coordinating the I-Codes and NFIP

COMPLETE REVISION

- Importance of coordinating
- Description of differences between NFIP & I-Codes
- Series of questions to help determine how best to coordinate
- Description of higher standards and more specific requirements
- Model code-coordinated ordinances



Reducing Flood Losses Through the International Codes®

Coordinating Building Codes and
Floodplain Management Regulations

4th Edition, 2014



in cooperation with the Federal Emergency Management Agency

Coordinating the I-Codes and NFIP

NEW CHAPTER that describes the most significant differences between the NFIP requirements and the provisions of the I-Codes and ASCE 24



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4th Edition, 2014



in cooperation with the Federal Emergency Management Agency

New RFL: Comparing NFIP & I-Codes

Adoption of FIS and FIRMs	Coastal A Zone
Flood Loads and Flood Resistance	Existing Buildings
BFE and Design Flood Elevation	Historic Structures
SFHA and Flood Hazard Areas	Additions
Buildings/Structures, and Development	Manufactured Homes
Risk/Occupancy Category & Flood Design Class	Registered Design Professional
Required Building Elevations	Building Official and Floodplain Administrator
Equipment Elevations	Inspections
Residential and Non-Residential Buildings	Record Keeping
Definition of Basement	SI / SI
Floodway	Variances
Use of Fill	Crawlspace and Under-floor Space
Dry Floodproofing	Livable and Habitable

Buildings/Structures & Development

- **Codes govern buildings and structures**
 - **Building:** any structure used or intended for supporting or sheltering any use or occupancy
 - **Structure:** that which is built or constructed

- **NFIP communities regulate development**
 - **Development:** any man-made change to improved or unimproved real estate, including but not limited to buildings or other structures, mining, dredging, filling, grading, paving, excavation or drilling operations or storage of equipment or materials.

Inspections

- **NFIP:** regulations do not specify inspections (FEMA 480 suggests inspections at several times during construction)
- **IBC and IRC:**
 - “upon placement of the lowest floor, including basement, and prior to further vertical construction” elevation documentation submitted
 - Submission of “as-built” elevation documentation prior to final inspection (2012)



New RFL: Nuts & Bolts

State rules administrated by a State agency?	Which code covers existing buildings?
How are conflicts/differences resolved?	Is IBC Appendix G adopted?
At which level are building code adopted?	Were flood provisions in the body of the Codes modified?
Which codes (and which editions) are adopted?	Was Appendix G of the IBC modified by the State?
Is Chapter 1 of the I-Codes adopted?	Does the State permit local amndts?'
Is Chapter 1 of the I-Codes modified?	How are FISs and FIRMs (and revisions) adopted?
Does the State regulate certain activities or buildings?	How are manufactured homes regulated?
Is specific work exempt from building permits?	Does the State Code Council issue interpretations?
Are specific buildings exempt from the Code	

Resolving Conflicts

If the community has both floodplain management regulations and enforces the I-Codes:

- The more restrictive prevails
- Understand which office is responsible for each requirement
- Go through coordination process to identify differences and gaps
- Decide how best to resolve those differences and eliminate the gaps (change code, change ordinance, rely on case-by-case application of “more restrictive prevails”)

Administrative Provisions

- How are administrative provisions of the codes handled?
 - Many States modify or rewrite
 - Some States allow communities to write their own
 - Some States use a single chapter for all codes
- Duties and powers of the building official
- Granting modifications ('variances')
- Content of construction documents and plans
- Inspections

State Code Amendments and Flood


- FEMA's consistency statement assumes no amendments that remove or weaken the flood provisions of the I-Codes
- Some States have modified the body of the codes
 - IRC additional elevation (freeboard)
 - IRC Require dwellings to be designed per ASCE 24

Local Code Amendments and Flood

■ Local amendments

- Some States permit, but only more restrictive
- Some States have authority to approve or disapprove; others do not
- Some States do not allow

