Guidance for Applying ASCE 24 Engineering Standards to HMA Flood Retrofitting and Reconstruction Projects

Federal Emergency Management Agency

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Overview

- Draft Hazard Mitigation Assistance (HMA) Policy
- American Society of Civil Engineers Standard 24-05, *Flood Resistant Design and Construction*
- FEMA Guidance Document
- Other Considerations
- Policy Implementation
Unified Hazard Mitigation Assistance Program

• Provides funding for mitigation activities
• Projects must be feasible and cost-effective
• HMA Programs are:
  • Hazard Mitigation Grant Program (HMGP)
  • Pre-Disaster Mitigation Program (PDM)
  • Flood Mitigation Assistance Program (FMA)
DRAFT HMA Policy

• “Minimum Design Standards for HMA Projects in Flood Hazard Areas”
• Draft policy being developed by FEMA
• Will require the use of ASCE 24 or its equivalent as the minimum design criteria for the following HMA project types:
  • Structure elevation
  • Dry floodproofing
  • Mitigation reconstruction
DRAFT HMA Policy

- Currently undergoing FEMA concurrence
- FEMA will conduct outreach to provide an opportunity for external consultation
- After consultation, policy will be revised as needed and finalized
Motivation behind ASCE 24 Policy

• Evaluated building performance following hurricane and flood events

• Hurricane Ike observations demonstrated the need for higher standards

• Need for higher standards reinforced by Hurricane Isaac observations
Benefits of ASCE 24 Policy

- Supports FEMA’s existing floodplain management regulations
- Exceeds NFIP minimum requirements and is in line with best practices
- Provides consistency of design and construction through a recognized consensus standard referenced in the International Codes
- Expedites technical review of project applications
ASCE 24: Flood Resistant Design and Construction

- Minimum flood-resistant design and construction of structures in flood hazard areas
  - New construction
  - Substantial Improvements
  - Historic structure exceptions
- Meets or exceeds NFIP regulations
- Requirements are functions of flood hazard area (Zone A, Zone V, other high risk) and structure classification
# ASCE 24 Structure Classification

<table>
<thead>
<tr>
<th>Nature of Occupancy</th>
<th>Category</th>
</tr>
</thead>
<tbody>
<tr>
<td>Buildings and other structures that present a <strong>low hazard to human life</strong> in the event of failure (e.g., agricultural facilities, certain temporary facilities, minor storage facilities)</td>
<td>I</td>
</tr>
<tr>
<td>All buildings and other structures <strong>except those listed in Categories I, III, and IV</strong> (e.g., most residential buildings)</td>
<td>II</td>
</tr>
<tr>
<td>Buildings and other structures that present a <strong>substantial hazard to human life</strong> in the event of failure (e.g., schools, theaters, jails)</td>
<td>III</td>
</tr>
<tr>
<td>Buildings and other structures <strong>designated as essential facilities</strong> (e.g., hospitals, fire stations, police stations, emergency operations centers, power generating stations and other public utility facilities required in an emergency)</td>
<td>IV</td>
</tr>
</tbody>
</table>
Key ASCE 24 Requirements More Specific than NFIP

- Buildings must be designed per load provisions in ASCE 7
  - Designer must determine several design flood conditions
- Coastal A Zone
- Design flood and design flood elevation
- Freeboard and elevation requirements
Key ASCE 24 Requirements
More Specific than NFIP

• Coastal A Zone
  • Area within special flood hazard area (SFHA), landward of a V Zone or landward of an open coast without mapped V Zones (delineated by LiMWA)
  • Principal source of flooding must be coastal
  • Wave height 1.5-3 ft during base flood
    • this provision requires designers to determine where CAZ conditions occur – this has been a problem when the LiMWA is not shown on FIRM
FEMA Guidance Document

- Explains key design and construction requirements in ASCE 24
- Addresses project eligibility
- Explains how to apply ASCE 24 concepts to mitigation projects
- ASCE 24 has applicability to elevation and dry floodproofing in some cases
  - Certain provisions must be met completely
  - Intent of remaining provisions must be met
### Deemed-to-Comply Table (Example)