Adding Higher Standards ... see RFL

Amend The I-Codes	Ordinance or IBC Appendix G
Additional Height (Freeboard)	Manufactured Home Limitations
Prohibit Enclosures Below Elevated Buildings	Flood Protection Setback Along Waterways
Limit the Size of Enclosures Below Elevated Buildings	Subdivision Limitations
Require Nonconversion Agreements	Compensatory Storage
Treat Coastal A Zone Like Zone V	Flood Hazard Map Other Than, or in Addition to, the FIRM
Cumulative Substantial Improvement	
Repetitive Flood Damage (Substantial Damage)	
Limitation on Use of Fill	
Design Certification of All Foundations	
Protection of Critical and Essential Facilities	



Exceeding NFIP Minimums

- Similar to building codes, the NFIP requirements are “minimums”
- Many States and communities elect to adopt “higher standards” for improved flood resistance
- The NFIP Community Rating System acknowledges exceeding the minimums and communities may qualify for discounts on NFIP Flood insurance premiums

Coordinating the I-Codes and NFIP

Remember . . .

- **NFIP §60.3(a)(3):** Designed to prevent flotation, collapse, lateral movement during flooding, constructed to minimize flood damage . .
- **IBC/IRC/IEBC:** requirements to safeguard the public safety, health and general welfare, through structural strength . . .
 - All the specific provisions tell the designer, builder, owner and code official how to achieve that performance expectation

Coordinating the I-Codes and NFIP

- Why “coordinate” codes and floodplain management regulations?
- Two regulatory instruments that govern the same thing:
 - Wording differences – meaningful?
 - Differences in requirements – does the “more restrictive” always prevail?
 - Burden on the regulated public and local officials

“Comprehensive and Coordinated” Approach

- Use the building code for design and construction of buildings and structures
- Use a companion ordinance for administrative provisions:
 - Adoption of effective maps (and map revisions)
 - Floodway encroachment analyses
 - SI/SD determinations
 - Variances
- Use a companion ordinance for development activities that aren't regulated by the building code

Model Code-Coordinated Ordinances

- Written to explicitly match up with the I-Codes
- All requirements for buildings and structures in the codes
- Some administrative provisions are in the ordinance
 - Adoption of FIS/FIRMs
 - Powers and duties of the FPA
 - Applications
 - Variances
- Requirements for development other than buildings
 - Subdivision, site improvement
 - MFH, RV
 - Tanks, “other building work,” temporary structures

Model Code-Coordinated Ordinances

Table 6-1: Selecting an Applicable Code-Coordinated Model Ordinance

	I-Codes with Chapter 1⁽¹⁾	I-Codes without Chapter 1⁽²⁾
I-Codes with IBC Appendix G⁽³⁾	Model Ordinance Version One	<i>[FEMA has not identified any States in this situation]</i>
I-Codes without IBC Appendix G⁽⁴⁾	Model Ordinance Version Two	Model Ordinance Version Three

Links are in there!

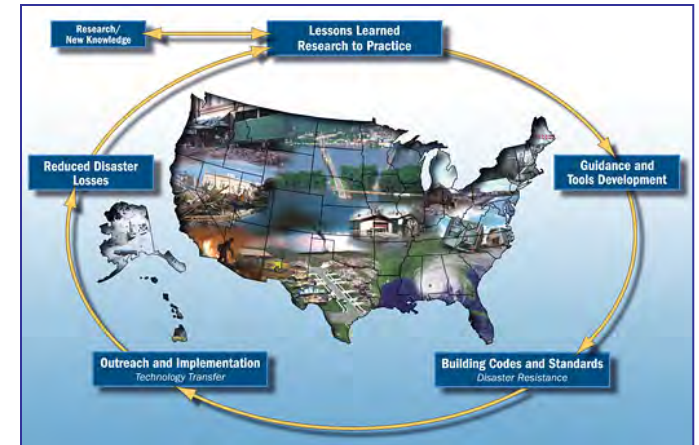


FEMA Building Code and Floodplain Management Resources

<http://www.fema.gov/rebuild/buildingscience/>

Click on Building Code Resources

- Flood Resistant Provisions of the I-Codes
- Highlights of ASCE 24
- Provisions of the I-Codes and ASCE 24 Compared to the NFIP





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