<table>
<thead>
<tr>
<th>Section</th>
<th>Title</th>
<th>Summary of ASCE 24-05 Provision</th>
<th>ASCE 24-05 Provision as applied to HMA</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.1</td>
<td>Scope</td>
<td>This standard applies to new and substantially improved/damaged structures in flood hazard areas that are subject to building code requirements</td>
<td>New construction and substantial improvements shall meet the requirements of ASCE 24-05. Mitigation reconstruction projects shall meet the requirements of ASCE 24-05. For all other projects, ASCE 24-05 shall apply only to the mitigated portions of those projects.</td>
</tr>
<tr>
<td>2.5</td>
<td>Slabs-on-Grade and Footings</td>
<td>Slabs shall be placed on structural fill or undisturbed soil with adequate bearing capacity. Top of slab shall be at or above elevation per Table 2-1. Bottom of turned down footings of slabs shall be below the depth of expected scour. Slabs shall be reinforced to prevent breakup if undermined. Slabs on structural fill shall suffer no loss of supporting soil during design flood. Footings shall support the structure (and prevent flotation, collapse, lateral movement) during design flood conditions. Slabs under elevated buildings shall not have turned down edges.</td>
<td>Slabs, footings, and underlying soil shall support the structure during design flood conditions such that the structure is not subject to flotation collapse or lateral movement. Existing slabs, footings, and underlying soil shall be evaluated using field observations and testing to a reasonable standard of care to verify that during design flood conditions they will not lead to structure floatation, collapse, or lateral movement.</td>
</tr>
</tbody>
</table>
Project Eligibility

• ASCE 24 policy applies to the following projects under the HMA grant program:
  • Structure elevation
  • Dry floodproofing
  • Mitigation reconstruction

• Eligibility and effectiveness depend on flood zone and flood risk area for certain project types
Structure Elevation

NFIP compliant building

ASCE 24 compliant building

Example for building elevated on piers

Local DFE
ASCE 24/05 Required BFE + freeboard
BFE

*The local DFE may equal the BFE or the ASCE 24/05 required BFE + freeboard. The highest of the three elevations should be adhered to.
### Table 2. Lowest Floor/Lowest Horizontal Structural Member Elevation Requirements in ASCE 24-05.

<table>
<thead>
<tr>
<th>Elevation</th>
<th>Flood Zone</th>
<th>Occupancy Category</th>
</tr>
</thead>
<tbody>
<tr>
<td>Elevation of Lowest Floor (A Zone: see Table 2-1 in ASCE 24-05)</td>
<td>All A Zones not identified as Coastal A Zones: elevation of lowest floor</td>
<td>Occupancy Category</td>
</tr>
<tr>
<td></td>
<td>DFE</td>
<td>I</td>
</tr>
<tr>
<td>Elevation of Bottom of Lowest Horizontal Structural Member (V Zone: see Table 4-1 in ASCE 24-05)</td>
<td>All V Zones and Coastal A Zones: where the lowest horizontal structural member is parallel to direction of wave approach</td>
<td>DFE</td>
</tr>
<tr>
<td></td>
<td>DFE</td>
<td>BFE +1 ft or DFE, whichever is higher</td>
</tr>
</tbody>
</table>
Structure Elevation: Foundations

• Zone A

• Zone V and Coastal A Zone

ASCE 24 design load provisions apply to mitigated or new sections of the foundation, including connections to the existing structure.
Structure Elevation: Other Requirements

• **Enclosures** below the minimum lowest elevation can only be used for parking, building access, and storage
  • Zone A: must include flood openings
  • Zone V and Coastal A Zones: walls must be breakaway

• **Building materials** below the specified elevation should be constructed of flood damage-resistant materials

• **Utilities and attendant equipment** must be elevated or dry floodproofed to the specified elevation
Dry Floodproofing

• Renders exterior walls and floor substantially impermeable to passage of floodwaters
• Intended for 12 to 24 hour duration
• Reduces, but does not eliminate, potential for flood damage
• Restricted to nonresidential buildings and historic residential buildings
• Not allowed in Zone V, Coastal A Zones, or high risk flood hazard areas
### Table 3. Elevation Requirements in ASCE 24-05 for Dry Floodproofing of Non-Residential Structures and Non-Residential Portions of Mixed-Use Buildings.

<table>
<thead>
<tr>
<th>Flood Zone</th>
<th>Occupancy Category</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>I</td>
</tr>
<tr>
<td>All A Zones not identified as Coastal A Zones: elevation to which dry floodproofing extends</td>
<td>BFE +1 ft or DFE, whichever is higher</td>
</tr>
<tr>
<td>All V Zones and Coastal A Zones: dry flood-proofing not allowed</td>
<td>Not permitted</td>
</tr>
</tbody>
</table>
Dry Floodproofing
Application of ASCE 24

• **Nonresidential Buildings**
  • Applies to all areas to be dry floodproofed
  • Applies to utilities and sanitary systems that may be affected by being outside of the dry floodproofed area

• **Historic Residential Buildings**
  • Non-residential occupancy: adhere as closely as possible without compromising historic designation
  • Residential occupancy: adhere to ASCE 24 provisions, including requirements for means of egress
  • Elevation will provide better protection from flood damage but might not be possible for some historic structures
Dry Floodproofing: Other Requirements

- **Foundation and connections** must be capable of resisting additional loads.
- **Walls, floors and openings** must be substantially impermeable to passage of floodwaters.
- **Utilities and attendant equipment** outside floodproofed area must be elevated to the minimum elevation specified for elevation projects.
- **Building materials** below the specified elevation should be constructed of flood damage-resistant materials.
- **Sump pumps** must only be used for small leaks and vapor seepage.
- **Means of egress** from dry floodproofed area must be above minimum lowest elevation.
Dry Floodproofing: Passive Measures

- Projects ideally use **passive measures** that do not require human intervention.
- If measures require human intervention, ASCE 24 requires:
  - Minimum warning times
  - A plan approved by the authority having jurisdiction outlining use, evacuation, storage, installation, and testing procedures
- Dry floodproofed buildings requiring active measures may result in increased flood insurance premiums.
Mitigation Reconstruction

- Treated as new construction
- ASCE 24 must be met in its entirety
  - Includes all requirements described previously for elevation projects
- Not permitted in Zone V or regulatory floodway
Other Considerations

• **High Risk Flood Hazard Areas**
  • HMA: no funding in floodway unless building is functionally dependent on its location
  • ASCE 24: restrictions for areas of alluvial fan flooding, flash flooding, mudslides, erosion, high-velocity flow, ice jam, and debris

• **Historic buildings**
  • Retain historic integrity while minimizing adverse effects
  • Repair materials or replace “in-kind”
  • Elevation and dry floodproofing are possible
Historic Buildings: Elevation

- Carefully consider:
  - Building height, scale, mass, and proportions
  - Architectural character
  - Building footprint, orientation, and location
  - Landscape
  - Archaeology
  - Site elevation and topography
  - Adjoining historic properties
Historic Buildings: Dry Floodproofing

- Reinforce existing structural system
- Minimize visibility of mitigation measures, such as structural reinforcement or relocation of mechanical systems
- Use appropriate sealants on historic materials
Policy Implementation

• During application process, certify that design meets applicable ASCE 24 requirements by:
  • providing an affirmative certification statement in project application

• Prior to project closeout, demonstrate conformance with ASCE 24 requirements by submitting:
  • Professional verification
  • Design documentation
For Technical Questions:
FEMA-BuildingScienceHelp@fema.dhs.gov
866-927-2104
fema.gov/building-science

For Grants Questions:
HMAGrantsHelpline@fema.dhs.gov
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www.fema.gov/hazard-mitigation-assistance